Implementing a flipped-classroom approach for metacognitive gains to prepare mathematics student-teachers for the 21st century

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ABSTRACT

There is a constant need to rethink education strategies as the role and nature of education are constantly changing due to the swift advancement of technology in the 21st century. My experience as a high school mathematics teacher led me to this investigation since I have witnessed the need for reflective teachers who can critically evaluate their practice and support and guide students in their deeper learning of mathematical content. Therefore, the construct of metacognition and how teachers can acquire this vital skill became an area of interest. South Africa urgently needs self-directed, self-regulated 21st century teachers with good metacognitive skills. Therefore, higher education institutions are required to design and evaluate strategies that support students in this regard.

For this investigation, the perusal of the literature set out to investigate which features of the flipped-classroom approach (FCA) have the potential to support students in developing metacognitive skills. Since the literature concurs that the flipped classroom has the potential to support these skills, this approach was used to deliver a specific mathematics module within the first year of the BEd programme offered by the North-West University (NWU - Potchefstroom Campus). Therefore, implementing an FCA and investigating how it should be designed for metacognitive gains was central to this study. From the literature it became apparent that the FCA can be designed and implemented in different ways and that there is no one way to do it. This initial implementation of the FCA provides an ideal opportunity to investigate how this approach should be designed to foster metacognition and consequently the self-directed learning (SDL) of mathematics student-teachers. The primary aim was to determine how an FCA should be designed to foster metacognition within mathematics student-teachers. The secondary aim was to suggest guidelines for an FCA implementation to promote metacognition at this higher education institution. The study was guided by a constructivist-interpretivist paradigm whereby the researcher's role was to understand and interpret the participants' experiences.

In this qualitative study, a design-based research (DBR) case study was employed to investigate participants' experiences of how the FCA to teaching and learning of a specific mathematics module in the BEd programme supported the development of student-teachers' metacognitive skills. Directing the investigation and, as suggested for DBR, the research questions have emerged from the identified problem for the need for metacognitive skills and how higher education institutes can foster their development as an important 21st century skill.

The main findings of the investigation emphasise that an understanding of the changed roles of both the lecturers and students in an FCA is crucial for metacognitive gains. Course content, the

scaffolding of both in-class and out-of-class learning, and the online environment can hinder or support metacognitive skills development in an FCA to teach and learn mathematics. An FCA needs to be meticulously planned and should incorporate explicit metacognitive teaching strategies for maximum metacognitive gains that play a crucial role in21st century learning.

Keywords: design-based research, flipped-classroom approach, mathematics teacher education, metacognition, 21st century skills

OPSOMMING

Daar is ’n voortdurende behoefte aan die herbesinning van onderrigstrategieë, aangesien die rol en aard van onderwys voortdurend verander as gevolg van die spoedige bevordering van tegnologie in die 21ste eeu. My ervaring as hoërskoolwiskunde-onderwyser het my gelei tot hierdie ondersoek, aangesien ek die behoefte gesien het van reflektiewe onderwysers wat hul praktyk krities kan evalueer en studente kan lei en ondersteun in hul dieper leer van wiskundige inhoud. Daarom het metakognisie en hoe onderwysers hierdie belangrike vaardigheid kan bekom, 'n area van belangstelling geword. Suid-Afrika benodig dringend selfgerigte, selfgereguleerde 21ste-eeuse onderwysers met goeie metakognitiewe vaardighede. Dus word van hoëronderwysinstellings verwag om strategieë te ontwerp en te evalueer wat studente in hierdie verband ondersteun.

Vir hierdie ondersoek is die bestudering van die literatuur uiteengesit om te ondersoek watter kenmerke van die omgekeerdeklaskamerbenadering (OKB) die potensiaal het om studente te ondersteun om metakognitiewe vaardighede te ontwikkel. Aangesien die literatuur saamstem dat die omgekeerde klaskamer die potensiaal het om hierdie vaardighede te ondersteun, is hierdie benadering gebruik om 'n spesifieke wiskundemodule binne die eerste jaar van die BEd-program deur die Noordwes-Universiteit aan te bied. Daarom was die implementering van 'n OKB en die ondersoek van hoe dit ontwerp moet word om metakognitiewe vaardighede te bevorder, sentraal tot hierdie studie. Uit die literatuur blyk dit dat die OKB op verskillende maniere ontwerp en geïmplementeer kan word en dat daar geen enkele manier is om dit te doen nie. Hierdie aanvanklike implementering van die OKB het ’n ideale geleentheid gebied om te ondersoek hoe hierdie benadering ontwerp moet word om metakognisie te bevorder en gevolglik die selfgerigte leer van wiskunde-onderwysstudente. Die primêre doel was om vas te stel hoe 'n OKB ontwerp moet word om metakognisie by wiskunde-onderwysstudente te bevorder. Die sekondêre doel was om riglyne voor te stel vir 'n OKB-implementering om metakognisie by hierdie hoëronderwysinstelling te bevorder. Die studie is gelei deur 'n konstruktivisties-interpretivistiese paradigma waar die navorser se rol was om die ervarings van die deelnemers te verstaan en te interpreteer.

In hierdie kwalitatiewe studie is ontwerpgebaseerde navorsing (OGN) as gevallestudie geïmplementeer om die ervarings van die deelnemers te ondersoek van hoe die OKB tot onderrig en leer, van 'n spesifieke wiskundemodule in die BEd-program, wiskunde-onderwysstudente se ontwikkeling van metakognitiewe vaardighede kan ondersteun. Die navorsingsvrae het, soos voorgestel vir OGN, na vore gekom uit die identifisering van die probleem vir die noodsaaklikheid

van metakognitiewe vaardighede en hoe instellings van hoër onderwys die ontwikkeling daarvan as 'n belangrike vaardigheid in die 21ste eeu kan bevorder.

Die belangrikste bevindings van die ondersoek beklemtoon dat 'n begrip van die veranderde rolle van dosente sowel as studente in ’n OKB van kardinale belang is vir die ontwikkeling van metakognitiewe vaardighede. Kursusinhoud, die steiering van leer binne en buite die klaskamer asook die aanlyn leeromgewing kan metakognitiewe vaardigheidsontwikkeling in ’n OKB vir die onderrig en of leer van wiskunde, belemmer of ondersteun. ’n OKB moet noukeurig beplan word en moet eksplisiete metakognitiewe onderrigstrategieë bevat vir die ontwikkeling van metakognitiewe vaardighede wat ’n belangrike rol speel in leer in die 21ste eeu.

Sleutelwoorde: ontwerpgebaseerde navorsing, omgekeerdeklaskamerbenadering, wiskunde-onderwysersopleiding, metakognisie, 21ste-eeuse vaardighede

DECLARATION

I, the undersigned, hereby declare that the work contained in this dissertation is my own original work and that I have not previously submitted it to any other university for a degree.



Signature

Date: 30 March 2021

ETHICAL CLEARANCE

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To Whom It May Concern

RE: Student name: **Ms C Lotz** - Student number: **29741343 - MEd – Mathematics Education**

I hereby confirm that the ethics application of the above mentioned student was approved on the Edu-REC meeting of 17 August 2017.

Ethics number: **NWU-00630-17-A2**

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Yours sincerely

Prof J Olivier
Chair Edu-REC

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CHAPTER 1 ORIENTATION OF THE STUDY

1.1 Introduction

There is a constant need to rethink education strategies as the role and nature of education is constantly changing, due to the swift advancement of technology in the 21st century. Contrary to traditional requirements for employable graduates in the 21st century, sought-after skills in the workplace are shifting more towards higher-order cognitive skills such as creativity, critical thinking, problem-solving, collaboration, digital literacy, innovation and communication (Tucker, 2012). This transformation of education goals is also crucial in the context of teacher education (Cishe, 2017) and specifically in the preparation of mathematics teachers, in light of the low mathematics standards currently experienced in South African schools (Taylor, 2008; The Centre for Developmental Enterprise, 2014). As indicated in the literature, critical thinking and problem-solving mastery can be improved through support of students' metacognitive skills (Akyüz et al., 2015; Moonsamy, 2014) and metacognition is a predictor of academic success (Downing, 2010; Winne, 1996). Moreover, there is overwhelming support in the literature for the necessity of metacognition in mathematics learning (Biggs, 1988; Campione, 1987; Kramarski et al., 2002; Schoenfeld, 2016). The body of scholarship indicates that the FCA in teaching and learning has the potential to support students in developing metacognitive skills (Lai & Hwang, 2016; Naccarato & Karakok, 2015; Steen-Utheim & Foldnes, 2018). These arguments served as motivation for this investigation that sets out to find guidelines to implement the FCA for metacognitive gains as part of mathematics teacher preparation at tertiary institutions.

Chapter 1 discusses the background and rationale for the investigation and serve as the departure point for the investigation of the research problem. Thereafter, the study is grounded in the relevant literature, and the research methodology is explained.

For this investigation this researcher will adopt a style of writing in the first person as suggested by Lichtman (2013). Lichtman is of the opinion that first-person writing is more engaging and this acknowledges my role in doing the research. However, in Chapter 4, where I report on data findings and refer to my journal inscriptions, I will then refer to that data source as *the researcher journal*.

In the next section, a clarification of the relevant terminology used throughout the investigation is provided.

1.2 Concept clarification

The following explains my understanding of core concepts within the context of the investigation.

- **Student-teacher:** A student enrolled for the BEd[1] programme.
- **Learner:** A school learner that will be in student-teachers‘ class once they enter practice.
- **Lecturer:** The teacher-educator lecturing within the BEd programme.
- **eFundi:** The learning management system (LMS) employed by the higher education institution is called *eFundi* and henceforth referred to as the LMS.
- **Flipped classroom:** It is a pedagogical approach where new concepts are introduced outside the classroom (videos), and face-to-face class time is transformed into an active learning space where the educator serves as a facilitator as students apply concepts (Bergmann & Sams, 2014).
- **Metacognition:** Defined as “thoughts about thoughts, knowledge about knowledge or reflections about actions” (Papaleontiou-Louca, 2008, p. 2); consists of metacognitive knowledge and metacognitive experience; metacognitive experience occurs when metacognitive knowledge enters consciousness (Flavell, 1987).
- **Self-regulated learning (SRL):** A process where learners methodically initiate and sustain thoughts and behaviours concerned with achieving their learning goals (Zimmerman & Martinez-Pons, 1986).
- **Self-directed learning (SDL)**: “In its broadest meaning self-directed learning describes a process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material sources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes” (Knowles, 1975, p. 18). According to Loyens et al. (2008, p. 418), self-directed learning concepts are more

[1] In South Africa the Bachelor of Education (BEd) degree is a four-year pre-service teaching qualification (North-West University, 2017).

comprehensive than self-regulation. For this study it is understood that self-regulated learning supports self-directed learning.

- **21st Century Skills:** A varied range of competencies are identified by different education systems as 21st century skills, and these skills are a combination of interpersonal and intrapersonal skills that generally include "critical thinking, collaboration, communication, problem-solving, and digital literacy" (Care et al., 2018, p. 8). According to Saavedra and Opfer (2012), these skills are more challenging to teach than rote skills, and 'learning how to learn' rather than rote skills are a demand for the 21st century (Wilson & Bai, 2010).

- **Constructivism:** As described by Richardson (1997, p. 3), constructivism is a "learning and meaning-making theory". Constructivist theory is rooted in the work of Piaget and Vygotsky (Schrader, 2015) and views concur on the principles that in a constructivist environment, instead of passively receiving information, students are actively constructing meaningful knowledge and skills (Biggs, 1996; Cobb, 1994; De Corte, 2012; Gravett, 2005; Kunnathodi & Sarabi, 2017; Schunk, 1996).

1.3 Background and rationale

Education, as a field of study, must seize the opportunity of the current technological revolution to challenge long-established teaching and learning paradigms that would include changing student and teacher roles as well as educational processes and activities (Schrader, 2015). Teacher education programmes should thus support prospective mathematics teachers to learn and in turn teach effectively, to equip them as 21st century teachers.

The Mission Statement of the North-West University (NWU), Faculty of Education (2017), includes the undertaking to inspire professional educators to be agents for change and to promote lifelong learning. Higher education institutions are encouraged to develop students who become lifelong learners, which refers to the process of "learning and relearning knowledge and experiences" to be equipped to build a sustainable future (Su et al., 2012, p. 158). The Organisation for Economic Co-operation and Development (OECD) reasons that the three major reasons for introducing lifelong learning is social stability, economic growth and personal well-being (Longworth, 2003). Bolhuis (2003) is of the opinion that lifelong learning is dependent on self-directedness. The development of self-directedness, self-regulation, and critical reflective skills for lifelong learning are set as required outcomes of South African teacher education programmes (Department of Higher Education and Training of South Africa, 2015). Furthermore, Zimmerman and Martinez-Pons (1986) describe self-

directed learning (SDL) as students' active involvement in their own learning in the areas of motivation and metacognition. De Baker (2012) states that most students at higher educational institutions have insufficient metacognitive skills to regulate learning effectively.

Educators should prepare learners to be self-directed, lifelong learners since they are to be prepared for an unpredictable future (Guglielmino, 2013). According to Loyens et al. (2008), SDL learning concepts are more comprehensive than self-regulation. For this study, it is understood that self-regulated learning (SRL) supports SDL and both concepts are regarded as important requisites for lifelong learning as well as for successful teaching in the 21st century. A basic understanding of the difference between SDL and SRL is that self-direction seems more focused on reaching goals whist regulation refers to the concrete activities required in order to reach these goal (Bolhuis, 2003). Stated otherwise, self-regulation skills are used to be self-directed. Loyens et al. (2008) accentuate the interrelatedness between SDL and SRL, and that both SRL and SDL activate metacognitive skills. Therefore, metacognition is an important requisite for the further development of SRL and SDL skills.

There is a dispute in the literature regarding the relationship between self-regulation and metacognition. Some researchers deem self-regulation to be a supplementary component of metacognition (Brown & DeLoache, 1978; Kluwe, 1987), whereas some see metacognition as a supplementary concept to self-regulation (Loyens et al., 2008; Winne, 1996; Zimmerman, 1995). Winne (1996) claims that metacognitive monitoring is an important activity for SRL. In agreement, Efklides (2008) and Muis (2007) assert that metacognition is a dominant feature to SRL. Self-regulated learners make use of different metacognitive strategies to regulate and control learning (Zimmerman, 2000). After considering all these points of view in the literature, for this study my understanding is that metacognition supports SRL that in turn supports SDL and finally lifelong learning. Therefore, a lack of metacognitive skills will influence SRL, SDL and ultimately lifelong learning that are requirements for 21st century teaching and learning. My interpretation of the relationship between these interrelated concepts as reported in the literature, and the way these concepts play a foundational role in the FCA, are illustrated in figure 1.1.

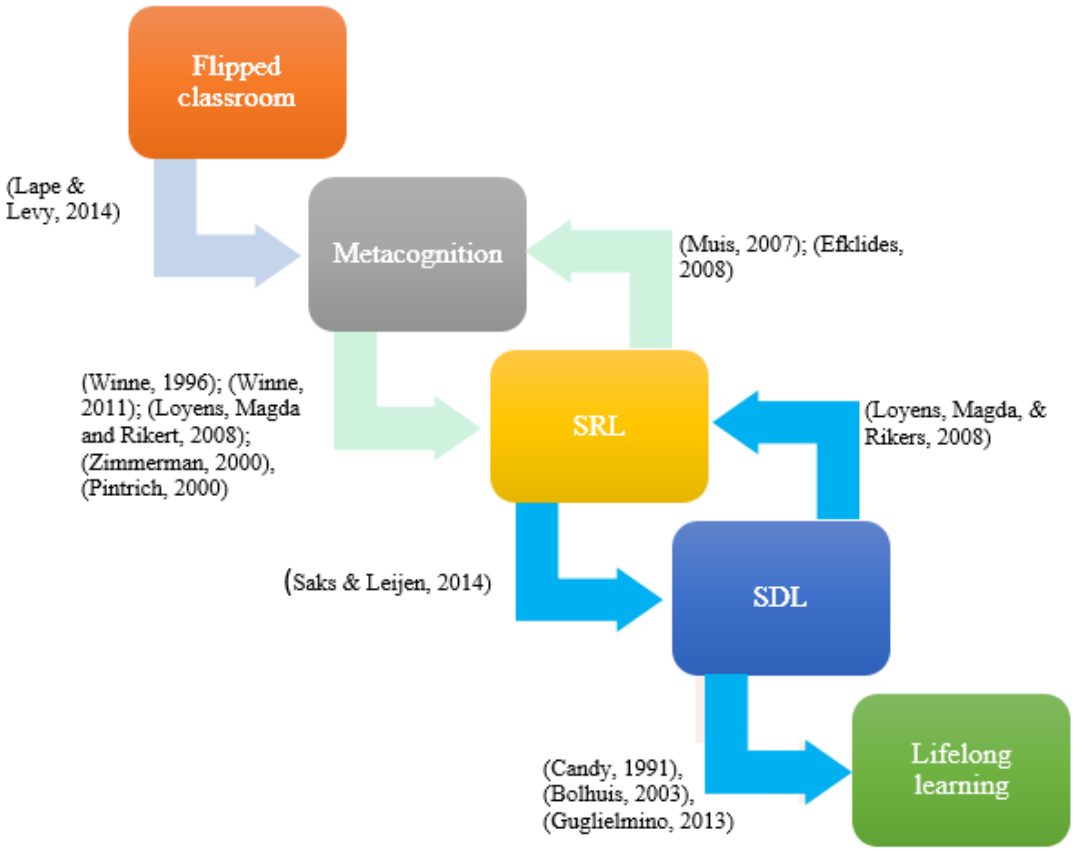


Figure 1.1 **A visual interpretation of the understanding of the relationship between the concepts of metacognition, SRL, SDL and lifelong learning.**

Akyüz et al. (2015) and Moonsamy (2014) assert that metacognitive skills improve critical thinking and problem-solving mastery. Academic success can be predicted by the use of metacognition (Downing, 2010; Winne, 1996). The lack of metacognitive skills such as the ability to monitor and reflect on their work is a factor that hinders students from performing well (White & Frederiksen, 1998), while research by Lester (2007) shows that the deployment of metacognitive behaviours is always productive. Curwen et al. (2010) additionally advocate that student-teachers need to be supported to become reflective and collaborative teachers, equipped with metacognitive skills. These skills correspond with the characteristics of the present-day professional teacher as proposed by Demirkasımoğlu (2010) which include flexibility and progressiveness, responsivity to change, self-regulation as well as the ability to collaborate with colleagues.

The aforementioned literature has implications for the designing of mathematical content delivery and student support at higher education level. The construct of metacognition as a

theoretical basis seems to be a requisite when supporting student-teachers to become more effective learners (Curwen et al., 2010; Shulman & Shulman, 2004). The question asked is how higher education institutions support this kind of learning in mathematics student-teachers. Veenman et al. (2006) claim that students naturally acquire the skill of metacognition from their parents, their peers, and especially their teachers but the development of this important competency can also be learned by those who lack this aptitude (Downing, 2010; King, 1991). Traditional lecturer-centred teaching approaches which mostly relied on direct instruction, are increasingly being criticised for not providing 21st century skills that are crucial for the young and next generations (Botha-Ravyse & Reitsma, 2015; Rutkowski & Moscinska, 2013). Furthermore, the mission statement of the university includes the intention to "transform education scholarship through innovative praxis[2]" (North-West University Faculty of Educational Sciences, 2017). Considering the current poor standard of mathematics education in South African schools, this transformation is crucial. Lecturers responsible for preparing student-teachers as self-directed teachers with essential metacognitive skills should therefore explore activities and techniques that can foster metacognition in their students and implement teaching approaches that have the potential to allow for metacognitive gains. Moreover, this innovative praxis needs to be evaluated and improved upon to ensure these students are properly equipped as 21st century teachers. One such innovation is the flipped-classroom approach (FCA) to teaching and learning. For this study, the flipped classroom was implemented as an educational approach with the potential to support student-teachers' metacognition. Guglielmino (2013) encourages metacognition to be integrated into a self-directed curriculum.

Literature pertaining to the FCA to teaching and learning agrees that this approach has the potential to provide more time for active learning and activities that activate critical thinking (Bergmann & Sams, 2014; Botha-Ravyse & Reitsma, 2015; Gullen & Zimmerman, 2013; Nederveld & Berge, 2015; Rotellar & Cain, 2016)(§1.7.3). Active learning is a pedagogy focused on student activity and engages the learner in the learning process, facilitated through collaborative learning and problem-solving (Prince, 2004).

Although there seems to be much confirmation of the value of the FCA (Bergmann & Sams, 2014; De Boer & Winnips, 2015; McLean, 2016; Nederveld & Berge, 2015; Rotellar & Cain, 2016), the need for further research on this fairly new approach to education is highlighted in the literature. According to Abeysekera and Dawson (2015) and Halili et al. (2014), qualitative research into student experience requires further research as well as small-scale local

[2]Reflecting and acting upon the world to bring about transformation (Freire, 2000, p. 51).

investigations into the success of the FCA in certain disciplines or with certain students (Abeysekera & Dawson, 2015). Furthermore, Naccarato and Karakok (2015) encourage research on how the FCA specifically affects metacognition and how we can effectively assess metacognition. Lastly, research is required on the aspects of an FCA implementation which explicitly benefit teaching and learning (Kim et al., 2014) and the supporting of SDL skills (Halili, 2014). Apart from the need for guidelines concerning FCA design features that will match the metacognitive learning needs of specific mathematics student-teachers, these identifiable gaps in the knowledge field serve as the rationale for the study.

The FCA was implemented during a BEd first year mathematics module, providing the opportunity to investigate how the approach should be implemented to foster metacognition in student-teachers. The mathematics module is a basic geometry module in a teacher education programme, and hereafter is referred to as the Mathematics module. For ethical reasons, the module code will not be used.

The focus on the role of metacognition in the FCA is grounded in the stance that metacognition supports self-regulation, self-directedness, and lifelong learning (figure 1.1). All the concepts in figure 1.1 are unpacked in the body of scholarship (§2.4.2; §2.4.3; §2.5; §2.6).

1.4 Problem statement

South Africa urgently needs 21st century teachers who are self-directed and have good metacognitive skills. Therefore, higher education institutions are required to design and evaluate strategies that support students in this regard. Since the literature concurs that the FCA has the potential to support these skills, this approach was used to deliver a specific mathematics module within the first year of the BEd programme. This initial implementation of the FCA provided an ideal opportunity to investigate how this approach should be designed to foster these skills within mathematics student-teachers. Irrespective of the support in literature concerning the potential of the approach to aid in the development of metacognitive skills (Kim et al., 2014; Lape & Levy, 2014; Naccarato & Karakok, 2015), it is acknowledged that the FCA itself does not foster metacognition but rather the way in which this approach is implemented. This investigation was thus necessary to provide guidelines for most relevant design features to be included in future FCA implementations to teaching and learning at this higher education institution for prospective mathematics teachers. This is an explicit problem since findings in the literature indicate the need for metacognitive skills (Flavell, 1979; Schoenfeld, 2016) and that students have the potential to develop these skills, with the necessary support (Callender et al., 2016; Schraw, 1998).

1.5 Research questions

The investigation was guided by the research question:

How should a flipped-classroom approach be implemented for metacognitive gains to prepare mathematics student-teachers for the 21st century?

The following secondary research questions directed the investigation:

> *1. What does the body of scholarship indicate with respect to design features of a flipped-classroom approach aiming to foster metacognition as a 21st century skill in student-teachers in their learning of mathematics?*
>
> *2. How do student-teachers and the lecturer experience the implementation of the flipped-classroom approach that aims to foster metacognition?*
>
> *3. How can the flipped-classroom design be revised to improve support for metacognition?*
>
> *4. To what extent do findings from the literature and the empirical study explicate critical elements that are required to be accommodated in a flipped-classroom approach to foster mathematics student-teachers' metacognition as preparation for teaching in the 21st century?*

1.6 Research aims and objectives

To find answers to the research question and secondary research questions, the primary aim of the investigation was to determine how a flipped-classroom approach should be implemented to foster metacognition within mathematics student-teachers at a higher education institution. The investigation's secondary aim was to suggest guidelines for the meaningful implementation of the FCA to foster metacognition for the teaching and learning of mathematics at this higher education institution.

The objectives of the study were to explore:

- what the body of scholarship indicates with respect to design features of a flipped-classroom approach aiming to foster metacognition as a 21st century skill in student-teachers in their learning of mathematics.
- student-teachers and lecturer experiences of the implementation of the flipped-classroom approach that aims to foster metacognition.

- the way the flipped-classroom design should be revised to improve support for metacognition.

- to what extent findings from the literature and the empirical study explicate critical elements that are required to be accommodated in a flipped-classroom approach for the learning of mathematics with the aim to foster student-teachers' metacognition.

1.7 Overview of the literature

Providing an overview of the literature grounds the research in the body of scholarship that already exists on the problem under investigation. Figure 1.2 below is a visual illustration of the theoretical framework and includes the concepts that were studied as part of the literature review.

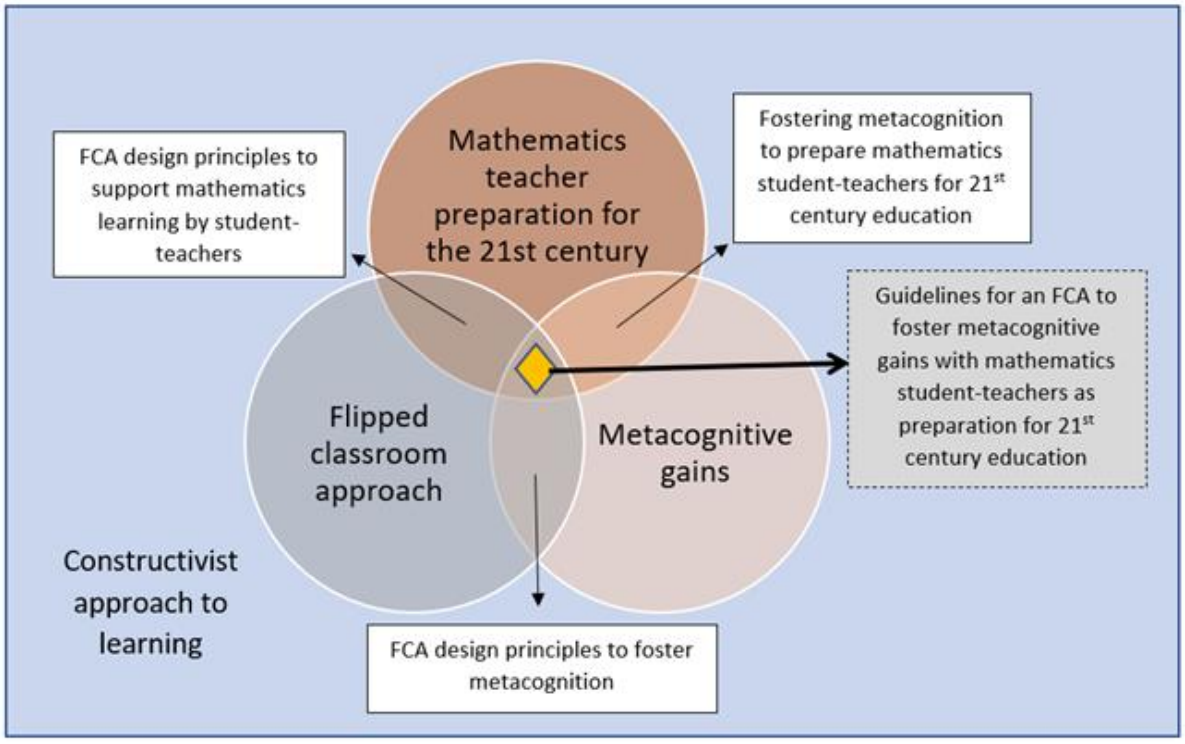


Figure 1.2 Fostering metacognition through an FCA for mathematics teacher preparation in the 21st century

An extensive literature review was conducted to gain knowledge on the three main components that are at the centre of the study, namely aspects related to mathematics teacher preparation, the FCA and metacognition, to come to a better understanding of the relation between these components as illustrated in figure 1.2. The focus on how an FCA should be designed to prepare mathematics student-teacher for practice in the 21st century firstly

required defining Mathematics as subject, both at school level and in teacher-education programmes, followed by an exploration of the different knowledge fields that form part of mathematics teachers' knowledge repertoire as well as their beliefs concerning mathematics education. An argument for reflective SDL by teachers to survive in a fluid 21st century education environment sets the backdrop for a literature review on a constructivist approach to education. Grounded in the theory of constructivism, 21st century skills are explored from the literature with specific focus on digital literacy, SDL and SRL as keystones of 21st century learning (§2.4) and supported by metacognition (§2.5). An exploration of the literature on metacognition, with specific focus on its role in mathematics education, concludes with a motivation for metacognition as higher order thinking skills, as depicted by Bloom's taxonomy of learning. Lastly the FCA as focus of the study is explored in depth from the literature as grounding for the empirical study that aimed to find answers to the research question and sub-questions.

1.7.1 Mathematics teacher preparation for the 21st century

The teachers' view of what mathematics and the role of mathematics education in the 21st century is, will play a role in the choices they make concerning teaching and learning strategies. As background to aspects related to mathematics teacher preparation for the 21st century, it is necessary to first look at how mathematics is defined in the literature.

1.7.1.1 Defining mathematics of the 21st century

Contrary to traditionally held beliefs that mathematics is a fixed body of facts and procedures to be mastered by rote memorisation and presented to learners through rote procedures, Li and Schoenfeld (2019) endorse the view of educationist Dossey (1992), who suggests that mathematics should rather be viewed as a human activity and that mathematics education should develop students' mathematical thinking about ideas. This view reflects the definition and aims of mathematics education as set by the Department of Basic Education (2011, p. 6) (§2.2.1), in which learners are supported to "recognize Mathematics as a creative part of human activity", leading to "deep conceptual understandings in order to make sense of Mathematics". Similar to the view held by Li and Schoenfeld (2019), the South African mathematics curriculum is grounded in the constructivist approach to learning and a learner-centred view of education, where the learner is actively involved in own meaning-making (Department of Basic Education, 2011). However, concern is expressed by Li and Schoenfeld (2019) that teachers still tend to believe that their learners learn best when the content is presented to them. They warn that "this situation needs to be changed, especially as we

prepare students for the continuously increasing demand for quantitative and computational literacy over the twenty-first century" (Li & Schoenfeld, 2019, p. 1).

Boaler (2016) is of the opinion that mathematics supports learners in their daily lives, not merely, because it will equip them to identify and solve problems in the real world, but because mathematics develops the skills of both quantitative and abstract thinking. Li and Schoenfeld (2019) warn about the large number of students dropping out of mathematics because they fail to see the value of mathematics. This phenomenon is not only limiting their future career choices but leads to shortages in mathematically literate citizens. Li and Schoenfeld (2019) believe that the responsibility to change the status quo lies with higher education institutions involved with mathematics teacher education, who do not provide student-teachers with opportunities to learn mathematics in the way learners should be learning in schools. Mathematics teachers should therefore be exposed to student-centred approaches to mathematics education and get first-hand experience of teaching and learning strategies that will motivate rich engagement and active learner participation in own learning. Active participation in own learning leads to deeper understanding (Li & Schoenfeld, 2019) and holds value for enhanced self-efficacy beliefs (Fook et al. 2015).

1.7.1.2 Mathematics teachers' knowledge

The role of teacher subject knowledge as well as pedagogical content knowledge plays a central role in learning outcomes (§2.2.2) (Hill & Chin, 2018). Chu et al., (2017, p. 110) underline that there is a paradigm shift in the 21st century in teacher education "from a knowledge-oriented curriculum to one that stresses more the activities and practices that bring about knowledge acquisition." With the fast changing knowledge, the focus is rather on the mastering of twenty-first century skills by teachers (§2.4) – not only for their own learning and development, but also to support the development of these skills with their learners (Chu et al., 2017). However, a sound subject knowledge plays a crucial role in mathematics education (Alex, 2019; Bowie et al., 2019).

Teacher content knowledge, knowledge of classroom management, curriculum knowledge, pedagogical content knowledge, knowledge of the learners, the educational contexts as well as knowledge of educational aims (Shulman, 1987, p. 8) have to be accommodated by teacher education programmes (§2.2.2). While subject knowledge and pedagogical content knowledge should be at the core of teacher knowledge (Ball et al., 2008), teacher metacognitive knowledge plays a crucial role in supporting successful learning in the 21st century (Menz & Xin, 2016; Wilson & Bai, 2010) (§2.2.2.3; §2.5). In light of the important role of technology in education in the 21st century, the teacher's knowledge of relevant technology

for education also forms part of the teachers' knowledge domain (§2.2.2.4). With specific interest in equipping student-teachers with knowledge for practice in the 21st century, the literature on teacher content knowledge, pedagogical content knowledge, metacognitive knowledge, and knowledge of technology for education, is explored in more detail in Chapter 2.

1.7.1.3 Teachers' beliefs about mathematics and mathematics education

Educators' beliefs about mathematics and how it is mastered will influence their approach to mathematics teaching (Kögce, 2017; Sawyer, 2017; Schoen & LaVenia, 2019; Wladis et al., 2017) and will also affect their learners' beliefs about mathematics and their ability to master mathematics (Wladis et al., 2017) (§2.2.3). Schoen and LaVenia (2019, p. 3) acknowledge the "influence of emotions, attitudes, and feelings of self-efficacy on instructional practice and student learning" but focus their definition of teacher beliefs on cognitive pedagogical content beliefs, that "form a default perspective put to use by an individual for the purpose of making decisions when complete information is not (or cannot be) available to the teacher at that time." Schoen and LaVenia (2019) recognise the influence of teacher beliefs about mathematics on learning outcomes. Deeply held beliefs about mathematics learning is difficult to change (Boaler, 2013), and higher education institutions should incorporate strategies to guide student-teachers to question their own beliefs to prevent them from entering the teaching profession with unfounded personal theories of meaningful mathematics education (Schoen & LaVenia, 2019).

Apart from supporting a sound subject knowledge (§2.2.2.1) as well as pedagogical knowledge relevant to 21st century demands (§2.2.4), student-teachers will need opportunities to critically reflect on their beliefs and knowledge and to make the necessary paradigm shift towards a more constructivist approach (§2.3.4) in support of deep learning by their future learners.

1.7.1.4 Constructivism

Constructivism is a philosophy of learning and creating meaning (Richardson, 1997). In addition, Richardson (1997) states that constructivism is not a philosophy of how individuals can learn, but rather a theory of how people evolve. As defined by Brooks (1999), a distinction between traditional and constructivist classrooms is that in a constructivist view, students are seen as thinkers and teachers seek their point of view, while knowledge is provided to students in a traditional space and teachers seek the correct answers to authenticate student learning.

In a constructivist environment, students actively construct meaningful knowledge and skills instead of passively receiving information (Biggs, 1996; Cobb, 1994; De Corte, 2012). Meaningful knowledge as described by De Corte (2012, p. 33) is acquired through following a constructivist approach to learning that includes collaborative and self-regulated learning.

Critics of the constructivist approach argue that strong learning guidance is most often found to be just as successful as unguided approaches, and that the latter has negative results when students develop misconceptions or incomplete knowledge (Kirschner et al., 2006). Although there are arguments against constructivist teaching techniques, the overwhelming support in the body of scholarship for a constructivist approach to education to support deep an sustained learning (Biggs, 1996; Jonassen et al., 1995; Schrader, 2015), has motivated constructivist teaching-learning strategies across the world for many a decade.

A social constructivist environment as suggested by Vygotsky (1978) involves the construction of knowledge whilst participating in a group and through collaborative dialogue (Schrader, 2015; Woolfolk, 2014). Various educationists in the field of mathematics support a more collaborative knowledge construction for learning with understanding (Ernest, 1998; Steffe et al., 2013; Vintere, 2018).

- **Constructivism and mathematics education**

Vintere (2018, p. 6) lists sustainable development of mathematical competences as a core value of a constructivist approach based on the way this approach supports “critical thinking, problem-solving approach, analytical skills as well as confidence, respect for others, etiquettes and social skills among learners.” An analysis of constructivism in mathematics education by Confrey and Kazak (2006) found that overall constructivism had a positive influence on mathematics education. In line with the views of Bruner (1961), they found constructivism valuable, based on the student-centredness and the changed role of the educator. The changed role of the educator is described by King (1993) as facilitator- guided learning and less direct teaching. Cobb et al. (1992) emphasise the important role of the educator by explaining that constructivism does not mean that students are merely left on their own to explore materials without guidance. Therefore, it is important that mathematics teachers be equipped to manage the mathematics learning process in a responsible way to facilitate learners’ understanding of mathematics (Boaler, 2016). Boaler (2016) also specifically emphasises the benefit of a constructivist approach to support problem-solving in mathematics learning.

De Corte (2012, p. 35) claims that many students believe mathematics is a fixed body of knowledge, rather than knowledge constructed by learners. As an initiative to address such restrictive convictions, Boaler (2016) suggests that students should talk to each other about ideas and ask questions like: “Why did I choose this method? Does it work in other cases? Is this method different from the methods other people used?”. The strategy potentially influences metacognition. Furthermore, as stated by Vijaya Kumari (2014), reflective operations are a feature of constructivism in teacher training. Kunnathodi and Sarabi (2017) define constructivism that forms part of teachers training as transformative, integrative, and meaning-making learning.

As evident in the literature, constructivism for developing the required skills for teaching and learning of mathematics is deemed an appropriate view in the 21st century. In the next section, a key competency, namely metacognition, that is relevant to this study and required for the 21st century, is explicated.

1.7.1.5 Twenty-first century skills

Global interconnectedness shifted the focus of learning from the mastering of content to 21st century skills such as the ability to communicate, collaborate and to solve problems across contexts (Saavedra & Opfer, 2012) while digital literacy, SDL and SRL are viewed as core features of learning in the 21st century (Binkley et al., 2012). Teachers therefore have the responsibility to equip their learners with 21st century skills implying that higher education institutions empower student-teachers to develop these skills with their learners (Li et al., 2013).

- **Digital literacy and information and communications technology**

Technology is viewed as a teaching and learning tool in 21st century education (Binkley et al., 2012; Kaur, 2016) and thoughtful implementation of technology has the potential to support teaching and learning of mathematics (Guri-Rosenblit & Gros, 2011; Li et al., 2013). Higher education institutions responsible for preparing teachers for 21st century teaching should therefore expose student-teachers to the use of these tools in teaching education programmes.

The literature confirms that digital technologies can support learners knowledge construction as well as their problem-solving skills in mathematics (Bray & Tangney, 2017), enhance mathematics achievement (Kaur, 2016) (§2.4.1), and support metacognition (Downing, 2010; Gama, 2004; Winne, 1996). However, the choice of technology for the specific content and learning aim will determine the contribution it will make to the learning outcomes (Bray &

Tangney, 2017; Guri-Rosenblit & Gros, 2011). Technology should not merely be used to support traditional practice but should rather foster higher order thinking such as creativity and problem-solving (Guri-Rosenblit & Gros, 2011), as well as metacognition (Van Vliet et al., 2015), if it is to contribute to improved mathematics learning (§2.4.1).

The FCA combines traditional interactive face-to-face learning in the classroom and online multimedia technology and therefore relies on the meaningful integration face-to-face and online learning through the skilful use of technology (Halili & Zainuddin, 2015; Hrastinski, 2019) (§1.7.3). Digital and ICT competence of both the teacher and the learner are therefore determinants of a successful FCA as a form of blended learning (Heinerichs et al., 2016; Hrastinski, 2019; Tang & Chaw, 2016).

- **Self-directed learning**

SDL is defined by Knowles (1975) as "a process by which individuals take initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material sources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes". The benefits of SDL in the 21st century is apparent, where the learner must continuously adapt to the fast-changing education environment of the 21st century (Chalkiadaki, 2018; Fahnoe & Mishra, 2013; Jaleel, 2017; Tekkol & Demirel, 2018). SDL is related to personal autonomy, self-management and learner-control (Candy, 1991) and plays a role in active learning through learner motivation, behaviour and metacognition that are features of SDL (Zimmerman & Martinez-Pons, 1986). SDL, furthermore, supports deep learning, higher levels of learning and prepares students to take responsibility for their own learning (Bolhuis, 2003), while it is also considered to foster lifelong learning (Loyens et al., 2008). In light of the values of SDL, teacher-educators in the 21st century need to adopt teaching approaches that support student-teachers' SDL (Nogueiras & Iborra, 2017) that will equip these prospective teachers to adapt to ongoing changes in education and to serve as drive to continuously improve their own practice through lifelong learning. The potential of the FCA to support SDL (Liu et al., 2018; Van Wyk, 2018; Zainuddin & Perera, 2018) could serve to motivate educators to explore this approach for teaching.

Adding to the discussion on the relationship between SRL and SDL (§1.3), Robinson and Persky (2020, p. 293) differentiate between SRL and SDL by pointing out that SRL is a narrower construct than SDL and "stems from cognitive psychology while SDL stems from adult education". However, today the principles of SDL are applied successfully to enhance learning on all levels. One of the main differences is that with self-regulation, the learning task comes from the instructor, while in SDL, the student has more control over the learning

environment. Self-regulation of own learning can help to scaffold SDL (Robinson & Persky, 2020).

- **Self-regulated learning**

The role of SRL in SDL is evident form Pintrich's (2000) Self-Regulation Model, consisting of four phases namely planning, monitoring, control and reflection (§2.4.3). Active learning is grounded in SRL as key 21st century skills (Binkley et al., 2012; Tan et al., 2015; Virtanen et al., 2017) and self-regulation enhances student academic achievement (Azevedo et al., 2013; De Corte, 2012; Winne, 1995; Zimmerman, 1989). Through SRL students monitor the effectiveness of their learning strategies and adapt these strategies as necessary (Zimmerman, 1989). The role of SRL in active learning is clear when he describes self-regulated students as "metacognitively, motivationally, and behaviourally active participants in their own learning process" (Zimmerman, 1989, p. 329). SRL offers a scheme to understand aspects of learning such as motivation, cognition and emotion (Panadero, 2017).

Motivational and emotional factors may hinder SRL (Ning & Downing, 2010; Tzohar-Rozen & Kramarski, 2014; Virtanen et al., 2017), and self-motivation and positive beliefs in own learning ability plays a determining role in self-regulative learning (Tzohar-Rozen & Kramarski, 2014). Educators therefore must create an environment that supports SRL. Teachers who have SRL skills, will be able to also instil these skills in their own learners (Virtanen et al., 2017), meaning that teacher-educators should employ teaching strategies that will motivate SRL. In order to improve mathematics teaching, educators must get into the habit of reflecting on instructional practice and cognitions (Artzt et al., 2008), and therefore student-teachers should receive regular opportunities to implement SRL.

Metacognitive processes take place during SRL (Muis, 2007) and teacher education should incorporate student activities that foster metacognition that in turn support students' SRL (Curwen et al., 2010).

1.7.2 Metacognition as a 21st century skill

Metacognitive skills are considered as vital for the 21st century (Binkley et al., 2012; Fadel et al., 2015; Geisinger, 2016; Saavedra & Opfer, 2012). In this section of the literature overview, the concept of metacognition is defined and discussed briefly and thereafter the importance of metacognition in mathematics is highlighted. Teaching and assessing for metacognitive gains are explicated in §2.5.3 and §2.5.4.

Metacognition is the awareness of one's thinking (Campione, 1987). Metacognition theories can commonly be defined as systematic frameworks used to explain and address cognition, metacognitive knowledge, and self-regulation skills (Schraw & Moshman, 1995). Some terms associated with metacognition are self-regulation, higher-order skills, feeling-of-knowing, the judgement of learning, metacognitive skills, metacognitive knowledge, metacognitive experiences, metacognitive beliefs, and metacognitive awareness (Veenman et al., 2006).

Flavell (1979), who initially coined the term metacognition, classified it as being made up of two parts: metacognitive knowledge and metacognitive experience. He categorises metacognitive knowledge into three types of knowledge: *person* knowledge, *task* knowledge, and *strategy* knowledge (Flavell, 1979). Metacognitive experiences have to do with cognitive endeavour and likely to occur when opportunities are provided for thought and feelings about one's thinking (Papaleontiou-Louca, 2008). Brown (1987) distinguishes between metacognitive knowledge and metacognitive regulation but stresses that the two concepts are closely related. Activities that oversee and regulate learning are metacognitive regulation (Montalvo & Torres, 2004; Papaleontiou-Louca, 2008).

In agreement with Brown (1987), Schraw and Moshman (1995) elaborate metacognitive knowledge and metacognitive regulation into being distinct concepts as the knowledge component refers to what a person knows about knowledge and the regulation component refers to the regulation and control of that knowledge. The latter is also described by Papaleontiou-Louca (2008) as activities that oversee and regulate learning, thus again corroborating Flavell's (1976) view by emphasising the role of metacognition in the self-regulation of own learning.

The literature generally agrees that metacognitive knowledge consists of three components: conditional knowledge, declarative knowledge and procedural knowledge (Lai, 2011; Schraw, 1998; Schraw et al., 2006). Schraw et al. (2006) and Paris and Byrnes (1989) agree that conditional knowledge enables a person to know in which situation to use a particular strategy and why the strategy is suitable. Declarative knowledge allows a person to identify what they know and what they do not know and realise the factors that influence performance. Procedural knowledge is merely the knowledge of different strategies that support learning. These authors accentuate the relationship between these metacognitive knowledge types and metacognitive skills, and it is evident that these knowledge types inform metacognitive skills. Kluwe (1987) views "metacognitive regulation" as three skills: planning, monitoring and evaluation. Planning comprises making use of suitable strategies and resources, monitoring refers to the awareness of understanding, and evaluation refers to reflecting on the processes of learning (Schraw & Moshman, 1995). The information is summarised in Table 1.1 below

and highlights that metacognitive knowledge informs metacognitive regulation. Veenman et al. (2006) profess that *planning* develops earlier than *monitoring* and *evaluation*. Furthermore, Schraw and Moshman (1995) opine that *monitoring* improves with time and practice, leading to an improved *evaluation* of learning.

Table 1.1 Summary of metacognitive knowledge and metacognitive regulation.

Metacognitive knowledge (Flavell, 1979)		
Conditional	Knowing how and when various strategies can be used	Using diagrams to organise thought; how to study for different content
Procedural	Knowing that some tasks are more demanding than others; Knowledge of different strategies.	Summarizing main ideas; judging your mathematics homework will take less time than your critical essay
Declarative	Knowing which factors impacts your learning; Knowing what you know and what you do not know.	Knowing your preference of visual aids for learning
Metacognitive regulation (Schraw & Moshman, 1995)		
Planning	Selecting appropriate strategies and resources	Setting goals; determining time and effort allocation
Monitoring	Awareness of comprehension; Determining whether a strategy is working	Self-testing while learning; Realising when to ask for support; Tracking number of mathematics problems completed
Evaluating	Assessing result of cognitive task after completion	Realising if a strategy leads to a good result; Changing planning and/or strategies as needed

Downing (2010) stated that before metacognition can be used as consciously controlled strategies, metacognitive skills are a prerequisite. Therefore, specific tools and interventions

can be used to foster the development of metacognition. Although the study focusses on foster and regulate BEd students' metacognition through the FCA, I acknowledge that metacognitive experiences are informed by students' current metacognitive knowledge and skills, serving as the basis for further development of their metacognitive knowledge.

- **Metacognition in mathematics**

There is overwhelming support in the body of scholarship for the need for metacognition in mathematics learning (Baten et al., 2017; Biggs, 1988; Campione, 1987; Schoenfeld, 1992; Su et al., 2016). Metacognitive monitoring and regulation play an important role in solving mathematical problems and serves as an aim to encourage and evaluate the metacognition of students (Jacobse & Harskamp, 2012). Metacognitive skills are also known to encourage critical thinking (Magno, 2010; Mariano et al., 2017). Specific tasks involving metacognitive skills in mathematics include estimating the solution, drawing sketches to help problem-solving, creating an action plan, showing step-by-step calculations, monitoring action plans and drawing conclusions about the problem (Apaydin & Hossary, 2017; Van der Stel & Veenman, 2010). Therefore, none of these tasks can be done successfully without employing metacognitive skills.

According to De Corte (2012) and Campione (1987), metacognitive skills are essential for building adaptive competence. Results from a study conducted by Lape and Levy (2014) indicating that students in a flipped classroom scored significantly higher than students in the traditional setting on adaptive competence measures strengthens the case for implementing an FCA to support meaningful learning. Furthermore, incorporating metacognition into teacher education provides the student-teacher the opportunity to reflect about learning, and subsequently, how to teach, which will hopefully impact their future pedagogical practice (Portilho & Medina, 2016). In the next section, the FCA to teaching and learning is defined and the potential to support metacognitive gains is highlighted.

1.7.3 The flipped-classroom approach to teaching and learning with the potential to foster metacognition

The FCA is generally regarded as a component of blended learning (Halili & Zainuddin, 2015; Kurt, 2017; Staker & Horn, 2012; Thai et al., 2017). Blended learning is an educational model which is defined by Staker and Horn (2012) as having two components: a controlled in class, face-to-face component and a flexible online component where students have control over the pacing and the time for accessing and completing the content provided online. Zainuddin and Halili (2016) note that the FCA forms part of blended learning since an FCA integrates both

face-to-face in-class learning with out-of-class learning where students watch online video lessons. However, Staker and Horn (2012) distinguish an FCA from traditional blended learning based on two aspects that set the FCA apart: firstly, in an FCA a set schedule exists for the in-class and the out-of-class components and secondly, the out-of-class component is used for introducing new concepts rather than completing homework.

The FCA is also known as the inverted classroom (Lage, 2000) and reverse instruction (Rutkowski & Moscinska, 2013; Tucker, 2012). The FCA moves instruction that is traditionally done in the classroom out of the classroom (Lage, 2000), and combines the use of technology as well as constructivist and traditional teaching techniques (Lape & Levy, 2014). Therefore, new concepts are brought in as an out-of-class component by making use of technology (Bergmann & Sams, 2014). As the definition in the clarification of concepts states (§1.2), the FCA is a pedagogical approach with an in-class component that is active, where students are to apply their knowledge, with the educator taking on the role of facilitator. Bishop and Verleger (2013) describe the flipped classroom as combining learning theories once thought to be irreconcilable. Firstly, constructivist activities such as active problem-solving are incorporated as well as direct instruction methods, based on behaviourist ideologies. This feature of the FCA holds advantages for meaningful learning of mathematics, where Boaler (2016) specifically emphasises the benefits of a constructivist approach to mathematics learning.

However, according to Flipped Learning Network (2014) (FLN), there is a distinction between flipped learning and a flipped classroom and that flipping a class does not always lead to flipped learning. In agreement with FLN (2014), Abeysekera and Dawson (2015) and Kim et al. (2014) state that merely changing the mode of transmission of knowledge without the implementation of other changes is unlikely to show significant gains in learning. One such change focuses explicitly on the role of the educator (§2.6.2) in an FCA.

Bishop and Verleger (2013) describe the flipped classroom as an approach that uses technology and emphasises active learning, problem-solving, and collaboration. The flipped classroom is *not* readings or worksheets as homework, or in-class activities that re-teaches the homework or, a mere ‘flip’ of a traditional approach where teaching and learning in-class consist of drill practice when students complete worksheets as homework for further practice of new concepts. This view is echoed by the FLN (2014), who add to the opinion of Bishop and Verleger (2013), who profess that to participate in flipped learning, as opposed to merely flipping a class, the following needs to be in place:

- A flexible environment needs to be created where students are provided with different modes and ways to learn content and space to reflect on their learning. The educator needs to adjust the flipped classroom based on observing and monitoring students.

- A learning culture that is active, student-centred, engaging in meaningful content through differentiation and feedback encourages students' evaluation of their learning. Also, where direct instruction is done as part of out-of-class learning.

- Intentional content is used to implement student-centred, active learning strategies that utilise class time optimally and considers the content and student level.

- A professional educator used formative in-class assessment to inform instruction based on their findings. Furthermore, professional educators take responsibility for transforming practice by reflecting and connecting with other educators.

Considering the information above, for purposes of this study, my understanding of a successful FCA implementation distinguishes between FCA principles and FCA strategies. My understanding of FCA principles is in agreement with those described by Bishop and Verleger (2013) and can be summarised as integrating technology to maximise meaningful in-class-learning time through facilitated higher-order tasks and collaboration. This involves that, as part of the out-of-class learning, new content required to complete the in-class work is introduced without re-teaching the content to the students during in-class activities. FCA strategies are put in place to enable the success of the FCA principles. They can include strategies to check for student preparation for in-class learning, use the online platform (for example, learning management systems) efficiently through scaffolding, and provide meaningful feedback to students.

The flipped classroom is therefore a pedagogical framework that encourages educators to incorporate different teaching methods based on their teaching objectives, rather than seeing it as an all-inclusive learning model, as Naccarato and Karakok (2015) emphasized. This implies that the flipped classroom can be implemented according to design principles based on different contexts and student needs, and that there is not only one correct way to implement the approach. For this investigation, design principles were extracted to find the most efficient strategies to enhance meaningful learning to best support metacognition.

Research findings suggest that flipped classroom activities are more student-centred than traditional teaching activities (Kim et al., 2014; Rotellar & Cain, 2016). Analysis of the impact of flipped learning proved to be valuable and presented positive impact on students' learning such as motivation and engagement (Botha-Ravyse & Reitsma, 2015; Zainuddin & Halili,

2016). Challenges in the use of the FCA also surfaced in the literature. Apart from studies that showed no significant difference in student performance between flipped classrooms and traditional classrooms (Davies et al., 2013; Lape & Levy, 2014; Strayer, 2012), Kim et al. (2014) found that students often had trouble with self-regulation and working collaboratively with peers during problem-solving activities in a flipped classroom environment. Although the research findings of Lape and Levy (2014) indicate that students in a flipped classroom experiment scored significantly higher on some of the measures of knowledge transfer compared to students in a traditional classroom, their results on metacognitive gain showed no difference between the flipped and the traditional groups. Considering the strong support in the literature for the FCA, contradictory findings raise questions regarding the specific way the approach is implemented.

Notwithstanding, there is overwhelming support in the literature for the value of the FCA, especially for the development of higher order thinking skills. The research findings by Strayer (2012) indicate that students in a flipped classroom became more aware of their own learning process, which implies metacognitive gains. In a study by Lape and Levy (2014) that provided for regulation of cognition, students demonstrated metacognitive gains in a flipped classroom context where students could watch videos again and control the pace. Additionally, this approach provides time for students to share their thinking and struggles (Naccarato & Karakok, 2015). Based on Krathwohl's (2002) revised version of Bloom's taxonomy, the following figure (figure 1.3) was constructed to illustrate the argument for the FCA as support for student-teachers to reach higher levels of thinking and mathematical reasoning:

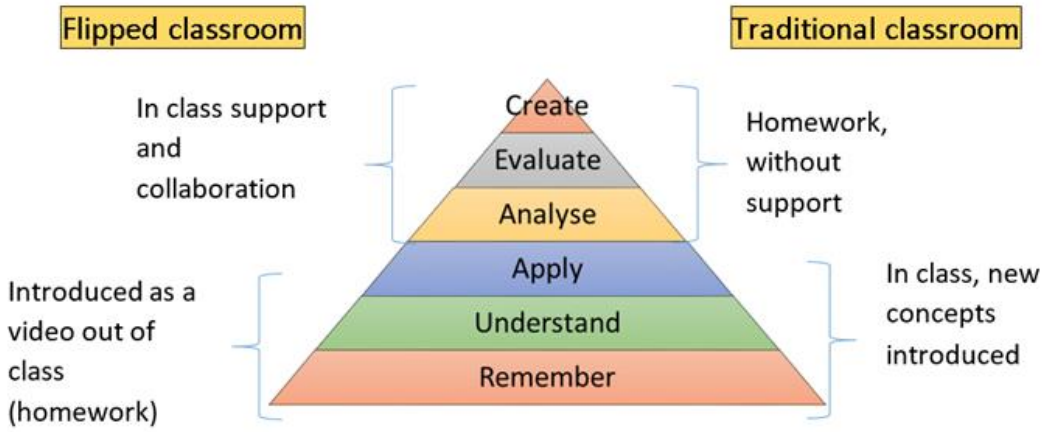


Figure 1.3 **Krathwohl's (2002, p. 214) revised version of Bloom's taxonomy of learning domains, applied to the FCA**

Figure 1.3 illustrates the potential of a successful FCA to support higher-order cognitive functions whereby students are guided to analyse (distinguish between facts and inferences), evaluate (make judgments about the value of ideas), and evidently create new meanings or structures as a result of learning (Krathwohl, 2002; Mayer, 2002). These functions clearly include metacognitive skills (§2.5.2). As claimed by Bergmann and Sams (2014), if lecturing is the primary mode of instruction and students are not actively involved, students will only reach the basic levels of Bloom's taxonomy (namely *Remembering* and *Understanding)*. The crucial role played by active learning in fostering higher-order levels of learning, like evaluation of knowledge and skills, is also accentuated by Heinerichs et al. (2016). Furthermore, De Boer and Winnips (2015) view the FCA to teaching and learning as a good example of the impact that active learning can have on student achievement and deep learning.

Kim et al. (2014) make suggestions for research focused on "a more robust set of discipline-specific flipping strategies, especially in light of the relevance to typical undergraduate courses" that support course learning goals for meaningful learning. These suggestions served as impetus for my own investigation into a more tailor-made approach to the FCA, which incorporates metacognition for SDL within a specific teaching context. Apart from an extensive literature study to establish relevant features to form part of the FCA design (§2.6), this investigation set out to find a tailor-made flipped classroom model highlighting the strategies, with the potential to foster metacognition that works for the context, resources available and the learner needs.

Some gaps have been identified in the literature pertaining to the flipped classroom, mathematics education and metacognition. An extended literature search revealed limited scientific research with focus on the FCA conducted in South Africa. Below are descriptions of the empirical studies on the FCA in South Africa.

- Botha-Ravyse and Reitsma (2015) implemented the flipped classroom for Health Science students. A mixed-method study was employed with the aim of accomplishing more student interaction, more interaction with study material and higher levels of thinking. The researchers found that students were reluctant at first, but their experience improved with time. Findings also indicated that students were better prepared for class and more engaged during contact sessions in a flipped classroom compared to a traditional classroom.

- Tanner and Scott (2015) implemented the FCA for a Systems Analysis, Design and Implementation course. The qualitative study set out to find the perceived benefits and limitations of a flipped classroom from the students' perspective. Overall, the

researchers found that the FCA had a positive effect on students' attitude to learning, student comprehension and student ability to engage and apply knowledge. The study provides a good description of the benefits and limitations of the flipped classroom on which future researchers can extend.

- Le Roux (2016) implemented a partially flipped classroom for an ecology course at the QwaQwa campus of the University of the Free State. Findings indicated that students showed high levels of engagement and improved understanding of complex concepts. She furthermore noted that she didn't experience reluctance from students with the implementation of the new approach. This result was found in contrast to Tanner and Scott's (2015) study, which indicated reluctance because of students' inability to engage in group discussions.

- Lubbe (2016) implemented the flipped classroom for accounting subjects at the NWU Vaal Triangle Campus. The mixed-method study set out to find whether an FCA to teaching and learning positively impacts students' mastering of accounting. Findings indicated that the flipped classroom had a positive effect on student engagement.

- Schabort and Reitsma (2016) implemented the flipped classroom for a biotechnology course at the NWU Potchefstroom campus. The quantitative study set out to find whether the FCA is appropriate in engineering education. Students experienced the flipped-teaching approach positively and reported that the approach helped them work independently and more self-directed. The study did not aim to measure student performance; however, the researchers did note that the flipped classroom did not negatively impact overall student performance compared to previous years.

Apart from anecdotal evidence, there have been limited extensive empirical studies in this regard, but especially in mathematics education in teacher education. Considering the strong support found in the literature for the FCA and the lack of literature on using the FCA for mathematics teaching and learning within the South African context, there is a definite need for research in this knowledge field. This gap in the international knowledge field is also acknowledged by Abeysekera and Dawson (2015, p. 2) when they express their concern that the FCA is under-researched, under-theorised, and under-evaluated. This concern is echoed by Ibrahim and Watts (2016), who posit that the use of university students' metacognition in an FCA is underrepresented in the literature. The need exists for qualitative research where lived experiences of the role players are explored – since experiences (positive or negative) strongly relate to motivation and attitudes, and this will determine if and how an FCA must be implemented in future. Therefore, the aforementioned served as impetus for my investigation

into a tailor-made approach to the flipped classroom with a specific focus on how this approach can support the development of student-teachers' metacognition within a particular context of teaching.

1.8 Research design and methodology

This research adopted a qualitative approach to participants' experiences in how the FCA supports the development of metacognitive skills of student-teachers in mathematics in the BEd programme. The FCA design features, with the potential to foster metacognition, were explored (planning, implementing, and evaluating) by employing DBR, which also happened to be a case study.

According to McMillan and Schumacher (2014), a qualitative approach contributes significantly to theory and practice, and the design can vary, depending on the theoretical framework. Merriam and Tisdell (2016, p. 242) also motivate the value of a qualitative approach to research in uncovering reality as follows: "An assumption underlying qualitative research is that reality is holistic, multidimensional, and ever-changing; it is not a single, fixed, objective phenomenon waiting to be discovered, observed, and measured as a quantitative research."

DBR is a theoretical framework characterised by iterative cycles in the research process and provides educational interventions based on students' learning process (The Design-Based Research Collective, 2003). Therefore, for this investigation, theory-driven DBR was used to study a pedagogical method (FCA) by implementing the design strategies into a real teaching environment (Tseng et al., 2016). As the primary goal of DBR, the initial design was tested and improved upon by ongoing reflection of the FCA participants' experience to eventually provide guidelines for implementing an FCA for metacognitive gains within mathematics student-teachers (Cobb et al., 2003).

1.8.1 Philosophical orientation

A constructivist-interpretivist paradigm (§3.3) directed the investigation and is suitable for qualitative research since the researcher and participants collaborate and co-construct (Ponterotto, 2005). Ponterotto (2005) describes the interaction between the researcher and the participants as a unique and significant characteristic of the interpretivist paradigm. Working in this paradigm, Cohen (2007) describes the researcher's role as understanding and interpreting the phenomenon from within as experienced by the participants. Said differently, every effort should be made to understand the participants' view rather than the researcher's view. To avoid my presumptions, I looked meticulously at data to ensure the data informed

the study about what is going on in the investigated problem environment (Cohen et al., 2007; Mack, 2010).

Considering the philosophical orientation of the investigation, while the study aimed to foster the metacognitive skills of student-teachers of a specific higher institution, it is essential to interpret student-teachers' experiences of how design features support them in developing metacognitive skills in light of their particular backgrounds, prior knowledge, and learning needs. Secondly, the voice of the lecturer who collaborated to design the flipped classroom strategies should be heard. The lecturer responsible for the Mathematics module had first-hand experience of the strengths and weaknesses of the design principles and barriers that may hinder the development and assessment of student-teachers' metacognitive skills.

1.8.2 Participant selection

The study population included BEd (Further Education and Training Phase) full-time first-year students registered for a specific Mathematics module, the current lecturer of the module, and the former lecturer of the module (§3.4).

After an independent person, who had no connection to the study, explained the research goals to the student population they were invited to participate (§3.4). Twelve students were willing to grant written informed consent to participate in focus-group interviews to gain access to students' lived experience and thinking about the potential of the FCA to foster metacognition within student-teachers to prepare them for the 21st century classroom. A once-off semi-structured interview with the module's former lecturer was conducted. The former lecturer was consulted as an expert working in the field where the educational problem under investigation exists and served as an essential first step in the DBR (Herrington et al., 2007). Also, as part of the DBR, semi-structured interviews were conducted with the lecturer currently responsible for the Mathematics module. The current lecturer responsible for the Mathematics module implemented the FCA voluntarily, and she provided access to valuable data about her experience of implementing the FCA during the previous semester. Furthermore, she provided valuable input on planning and implementing FCA principles and her interpretation of students' lived experience of the FCA during the DBR process.

All participants had free access to the internet and to computers on campus. For an FCA implementation, Botha-Ravyse (2015) warns that students should be provided with technological support to ensure that technology contributes to meaningful mathematics learning. Students had access to training in using the LMS as part of the first-year introduction programme. Also, biographical information was collected from all participants. The information

had to be considered when interpreting data where aspects such as diverse student-teacher background and prior knowledge were acknowledged.

Participants did not receive any compensation for participation. However, Herrington et al. (2007) claim that a benefit of DBR is that it enhances the professional development of all involved. Furthermore, student-teachers who participate in focus group discussions benefited from participating as members of a community of practice (Shulman & Shulman, 2004).

The study's focus of fostering metacognition of student-teachers through an FCA served as the motivation to select the participants mentioned above and the specific mathematics module.

1.8.3 Methods of data collection

Data were collected through semi-structured interviews (§3.5.1), focus-group interviews (§3.5.2), and both a lecturer (§3.5.3) and researcher journal (§3.5.4). All data sources for the DBR are shown in Table 3.1. Interviews in qualitative research move away from a standardised form and instead conduct semi-structured interviews, with some structure but which are still flexible (Cohen et al., 2007). Therefore, the open-ended questions of the semi-structured interviews allowed for elaboration by participants to enrich the data on their views and lived experiences of the potential of the FCA to foster metacognition (Gill et al., 2008).

In a focus-group interview, the researcher works with several people simultaneously and this method of data collection can be used in different stages of research to obtain feedback to enhance understanding of the research findings (Coghlan & Brydon-Miller, 2014). For this study, focus-group interviews included a maximum of eight students and lasted approximately 45 minutes per discussion. Coghlan and Brydon-Miller (2014) indicate that a possible limitation related to focus-group interviews is that students may not share their true feelings in a group setting. Therefore, students were encouraged to share their thoughts and experiences honestly to contribute to the FCA design, and the focus-group interviews aimed to lessen participants' discomfort to enrich the collected data (Merriam & Tisdell, 2016; Nieuwenhuis, 2007). The focus-group interviews were scheduled according to the students' timetable to ensure that everyone could attend during times that they were already on campus. Focus-group interview schedules were open-ended to allow for flexibility and allowed for emerging information that may not have been anticipated before the FCA implementation (Creswell, 2007). All interviews and focus groups were voice-recorded and transcribed. (Appendix F)

A journal kept by the lecturer served to reflect the participants' view (Merriam & Tisdell, 2016). Creswell (2012) advises providing guidelines such as length of entries and format to align

journal entries with research questions. Therefore, the lecturer was supplied with reminders of the aspects of the design and the learning environment. Her thoughts on lived experiences and her view of student-participants' lived experiences were critical in improving the FCA design for metacognitive gains. (Appendix G)

A researcher's journal consists of diary entries that generates research material (Amankwaa, 2016). Diaries are used to overcome limitations and supplement other data sources such as interviews and some characteristics of a researcher diary are regular diary entries including relevant ideas, dates, interactions and personal reflections (Alaszewski, 2006). Also, Newbury (2001) defines the researcher's journal as a way to freely identify and integrate into a constructive relationship the interaction of objective and subjective characteristics of the investigation. My research journal served as a diary where I made regular entries during the investigation process, as suggested by Amankwaa (2016) (Appendix G). Journal entries included personal reflections and any information relevant to the study that had to be considered while reporting the data, thus fulfilling the potential of the researchers' journal for enhancing trustworthiness (Ortlipp, 2008). In the next section, the DBR is discussed.

1.8.4 Explaining design-based research for this study

The DBR model suggested by McKenney and Reeves (2012) was implemented to determine how a flipped classroom should be designed to foster the metacognition of student-teachers. The cyclic nature of the DBR is explained in detail in Chapter 3 (§3.6), and, as in most educational DBR studies, the macro-cycle consisted of meso-cycles with various micro-cycles (McKenney & Reeves, 2012). Table 3.1 (§3.6) indicates data sources per micro-cycle. The DBR set out to answer the primary research question: *How should a flipped-classroom approach be implemented for metacognitive gains to prepare mathematics student-teachers for the 21st century?*

Three core phases of the DBR were implemented: analysis and exploration, designing and constructing, and evaluation and reflection (Plomp, 2013). The following description indicates the purpose of each micro-cycle and how each helped the research process with the ultimate objective of answering the research question.

1.8.4.1 Micro-cycle 1 (analysis and exploration)

An FCA was implemented for the teaching and learning of the Mathematics module, with the anticipation that this constructivist student-centred approach will support metacognitive gains. In this micro-cycle (§3.6.1), I conducted a semi-structured interview (§3.5.1) with the previous lecturer of the Mathematics module with the purpose of analysing and exploring the problem

by obtaining information on the relevant Mathematics module, the student population, as well as challenges related to student metacognition and SDL skills, and potential suggestions to improve the student's development of these skills. Since the previous lecturer did not participate in the design process of the DBR, micro-cycle 1 did not form part of meso-cycle 1. However, data collected in this initial micro-cycle provided important grounding for data collected in the first meso-cycle.

1.8.4.2 Meso-cycle 1

As indicated in Figure 3.1, micro-cycles 2, 3, and 4 constitute meso-cycle 1.

- **Micro-cycle 2 (designing and constructing)**

Micro-cycle 2 (§3.6.2) contributed to answering the main research question and secondary research questions 2 and 3 (§1.5). The micro-cycle involved a semi-structured interview (§3.5.1) with the current lecturer of the Mathematics module, since this micro-cycle aimed to inform the collaboratively planning of lessons with the lecturer, as suggested by Herrington et al. (2007). During the interview the lecturer first reflected on her lived experiences of implementing the FCA in the previous year and its potential to support metacognition, and how the design can be improved upon. Therefore, the interview also added to the analysis and exploration of the problem and the data collected in micro-cycle 1.

- **Micro-cycle 3 (evaluation and reflection)**

In this micro-cycle, data collected through focus-group interviews (§3.5.2) and journals of the lecturer (§3.5.3), as well as the researcher (§3.5.4), contributed to answering the main research question along with secondary research questions 2 and 3 (§1.5). The purpose of the micro-cycle was to collect data to provide reflections for an improved FCA.

- **Micro-cycle 4 (analysis and exploration)**

Analysing the data through content analysis was the aim of this micro-cycle. All qualitative data collected during the study thus far was transcribed, coded and analysed (§3.7). The empirical data served as data to refine the design of the FCA with the potential to foster metacognition in student-teachers (Plomp, 2013).

The next section describes Meso-cycle 2, that was incorporated to utilise analysed data from meso-cycle 1 as well as collect further empirical data with focus on the investigation of a revised FCA design with the potential to foster metacognition.

1.8.4.3 Meso-cycle 2

Micro-cycles 5, 6, and 7 make up meso-cycle 2 (§3.6; Figure 3.1).

- **Micro-cycle 5 (designing and constructing)**

In correspondence with micro-cycle 2, data collected from this micro-cycle further contributed to answering the main research question as well secondary research questions 2 and 3 (§1.5). Data were collected through a semi-structured interview with the current lecturer (§3.5.1). Data from meso-cycle 2 were considered whilst collaborating with the lecturer to improve on the initial FCA design, to gain access to her lived experience as well as her perceived experience of student experiences of the FCA with the potential to foster metacognition. Also, more literature was reviewed (Creswell, 2007) and analysed to revise the initial design implemented in meso-cycle 2.

- **Micro-cycle 6 (evaluation and reflection)**

This micro-cycle provided additional data to answering secondary research questions 2 and 3 and subsequently the main research question (§1.5). As in micro-cycle 3, data collected through a focus-group interview (§3.5.2), researcher journal (§3.5.4) and the lecturer journal (§3.5.3) served to inform the refining of an FCA design for the teaching and learning of this Mathematics module with specific focus on metacognitive gains.

- **Micro-cycle 7 (analysis and exploration)**

All qualitative data collected in meso-cycle 2 were transcribed, coded and analysed through content analysis (§3.7). Also, in this phase, empirical data collected during the whole DBR macro-cycle, as well as a final semi-structured interview with the lecturer (§3.5.1), were reflected upon in order to provide suggested guidelines for an FCA for metacognitive gains for mathematics education student-teachers, including possible determinants that might play a role during design implementation.

1.8.5 Methods of data analysis

For this qualitative study, content analysis was used for data analysis throughout the DBR. Patton (2002) describes content analysis as a method that enables the researcher to analyse large volumes of qualitative data and make sense of data by identifying essential consistencies and meanings. Coding was used to analyse the data. Applying a metacognitive lens for the analysis enabled me to report on the way the lived experiences of the participants explicate design features to be accommodated in the FCA for metacognitive gains. The coding process

entails labelling pieces of data, long or short chunks, based on the meaning assigned to different research aspects to make the data easily retrievable (Cohen et al., 2007; Merriam & Tisdell, 2016; Punch, 2014).

Categories for the investigation were determined based on the body of scholarship regarding the FCA and its potential to prepare mathematics teachers for the 21st century by fostering their metacognition. Furthermore, these categories were modified as the study progressed, and data findings were considered (Cohen et al., 2007). The data collected were analysed within and across cycles, and non-verbal cues, such as intonation, gestures, or refraining from participating, were also captured and analysed.

ATLAS.ti™, a computer software tool for qualitative data analysis, was used for deductive and inductive coding (§3.7) of transcribed qualitative data and interpretation of any observed patterns, insights or concepts concerning the way the FCA design supports metacognition. The concept map feature enables the researcher to visualise relationships amongst codes and themes. Themes and categories emerging from the data were organised and compared to conclude how the data answers the research questions. The computer programme, supported me to arrange and organise the data and to make it easily accessible, as suggested by Creswell (2007).

1.9 Trustworthiness

Amankwaa (2016) notes that ensuring trustworthiness is a crucial aspect that needs the researcher's constant consideration in a qualitative study. Trustworthiness in qualitative research encompasses both the components of quantitative research's validity and reliability (Golafshani, 2003).

For this investigation, the criteria to enhance trustworthiness as set out by Lincoln and Guba (1985) was considered and adhered to. These authors suggest measures to ensure credibility, transferability, dependability, and confirmability in a qualitative study (further explained in §3.8).

To enhance credibility, triangulation was incorporated to strengthen the findings and potentially enrich the analysis and understanding of the data (Berg, 2004). Furthermore, the combination of the data collection methods provides different perspectives and a deeper understanding of the data to further enhance trustworthiness (Creswell, 2012).

To improve transferability, a detailed description of the context and background is provided to allow comparisons to be made in similar contexts to determine the extent to which findings

can be generalised (Bless et al., 2013). I further improved the transferability by describing the sampling, data collection, and methods for data analysis (Sarma, 2015) (Chapter 3) for others to determine if the findings are transferable to their specific context.

To enhance dependability, I kept a journal as an audit trail[3] during the research process and recorded significant activities, including dates, time and thoughts as they occur, that may be valuable for the research process and to support authenticity and consistency. Furthermore, my journal was used to record each data collection phase's observation and thoughts, emerging themes in the data collected (Shenton, 2004).

Finally, to achieve confirmability, I engaged in the process of critical reflection to limit my potential influence on the findings and to ensure that the findings are based on participants' experiences (Shenton, 2004). To avoid my own biases influencing the analysing and reporting of data findings, as the researcher, I attempted to maintain focus on the participants' experience and views rather than my own biases based on prior knowledge, experiences, and assumptions. Statements by participants were quoted in the reporting and the data findings to support my interpretation of the data.

1.10 Ethical aspects of the research

Research ethics is an essential component of research and draws attention to all aspects of planning and conducting the research process (Punch, 2014). Creswell (2007) cautions that qualitative researchers may come across ethical issues whilst collecting, analysing, and disseminating qualitative data. Additionally, Cohen et al. (2007) note that a possible challenge to conduct ethical research may be to keep the balance between adhering to the rights of participants and the pursuit of the knowledge required to reach the aims of an investigation. Therefore, for this investigation, I always strived towards applying ethical principles by maintaining a professional relationship with participants, considering participants' privacy, and ensuring trustworthiness.

Because people were involved, ethical clearance for the investigation was sought (Yin, 2014). Ethical clearance was requested from the Ethics Committee of the Faculty of Education Sciences (EduREC) and the Research Data Gatekeeper Committee (RDGC) of the NWU before commencing with the research process. The study was considered low risk and an

[3]A clear description that describes the research procedures and decisions from the start of the research to the reporting of findings (Shenton, 2004).

ethical clearance certificate (NWU-00630-17-A2) was issued before commencing with the research process.

After permission was granted, participants were approached, and the purpose and the aims of the investigation were explained to them by an external person who was not involved in the investigation. Participants had the opportunity to ask questions before providing signed informed consent to participate (Creswell, 2012). Participants were also informed that participation was voluntary and that they could withdraw at any point with no negative repercussions as a result of their withdrawal (McMillan & Schumacher, 2014). Participants were not compelled or coerced to participate and the study in no way affected the marks of the student-participants for the Mathematics module.

Participants were ensured that collected data would be handled confidentially and that no names would be used during the reporting of the findings. Additionally, if names were used during focus-group interviews, names were replaced with pseudonyms (§3.9).

1.11 Role of the researcher

The researcher's concern, as suggested by Merriam and Tisdell (2016, p. 237), is to produce "valid and reliable knowledge in an ethical manner". With these concerns in mind, it was my responsibility to research ethically, stimulate reflective thinking by asking quality questions, and be immersed in the process to record and report data. During the focus-group interviews, I aimed to act as a facilitator and not an interviewer (Punch, 2014) and create an environment in which participants could share diverse perspectives that are crucial for the effectiveness of a focus-group interview (Coghlan & Brydon-Miller, 2014). For focus-group interviews as well as semi-structured interviews, I followed interview procedures as advised by Creswell (2007)(§3.5.1; §3.5.2) by making notes alongside the recordings, striving at all times to adhere to the time frame agreed upon, to ask quality questions, to be respectful, and to listen attentively. As part of reporting on the research findings in Chapter 5, I also report on the limitations of the study, negative findings, and methodological constraints (Bless et al., 2013).

1.12 Conclusion

Chapter 1 provided a picture of the DBR that was employed to investigate participants' experience of the FCA design with the potential to foster metacognition. The background and rationale provided a clear picture of the study's context and were grounded in the literature. Also, the literature overview provided a backdrop for the investigation. The problem that led to the investigation was described, and the research aims explicated. The research questions that guided the study were also clarified. The chosen qualitative research methodology,

enhancing trustworthiness and ethical consideration, have been grounded in the literature and are explained further in detail in Chapter 3.

The next chapter (Chapter 2) reports the findings of an extensive review of the literature and serves to ground the DBR in relevant literature on the principles for an FCA design for metacognitive gains.

CHAPTER 2: LITERATURE OVERVIEW

2.1 Introduction

Supporting student-teachers in meaningful mathematics learning has implications for teacher education programmes, especially considering the requirements for education in the 21st century. This inquiry set out to determine how an FCA can be implemented to support metacognition of mathematics student-teachers, necessitating an exploration of the literature on the underlying principles of both metacognition and the FCA. This chapter thus sets out to answer the first secondary research question (§1.5) namely:

> *What does the body of scholarship indicate with respect to design features of a flipped-classroom approach aiming to foster metacognition as a 21st century skill in student-teachers in their learning of mathematics?*

Teachers' approaches to the teaching of mathematics and their choice of strategies employed, will be influenced by their knowledge and views of mathematics and mathematics education. Therefore, to provide context for the study, the literature on teachers' knowledge and beliefs concerning mathematics education is firstly explored as well as the role of these aspects in mathematics teacher preparation for the 21st century (§2.2). Secondly, since constructivism is the theoretical underpinning for teaching, learning and assessment in mathematics education, the literature on a constructivist approach to mathematics education is explored (§2.3). Thirdly, consideration is given to key 21st century teacher competencies (§2.4) followed by a review of metacognition (§2.5), with focus on the role of metacognition in mathematics, teaching for metacognitive gains and how to assess metacognition. Lastly, in §2.6, the principles of the FCA are explored as well as the value of this approach for teaching and learning. The literature was specifically perused for concurrence on how the FCA accommodates metacognition as well as the key competencies that are viewed as the bedrock of meaningful mathematics education in the 21st century.

2.2 Mathematics teacher preparation for the 21st century

Mathematics is a complicated topic and different views exist on what it is and how it should be taught (Tall, 2013; Ziegler & Loos, 2017). To make it even more complex, the mathematical landscape keeps on changing due to developments in technology (Tall, 2013) (§2.4.1).

2.2.1 Mathematics defined

Mathematics is viewed as a crucial life skill (Chinnappan, 2008; Van de Walle et al., 2010) and it is generally acknowledged that mathematical problem-solving skills equip learners to solve real life problems (Gurat & Medula, 2016). Ziegler and Loos (2017) refer to the contention in the literature on how mathematics should be defined, based on the different viewpoints of what mathematics should do and how it should be studied. In the South African education context, the definition provided by the South African Department of Basic Education (DoE) in the Curriculum and Assessment Policy Statement (CAPS) for Mathematics is therefore regarded as a guideline for South African teachers and teacher educators concerning the teacher knowledge and competence required to deliver the subject as anticipated by the DoE:

The CAPS for Mathematics (Grades 4 to 6) provides the following definition: “Mathematics is a language that makes use of symbols and notations for describing numerical, geometric, and graphical relationships. It is a human activity that involves observing, representing, and investigating patterns and qualitative relationships in physical and social phenomena and between mathematical objects themselves. It helps to develop mental processes that enhance logical and critical thinking, accuracy and problem-solving that will contribute in decision-making.” (Department of Basic Education, 2011, p. 8).

To mediate the above envisioned mathematics in South African schools not only emphasises the need for teacher content knowledge and pedagogical knowledge, but also requires knowledge to support the development of their learners’ mental processes, logical and critical thinking, accuracy, problem solving and decision making (Department of Basic Education, 2011), implying the need for teacher metacognitive knowledge and skills.

2.2.2 Mathematics teachers’ knowledge

The categories of teacher knowledge suggested by Shulman (1987) informed many curricula of higher educational institutions involved with teacher education. These categories include content knowledge, knowledge of classroom management, curriculum knowledge, pedagogical content knowledge, knowledge of the learners, the educational contexts as well as knowledge of educational aims and values. Ball et al. (2008) explored these categories and concluded that a specialised content knowledge as well as pedagogical content knowledge should be at the core of teacher knowledge. Shulman (1986) further views metacognitive awareness as a trademark of a professional teacher. Considering the important role of technology in education in the 21st century, the teacher’s knowledge of relevant technology for education will also need to form part of the teachers’ knowledge domains. With specific interest

in equipping student-teachers with knowledge for practice in the 21st century, the literature on teacher content knowledge, pedagogical content knowledge, metacognitive knowledge, and knowledge of technology for education, was explored.

2.2.2.1 The teachers' content knowledge

Mathematics content knowledge which is also referred to in the literature as subject knowledge, is an important pillar of mathematics student-teachers' Pedagogical Content Knowledge (PCK). Reports in the literature concur that South African mathematics teachers are generally weak on mathematics content knowledge (Alex, 2019; Bowie et al., 2019). Although the content to be mastered by learners is set out in the CAPS for each school grade, Hill and Chin (2018) as well as Ball et al. (2008) emphasise that mathematics teachers should have a specialised mathematical content knowledge to support meaningful learning by their learners. Alex (2019) warns that "Teachers' content knowledge impacts on what they teach, how they teach and what their students learn." Alex (2019) ascribes the poor mathematical content knowledge of pre-service teachers to deficits in higher education institutions curriculum. Setyaningrum and Mahmudi (2018) also emphasise the important role of sound teacher mathematical content knowledge in identifying learners' mathematics misconceptions, emphasising the role of sound content knowledge in meaningful assessment.

Providing student-teachers as well as school learners with ample and challenging content within their zone of proximal development (§2.3) increases the likelihood of opportunities to learn mathematics more deeply (Biggs, 1996). When the level of content does not motivate deeper learning, content can impose boundaries on students' learning (Stigler & Hiebert, 1999). Higher education institutions should therefore critically reflect on the way their teacher education programmes support mathematics student-teachers to gain the necessary mathematical content knowledge as expected in professional mathematics teachers and the level of these mathematics courses should also be on a challenging level to promote learning.

2.2.2.2 The mathematics teachers' pedagogical content knowledge

While pedagogical knowledge is viewed as "knowledge about teaching and learning that is not topic-specific, such as knowledge of learning theory, classroom management, and student motivation" (Auerbach & Andrews, 2018, p. 1). Shulman (1987) gives specific attention to the way teachers should be able to merge their content knowledge with pedagogical knowledge to ensure that teaching facilitates optimal learning by their specific learners. Shulman (1987) defines a teacher's pedagogical content knowledge as:

> the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction. Pedagogical content knowledge is the category of knowledge most likely to distinguish the understanding of the content specialist from the pedagogue. (p. 8)

The above definition clearly demonstrates the need for specialised teacher content knowledge, sound pedagogical knowledge and critical reflective competence, to blend content and pedagogy to accommodate the diverse mathematics learning abilities and different learning styles of all learners.

Successful learning of mathematics on any level of education, depends on the ability of the teacher to create an environment for deep meaningful learning that is again informed by the teacher's pedagogical and content knowledge (Schoenfeld, 2019) and an understanding of the mathematics learning process (Conrady, 2015). Van de Walle et al. (2010, p. 13) view mathematics learning as a result of 'doing' mathematics that provides the opportunity for learners to find, explore and make sense of the "pattern of regularity and logical order" that is at the core of mathematics. Based on this view, involvement in own learning is key to learning mathematics for understanding. The knowledge to create an environment for this kind of active learner-centred learning through discovery is a crucial teacher competence that mathematics teachers should be equipped with (§2.3). An environment where rote learning of facts to be regurgitated by the learners and assessed through rigid summative assessment strategies, will not be conducive to deep learning – especially by younger learners.

Often assessment is viewed as separate from teaching and learning but according to Ellies and Denton (2010), in order to determine meaningful progress, one will do well to integrate teaching, learning and assessment, implying that pedagogical and content knowledge inform the teacher's choice and implementation, as well as the skilful integration of assessment strategies. The term "assessment" is used for all teacher and student activities that provide evidence that is used as feedback and to alter activities where needed, based on the evidence (Black & Wiliam, 2005). Meaningful learning is the main aim of teaching and without evidence of learning it cannot be determined if teaching ever took place. Schoenfeld (2007, p. 64) postulates that "one's concept of what counts as mathematics matters a great deal—and, what you assess counts a great deal". Stiggins (2002) highlights that both assessment "of" learning and assessment "for" learning are crucial. Assessment for learning leads to greater learner motivation and learners taking responsibility for their learning, and according to Stiggins (2002), this is key in lifelong learning. The decisive role of effective feedback in learners' mathematics learning (Black & Wiliam, 2005) and the relation between teachers' pedagogical

content knowledge and choice of assessment strategies (Buhagiar & Murphy, 2008; Nortvedt & Buchholtz, 2018), entail that teacher education programmes guide mathematics student-teachers to experience these constructs as interrelated. An awareness of this interrelatedness will ensure that teachers choose the most relevant strategies to assess learners mastering of a specific mathematics concept and to adjust assessment strategies according to the learners' specific needs and the changing demands of learning in the 21st century, thereby sustaining deep learning of the specific content.

A teacher's pedagogical content knowledge will influence choices of teaching, learning and assessment strategies. Wolfram (2010) expressed concern about "how" mathematics is taught in the 21st century. He notes that mathematics is supposed to enhance logical thinking, but mostly involves calculations that can be done by a computer. Such a mechanistic approach to mathematics may influence views on "what" mathematics is important to learn (Gravemeijer et al., 2017). Adding to the argument, Gravemeijer et al. (2017) suggest that serious consideration needs to be given to what mathematical proficiency means in today's world and what changes need to be made in both content and pedagogy to prepare students for mathematical reasoning in the 21st century. The concerns of Wolfram (2010) and Gravemeijer et al. (2017) serve as motivation to investigate an approach to teaching that could contribute to meaningful and deep learning of mathematics in the 21st century.

Deep learning is described as learning that is associated with "students' self-directed application of critical and creative thinking, problem-solving, communication, and collaboration to deepen their understanding of key concepts of the curriculum" (Bellanca & Boss, 2015, p. glossary). Deep learning strategies facilitate higher-order thinking (Lee & Choi, 2017), that is core to 21st century skills (Collins, 2014), while metacognition plays a role in higher levels of reasoning (Alias & Sulaiman, 2017; Fadel et al., 2015; Krathwohl, 2002). Supporting one's learners in developing metacognitive skills requires sound pedagogical content knowledge (Wilson & Bai, 2010). Equipping mathematics student-teachers with relevant pedagogical content knowledge will therefore enable them to create a learning environment that will support deep learning informed by metacognitive thinking (§2.5).

2.2.2.3 The mathematic teacher's metacognitive knowledge

While supporting learner metacognition implies a sound pedagogical knowledge (Menz & Xin, 2016; Wilson & Bai, 2010), Menz and Xin (2016) emphasise the role played by the mathematics teachers' awareness and knowledge of their learners' metacognitive processes (explained and defined in detail in §2.5) in order to support learning with understanding. Artzt et al. (2008), underline the point that teachers' actions should be driven by their learners'

cognition. When teacher-educators therefore support mathematics student-teachers in developing metacognitive awareness and skills, grounded in pedagogical content knowledge, these prospective teachers will be more able to apply these skills, not only continuously to improve their own practice, but also to support their learners in developing metacognitive skills to become "more skilful and successful learners" (Menz & Xin, 2016, p. 164). Supporting the development of metacognitive skills is only possible when learners, at both school and higher education levels, are actively involved in their own learning. The positive relation between the use of technology and learner motivation for active participation in mathematics learning in this digital era (Higgins et al., 2019), motivates the use of various digital technologies for mathematics education. Thus, the teacher should have knowledge of the most effective technology to match the learners' cognitive needs as well as the content to be mastered. Consideration therefore needs to be given to pedagogical approaches that include the meaningful use of technology in support of constructivism and metacognition such as the FCA (§2.6).

2.2.2.4 The teacher's knowledge of technology for mathematics education

Accessing and producing new knowledge grew exponentially with the arrival of the digital age (Fadel et al., 2015), and with the incorporation of technology as a 21st century skill, has been found to support mathematics learning at different levels of education (Hillmayr et al., 2020; Van Alten et al., 2019). Technology is regarded as the new mediator of learning that enhances learning and teaching methods (Kaur, 2016; Schrader, 2015) and education processes cannot avoid incorporating new technology innovations any longer (Daniels, 2013). The teacher therefore needs to be equipped with the relevant knowledge and skills to use technology in support of mathematics learning.

Tall (2013) is of the opinion that computers can complement the human mind and therefore allows for new possibilities. Shen and Liu (2011, p. 148) notice that "to increase students' performance in self-monitor, self-modify, and self-evaluate, more training on structural reflection, social interaction, and self-awareness should be involved in e-learning materials". This implies that students still require educator support and guidance whilst taking responsibility for their learning as self-directed learners (§2.4.2).

Technology is also increasingly used for the assessment of mathematics learning (Lee & Choi, 2017) as well as feedback to students (Denton et al., 2008). Equally, the expanding role of technology in the 21st century necessitates that we know more and different mathematics (Willoughby, 2000). There are, however, many challenges when using technology to increase student learning (Strayer, 2012) (§2.6). Mathematics done in classrooms should not merely

consist of manually doing rote calculations that technology can do for us, but the focus should be on converting real-world problems into mathematics formulation, using technology to do the calculations and then converting solutions back to the real world (Wolfram, 2010). Examples of possible technological challenges in teaching and learning, as mentioned by Akçayır and Akçayır (2018), include technology accessibility, technology competency and developing high quality materials for online use (Li et al., 2013).

Research by Bray and Tangney (2017) as well as Hardman (2019) illustrate the role that technology-enhanced mathematics education can play in a collaborative and constructivist approach to mathematics education, leading to students taking more responsibility for their own mathematics learning. Hardman (2019) cautions that, although the use of ICTs holds value for learners' mathematics performance, a constructivist pedagogy is crucial opposed to a traditional transmission-based pedagogy.

Van de Walle et al. (2010) declare that learning mathematics in the 21st century requires that effective educators optimally use technology to develop students' mathematical skills. Effective pedagogy for ICT implementation in mathematics education, therefore, has implications for teacher knowledge and competence (§2.2.2), which teacher-educators should note. The role of digital and ICT literacy as 21st century skills is further explicated in §2.4.1 and the role of technology in the FCA is discussed in §2.6.2. Kim et al. (2013, p. 77) posit that "teachers' beliefs of self-efficacy, beliefs about the value of technology" as well as their "fundamental beliefs about what is important in student learning and thus teaching", can play a role in the way technology is integrated in their practices. While a teacher's knowledge influences beliefs, a teacher's beliefs about mathematics have a direct impact on their decisions, planning and teaching strategies (Kögce, 2017; Schoen & LaVenia, 2019), and are influenced by their own experience as learners of mathematics (Sawyer, 2018).

2.2.3 Teachers' beliefs about mathematics and mathematics education

Teacher's beliefs about mathematics have a direct impact on their decisions, planning and teaching strategies (Kögce, 2017; Sawyer, 2018; Schoen & LaVenia, 2019) while teachers' beliefs about mathematics teaching and learning is influenced by their own experience as students of mathematics (Sawyer, 2018; Schoen & LaVenia, 2019). The influence of teachers' beliefs on a mathematics teacher's content and pedagogical choices is illustrated when Thompson (1992, p. 132) defines a teachers' beliefs about mathematics as their "conscious or subconscious beliefs, concepts, meanings, rules, mental images, and preference concerning the discipline of mathematics". Boaler (2013) cautions that deeply held beliefs about mathematics learning is very difficult to change but doing so must form part of learning

improvement initiatives. De Corte (2004) is of the opinion that naïve or incorrect beliefs about mathematics have negative effects on student approaches to mathematical problems. Teachers who believe that the educator is the sole source of information and is responsible for transmitting mathematics content to the learners, will tend to demonstrate procedures and solutions to problems to the learners and expect them to follow the same steps as demonstrated (Artzt et al., 2008). Such an approach will also hamper the opportunity for own or social knowledge construction in mathematics education (Ernest, 1992; Ernest et al., 2016).

Informed by their past experiences of mathematics education, prospective mathematics teachers enter higher education institutions with their own beliefs and assumptions of what mathematics education entails (Schoen & LaVenia, 2019), and if not challenged to question their own beliefs, they may enter the teaching profession with unfounded personal theories of meaningful mathematics education. In conjunction with a sound subject knowledge (§2.2.2.1), as well as pedagogical knowledge relevant to 21st century demands (§2.2.2.2), teacher educators therefore have to provide opportunities for student-teachers to critically reflect on their beliefs and knowledge and, if necessary, to make the paradigm shift towards a more constructivist approach in support of deep learning by their future learners.

2.2.4 Preparing 21st century teachers as reflective self-directed teachers

The demands of education in the 21st century add higher order thinking skills to the list of teacher requirements (Saavedra & Opfer, 2012). Nearly two decades ago, Aaronsohn (2003, p. vi) already warned that, in order for teachers to make a difference, the next generation of teachers should not only be prepared as expert practitioners, but should also be empowered as "the most reflective, imaginative, courageous, multidimensional, flexible, and fully actualized adults, worthy of having children's minds, bodies, and spirits entrusted to them". Apart from equipping future mathematics teachers with relevant mathematical pedagogical content knowledge, higher education institutions thus also have the responsibility to support student-teachers in developing 21st century skills including reflective and self-directive learning, that will empower them to also prepare their learners as 21st century citizens.

Shulman (1987) refers to the important role of teacher pedagogical reasoning in informing teacher action. Shulman (1987, p. 13) emphasises teaching as "comprehension and reasoning, as transformation and reflection." Apart from teacher comprehension of the subject purpose and content, teacher reasoning also supports transformation of practice through critical interpretation of subject content and purpose. Teacher reasoning should also focus, amongst others, on reflection on own practice to inform the "reviewing, reconstructing, re-enacting and critically analysing one's own and the class's performance" (Shulman, 1987, p.

14). Shulman (1987) states that such pedagogical reasoning and actions through learning from experience, will lead to new understandings of the subject purpose and content, as well as of the student, teaching and the self. In a fast and ever-changing educational context, continuous reflection on all possible determinants that may hinder learning and changing own behaviour accordingly, is imperative.

Although teacher reflection without action will not have an impact on practice, there is overwhelming support in the literature that teacher reflection, as part of SDL, holds value for sustained improvement and transformation of practice (Brookfield, 2017; Shulman & Shulman, 2004). Teacher metacognition, whereby they reflect on their own learning processes, will further contribute to their professional development, when they become aware of their own strengths and weaknesses and find ways to improve their knowledge and skills.

The fast and continuous changes of 21st century education require teacher reflectivity, and more specifically critical reflection on own practice, as well as SDL, as core teacher competencies. The development of these competences should therefore be supported by teacher education curricula, aiming to prepare teachers to sustain meaningful learning outcomes in their classrooms. Through a critical reflective approach to own practice, teachers will also be more conscious of the way they are involving the learner in active construction of own knowledge and to transform their practices from a teacher or content-centred teaching approach to a more learner-centred approach if necessary.

Research confirms the relationship between a constructivist approach to learning and metacognitive gains (Luneta, 2016; Van Vliet et al., 2015). Therefore, the exploration of the literature on a constructivist approach to education serves as grounding for the section on metacognition as an important 21st century skill. The literature explored the implications for this approach to education on both learning at school level and at the level of higher education by student-teachers.

2.3 Constructivism in education

Through the ages, psychologists have been exploring the way people learn, leading to the development of various learning theories. Two mainstream schools of thinking developed, namely, behaviourism and constructivism. While behaviourists are concerned with observed learner behaviour as a result of learning through “environmental rewards or gratification” (Pritchard, 2009, p. 3), the constructivist holds a cognitive view of learning as knowledge construction “when new information is built into and added onto an individual’s current structure of knowledge, understanding and skills” (Pritchard, 2009, p. 17).

2.3.1 Defining the constructivist approach

Constructivist theory is rooted in the work of Piaget and Vygotsky who accentuate the necessity of knowledge construction (Schrader, 2015). Piaget emphasised that cognitive development is active in nature and that information cannot merely be passed on (Woolfolk, 2014). Constructivism is a learning and meaning-making theory with focus on the way in which people develop, rather than on the way people should learn (Richardson, 1997). Schunk (1996) concurs that a constructivist environment is one where student involvement means students actively making use of material, rather than a traditional approach where teachers deliver instruction. Constructivism encourages reflective learning (Vijaya Kumari, 2014), where students are seen as constructors and thinkers that are encouraged to develop and test their own ideas (Biggs, 1996; Brooks, 1999; Gravett, 2005). Gravett (2005) explains that constructivism represents a group of interrelated ideas known as radical constructivism, social constructivism, emancipatory constructivism, and socio-cultural approaches. Considering the important role of collaborative learning in an FCA, that is, the focus of this study, social constructivism needs further exploration.

2.3.2 Social constructivism

Piagetian constructivism is critiqued for its focus on individual meaning making and failing to recognise the social element of learning (Richardson, 1997). Social constructivism derives from the work of Vygotsky (1978), and here the development depends on social interaction (Richardson, 1997; Schrader, 2015). Learning in a social constructivist environment is to construct knowledge whilst participating in a group and through collaborative dialogue (Schrader, 2015; Woolfolk, 2014). Collaborative dialogue is usually with someone more expert, in what is termed by Vygotsky as the learner's zone of proximal development (ZPD) (Ernest et al., 2016).

Brooks (1999) plea for a move away from traditional ways of schooling to a more collaborative knowledge construction in educational reform through solving of real-world problems in support of deeper and sustainable learning, is still echoed more than two decades later (Stehle & Peters-Burton, 2019). Smith and Mancy (2018) highlight the relationship between metacognition and a social constructivist approach to learning. When learners collaboratively reflect on different solutions to a problem, social construction of knowledge holds potential to create a metacognitive awareness with the learners. Student-teachers should therefore be prepared to facilitate this kind of learning of mathematics with their learners.

2.3.3 Constructivism in teacher education

Constructivism in teacher education is transformative, irreversible, integrative and is learning by meaning making (Kunnathodi & Sarabi, 2017) and supports reflective activities (Vijaya Kumari, 2014). Paris and Byrnes (1989) claim that although social guidance and direct instruction is valuable in a constructivist environment, the primary emphasis is on intrinsic motivation – to reflect on one's self, one's behaviour and knowledge. Kunnathodi and Sarabi (2017) acknowledge constructivism in teacher education as a troublesome idea yet one which student-teachers and student-educators need to fully embrace to be equipped to face the challenges as educators in the 21st century. The strong support for the value of this learner-centred approach, the successful implementation of constructivist principles on any level of education, requires extensive knowledge and skills on the part of the educator.

Although there are arguments against constructivist teaching techniques (Anderson et al., 1996; Kirschner et al., 2006; Liu & Matthews, 2005; Stott, 2018)(§1.7.1.4), the overwhelming support for constructivism in the body of scholarship discussed above, and that is grounded in research (Biggs, 1996; Jonassen et al., 1995; Schrader, 2015), has motivated constructivist teaching-learning strategies across the world for many a decade. Although some behaviouristic traits will play a role in most education, the importance of knowledge construction in the meaningful learning of mathematics with understanding, emphasises that a cognitive constructivist approach to mathematics education is key (Clements & Battista, 1990).

2.3.4 Constructivism and mathematics education

Clements and Battista (1990) rest their argument for a constructivist approach to mathematics teaching on the following citation:

> In reality, no one can teach mathematics. Effective teachers are those who can stimulate students to learn mathematics. Educational research offers compelling evidence that students learn mathematics well only when they construct their own mathematical understanding (MSEB and National Research Council 1989, 58, cited by Clements and Battista, 2009, p. 34).

In a constructivist approach, mathematical tasks are complex and learners are free to find different routes to solve problems that include real-world applications (Boaler, 2016; Van de Walle et al., 2010). Van de Walle et al. (2010) assert that mathematics done in a classroom setting should closely resemble mathematics in the real world to find regularity or order and making sense of it (§2.2.2.2). Polman et al., (2020) however warn that, although real-world

problems promote meaningful learning of mathematics, the teacher will need to take contextual factors such as cultural and socio-economic factors into consideration when planning real-life problem-solving, again implying teacher knowledge (§2.2.2). In line with constructivism (§2.3.1), as well as with Vygotsky's ZPD (1987) (§2.3.2), Boaler (2016) indicates that learning through problem-solving should start with a low entry point but should constantly challenge students in order for them to work at the highest level that is also the most appropriate level for them. Low entry tasks are those that are accessible to all students but can be extended to higher levels. Artzt et al. (2008), also emphasise that when mathematics activities are too easy, students lose interest and possibly will not apply the required effort and when activities are too difficult, students might get frustrated and possibly give up. Therefore, resembling Vygotsky's ZPD (1978), mathematics activities must be sufficiently challenging for meaningful learning and on a difficulty level where a person can master a task if given befitting support (§2.3.2).

The constructivist approach to mathematics education supports learner centredness (Bruner, 1961; Confrey & Kazak, 2006; King, 1993). King (1993, p. 30) describes the changed role of the educator in this approach as a shift "from the sage on the stage to being a guide on the side, facilitating learning in less directive ways". In a literature review with focus on publications over the previous 30 years on the role of constructivism in mathematics education, Confrey and Kazak (2006) report that overall, constructivism has had an impressive impact on mathematics education with specific credit given to the student-centredness in learning. Placing the student at the centre, we need to know how to make students aware of what they believe and know and how collaboration helps with these notions (Confrey & Kazak, 2006). Furthermore, the facilitating role of the educator in a student-centred approach is crucial in supporting students to develop critical thinking, that is strongly related to mathematical thinking (Çelik & Özdemir, 2020). Cobb et al. (1992) emphasise that constructivism does not mean that students are merely left on their own to explore materials without guidance, while Corte (2012) also highlights that a constructivist learner-centred approach does not do away with coaching, scaffolding[4], feedback and modelling by teachers and peers.

SDL skills are requisite to successful learning in a constructivist approach and skills such as active, inquiry and independent learning are grounding principles of the constructivist approach to education (Candy, 1989). Joseph (2003) proposes equipping students with SDL

[4] In this research, scaffolding is seen as a tool to provide guidance to learners in advance of activities (Kim & Lim, 2019).

skills, before we can expect them to take responsibility for constructing their own knowledge. A strategy that can be used to integrate SDL into the classroom is to encourage metacognitive skills development by implementing self-assessment (Siegesmund, 2017), providing scaffolding (Belland, 2017; Kim & Lim, 2019) and reflective learning (Baten et al., 2017; Menz & Xin, 2016).

Anderson et al. (1996) critique constructivism based on their findings that knowledge only transfers to tasks that are almost identical and in the same context. However, De Corte (2012. P. 39) argues that adaptive competence in support of knowledge transfer in mathematics can be promoted by the integrated teaching of "cognitive, metacognitive, and motivational strategies, using thereby a variety of teaching methods". Ramocki (2007) also highlights the role of metacognitive skills in increasing transferability potential that strengthens the case for the important role of supporting metacognition in a constructivist approach to education. Furthermore, constructivism also has the potential to support students in developing metacognition through active involvement in the learning process, constructing knowledge as they are collaborating with the educator and peers (Kameda, 2017; Ruey, 2010). As evident in the literature, constructivism is generally regarded as appropriate for developing the required skills for teaching and learning of mathematics (Bakar & Ismail, 2019; Seto, 2016). Wilson and Bai (2010) reiterate that, how learners learn, rather than merely mastering content knowledge, is a demand of the 21st century, implying the crucial role of 21st century skills in the teaching and learning of mathematics. The literature furthermore confirms the connection between the FCA and the social constructivist approach to teaching in the 21st century (Ahmed, 2016; Jarvis et al., 2014) (§2.3.2), as well as the role of learning mathematics through active and social knowledge construction in supporting the development of 21st century learning skills. In the next section, key competencies that are relevant for this study and requirements for learning and teaching in the 21st century are explicated.

2.4 Twenty-first century skills

The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn. (Attributed to Alvin Toffler *Future Shock* 1970)

With reference to the above quote, Saavedra and Opfer (2012, p. 8) warn that "the interconnectedness of the global economy and political networks require that students learn to communicate, collaborate, and problem solve with people worldwide". Teachers therefore have the responsibility to equip their learners with 21st century skills implying that student-teachers are empowered by higher education institutions to develop these skills with their learners. It is however necessary for teachers themselves to develop these 21st century skills

before they will be able to support their learners in the development of these skills. Li et al. (2013) propose an enactivist perspective to the demonstration of 21st century skills:

> From the enactivist perspective, it would be difficult to teach someone else a skill that was not currently embodied or experienced by the teacher. As such, providing teachers with experiences of exercising 21st century skills may help them better facilitate these skills in their future classrooms. In this enactivist learning world, teachers are the agents of their own learning: They determine their own role in the process and choose their own way of interacting with the software, colleagues, and players. (p. 328)

These authors therefore accentuate the responsibility of higher education institutions in supporting student-teachers in developing 21st century skills, which forms the basis of arguments in this section. Fadel et al. (2015) describe a 21st century learner as one who has knowledge (what we know and understand), character (how we behave and engage in the world) and skills (how we use what we know). Geisinger (2016) notes that 21st century skills should be inherent to the curriculum, teaching and assessment in education. Developing these requires 21st century teaching methods. It should be the goal of teachers to prepare students for lifelong learning, support them in becoming independent and taking responsibility for their learning as well as monitoring their own learning (Kruger & Adams, 1998), that reflects Knowles's (1975) description of SDL (§1.2). According to Saavedra and Opfer (2012), most definitions of 21st century skills are in agreement that these skills, with emphasis on higher-order thinking and communication, are more difficult to teach than rote skills.

Traditional teaching methods are increasingly being criticised for not addressing 21st century skills that are crucial for the young and next generations (Botha-Ravyse & Reitsma, 2015). Twenty-first century skills are encouraged by the current South African Department of Basic Education as expressed by the Director-General, Mr Hubert Mathanzima Mweli, on a DBE Lekgotla held in 2018:

> In our assessment of the curriculum we have to ask ourselves what kind of a learner do we want to see emerge from the Education Sector? We need to reposition the Sector to provide skills for a changing world, mostly skills that do not yet exist (Department of Basic Education, 2018).

The CAPS for Mathematics also includes, as one of the aims of education, "to prepare the learners for further education and training as well as the world of work" (Department of Basic Education, 2011). Teaching approaches in classrooms – whether in school or classrooms of teacher-educators - should therefore support the development of 21st century skills.

Despite an overwhelming call for education to equip learners for the 21st century, Ananiadou and Claro (2009) argue that 21st century skills may not be relevant in all contexts and social-economic disparities might be widened if these skills are promoted to the world's elite. Their concern is that such a focus on 21st century skills can lead to a neglect of the needs of developing countries where not all students will become knowledge-intensive workers. This concern calls for reflection on the way approaches employed to support these skills can be adapted according to the learning needs of the target population.

Wagner (2010) proposes seven crucial skills that learners need to survive in the 21st century, including:

- critical thinking and problem-solving,
- collaboration across networks and leading by influence,
- agility and adaptability,
- initiative and entrepreneurialism,
- effective communication skills,
- accessing and analysing information, and
- curiosity and imagination.

The seven skills reflect the role of SDL in 21st century education that is also echoed in the literature (Binkley et al., 2012; Jaleel, 2017).

Binkley et al. (2012) suggest a model to organise and analyse 21st century skills in which ten skills are categorised into four broad categories namely ways of thinking, ways of working, tools for working, and living in this world (Figure 2.1).

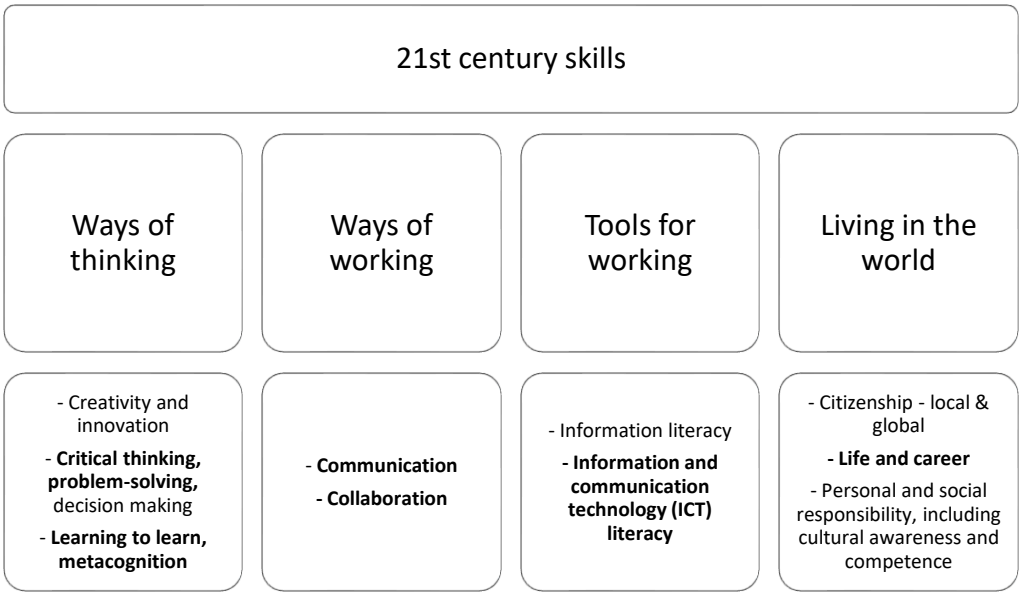


Figure 2.3 21st century skills adapted from Binkley et al. (2012, p. 36)

After an analysis of the 10 skills, Binkley et al. (2012) grouped the skills under the acronym KSAVE: knowledge, skills, attitudes, values and ethics. As part of 'ways of thinking' Binkley et al. (2012, p. 43) suggest operational definitions of "learning to learn and metacognition" according to the KSAVE model, of which the most relevant for this study are listed in Table 2.1:

Table 2.2 Learning to learn and metacognition as 21st century skills (Binkley et al., 2012, p. 43)

Knowledge	**Skills:**	**Attitude, values and ethics:**
Knowledge and understanding of one's preferred learning methods, the strengths and weaknesses of one's skills and qualifications.	Effective self-management of learning and careers in general. Ability to dedicate time to learning, autonomy, discipline, perseverance, and information	A self-concept that supports a willingness to change and further develop competencies as well as motivation and confidence in one's capability to succeed. Positive appreciation of learning as a life-enriching activity and a sense of

	management in the learning process. Ability to reflect critically on the object and purpose of learning. Ability to communicate as part of the learning process by using appropriate means.	initiative to learn. Adaptability and flexibility; Identification of personal biases.

Considering the principles of the FCA (§2.6), the role of metacognition as 21st century skill in learning to learn, as suggested by Binkley et al. (2012), strengthens the case for an FCA to foster metacognition of mathematic student-teachers as preparation for living and teaching in a 21st century world.

Although a myriad of skills are listed in the literature as imperative 21st century skills (Aabla, 2017), the roles of digital and ICT literacy, self-directed and self-regulated leaning are of specific interest for this study, with focus on the way metacognition is fostered in an FCA. Technology is used as the learning tool for self-directed (§2.4.2) and self-regulated (§2.4.3) out-of-class learning activities (§2.6.2), as well as for communication between the teacher (or lecturer) and the learner (or student), while SDL and SRL play determinant roles a student-centred approach to education, such as the FCA. Therefore, these three concepts are explicated from the literature.

2.4.1 Digital literacy and information and communications technology

In context of this study, technology is regarded crucial in two ways: as instrument to implement the FCA and as crucial 21st century skill (§2.2.2). While the teaching and learning of mathematics is enhanced by the use of technology, technology plays an important role in all aspects of education in the 21st century (Kaur, 2016). The digital age has brought about great changes in teaching and learning and technology, such as ICT, is viewed as crucial tool for work (Binkley et al., 2012). Digital and ICT literacy as 21st century skill has implications for education at school level as well for higher education institutions responsible for preparing teachers. The National Council Of Teachers of Mathematics (NCTM, 2015, p. 1) suggests a strategic use of technology in the teaching and learning of mathematics that requires thoughtful design and careful implementation of digital and physical tools and that technology

should also only be used when it will “enhance how students and educators learn, experience, communicate, and do mathematics”. However, in a digital age, thoughtful use of technology in mathematics teacher education programmes not only holds potential for these prospective teachers’ own mathematics learning of knowledge and skills, but will also expose them to 21st century teaching and learning approaches that they can apply in their own practices (Li et al., 2013).

Digital technologies of the 21st century have the potential to support learners with constructing new knowledge and problem-solving in mathematics (Bray & Tangney, 2017), while the use of technology affects student achievement in mathematical knowledge and practical skills (Kaur, 2016) (§2.2.2.4). Gama (2004) proclaims that computers can be an effective metacognitive tool, and since the literature confirms that metacognition is a predictor of academic success (Downing, 2010; Winne, 1996) (§2.5), ways should be explored to use technology in such a way that it will support metacognition as 21st century skill. However, concern is expressed in the literature that digital technology is rather used to enhance traditional practice, overlooking the value of technology to foster higher order thinking skills such as creativity and problem-solving skill (Bray & Tangney, 2017; Guri-Rosenblit & Gros, 2011), that are related to metacognitive skills (§2.5). Olive et al. (2009) also warn that, for technology to be an effective metacognitive tool in the 21st century, technology should be used to significantly transform mathematical activities instead of being used for activities that can be done without technology, implying a need for digital and ICT literacy.

Digital technologies and ICT play a central role in 21st century education where e-learning approaches are employed more and more. Guri-Rosenblit and Gros (2011) define e-learning as “a generic term used to describe a wide range of applications of electronic technologies (TV, radio, CD-ROM, DVD, cell phone, Internet, etc.) in study environments, with a special emphasis on learning through the web”. A well-functioning FCA has the potential to employ technology in such a way that it essentially promotes active learning (Bray & Tangney, 2017) (§2.6.2). Using technology such as video-recordings for self-exploration of a topic by students in an FCA supports SDL (Rutkowski & Moscinska, 2013). When mathematics student-teachers get first-hand experience of the use of technology for meaningful learning, they will also be more motivated to use technology in an innovative way in their future practices (Li et al., 2013).

The FCA is a form of blended learning (§1.7.3) that relies on digital technologies and ICT competence of both the teacher and the learner (Heinerichs et al., 2016; Hrastinski, 2019). Since blended learning combines traditional learning face-to-face interaction in the classroom and online multimedia technology for out-of-class learning, the quality of blended learning, and

therefore also the FCA, will depend on the meaningful integration of the benefits of face-to-face and online learning (Halili & Zainuddin, 2015; Hrastinski, 2019). The digital literacy level of the teacher (or teacher-educator in context of higher education) will influence students' behaviour in a blended learning environment, including self-regulation and metacognition (Rasheed et al., 2020), and therefore also successful learning outcomes. While blended learning such as the FCA holds potential to support the development of digital literacy, it may be necessary to first ensure that learners know how to use technology for learning and teaching before embarking on blended learning approaches (Tang & Chaw, 2016). These authors are also of the opinion that, when the necessary digital and ICT skills are in place, technology can successfully support SDL, SRL, and metacognition as 21st century skills.

2.4.2 Self-directed learning as 21st century skill

While the literature confirms the potential of the FCA to support SDL (Van Wyk, 2018; Zainuddin & Perera, 2018) there is overwhelming support for the notion that SDL is a crucial skill necessary to adapt to the changing education environment of the 21st century (Chalkiadaki, 2018; Fahnoe & Mishra, 2013; Jaleel, 2017; Tekkol & Demirel, 2018) (§1.7.1.5). For this study, SDL is informed by the definition of Knowles (1975) (§1.2) and is viewed as the process where students take initiative and are actively involved in their learning by formulating goals, applying learning strategies and assessing if learning goals were met. SDL is described by Candy (1991) as a process that organises instruction, as a concept that is used in a number of different ways such as personal autonomy, self-management, learner-control and as a characteristic that educators should seek to evoke. Zimmerman and Martinez-Pons (1986) describe SDL as the extent to which students are active in their own learning in the areas of motivation, behaviour and metacognition.

Bolhuis (2003) argues that self-directedness is a necessity for students to be prepared for higher levels of education where more independence is required as well as taking responsibility for learning throughout life. SDL is also a characteristic of deep learning (Bellanca & Boss, 2015). Nogueiras and Iborra (2017) advocate that educators in higher education institutions need to adopt teaching approaches that support students to be more self-directed. These authors furthermore discourage any teaching practices that perpetuate students' dependence on external authority that might have developed during their school years. A well-known way to improve SDL is to focus on students' awareness and their selecting of study strategies (Griffin et al., 2013). Students should be supported in moving towards carrying out self-directed activities instead of following orders, from memorisation to discovering and integrating, from theory to application of theory and from listening and reacting to taking responsibility (Guglielmino, 2013). Teachers who have developed these approaches

to teaching will take responsibility for their own practices and make relevant adaptations to meet the diverse learning needs of their learners.

Guglielmino (2013) emphasises that lifelong SDL is crucial in order to survive personally and professionally, surviving in the workplace and the thriving of communities. Candy (1991) explains the relationship between SDL and lifelong learning, where lifelong learning refers to the skills to keep on learning once formal schooling is complete and SDL is the independent quest for learning. Loyens et al. (2008, p. 416) conclude that "SDL can be considered both a means and end to lifelong learning". Acquiring SDL skills is more crucial than ever because of the fast-changing world informed by information and technology (Guglielmino, 2013). Guglielmino (2013, p. 4) goes on to say that "the SDL of individuals is the basic building block of strong families, organisations, communities, and countries". Teacher-education therefore needs to equip student-teachers to be lifelong self-directed learners in order to prepare them to adapt to continual changes and to ensure that changes made to their teaching are based on newly found information in order to reach education outcomes.

Another aspect that needs to be considered in order to reach outcomes is the regulation of learning. Loyens et al. (2008) distinguish between the similarities and differences of SDL and SRL and argue that, although both imply a measure of student control, the concept of SDL is broader than SRL (§1.3). In SDL student control lies in the choice of learning tasks made at the onset, while SRL involves students taking control of the steps in the learning process such as the setting of learning goals and choice of learning strategies. Metacognition plays a central role in self-regulation (Zimmerman & Moylan, 2009) and therefore SRL as 21st century skill is deemed important to be explored further.

2.4.3 Self-regulated learning as 21st century skill

SRL as requisite for active learning, emerges often in the literature as key 21st century skills (Binkley et al., 2012; Tan et al., 2015; Virtanen et al., 2017). Zimmerman (1989) was one of the first educationists to publish research in the field of SRL and defined his socio-cognitive model of SRL as a cyclic process where students monitor the effectiveness of their learning strategies and respond by adapting strategies that are not working with new strategies. The role of SRL in active learning is clear when he describes self-regulated students as "metacognitively, motivationally, and behaviourally active participants in their own learning process" (Zimmerman, 1989, p. 329). Various educationists elaborated on his theory, such as Panadero (2017), who advocates that in order to understand cognitive, motivational, and emotional features of learning, SRL is fundamental.

As stated in Pintrich's (2000) Self-Regulation Model, self-regulation is made up of four phases namely planning, monitoring, control and reflection.

- Planning: Setting goals, identifying skills to reach goals (activating prior knowledge), time management and activating self-efficacy
- Monitoring: Metacognitive awareness – feeling competent for the task at hand, awareness of own behaviour (of what is understood and what not)
- Control: Using cognitive and metacognitive strategies – employing thought control strategies, motivational strategies, and emotional control
- Reflection: Evaluation regarding task completion – Was it successful? Were criteria met? Or should future behaviour be adapted? What emotions were evoked by task result? (Pintrich, 2000, p. 453).

Dweck (2008) is of the opinion that self-theories – which state that intelligence is fixed – influence self-regulation. There is however strong evidence that SRL can be developed or improved in essentially any learner in conducive learning environments (Montalvo & Torres, 2004; Nilson, 2013). SRL involves several parts of the brain and, other than self-theories, character traits such as self-discipline, perseverance, determination and self-control have an effect on SRL (Nilson, 2013). SRL strategies can be taught through directly teaching the strategies, modelling the strategies, self-observation, feedback and removal of scaffolding when a student reaches a desired level of self-reflection (Montalvo & Torres, 2004). Self-reflection plays a central role in SRL (Paris & Byrnes, 1989).

Although the literature strongly concurs with the fact that self-regulation enhances student academic achievement (Azevedo et al., 2013; De Corte, 2012; Winne, 1995; Zimmerman, 1989), motivational and emotional factors may hinder this benefit of SRL (Ning & Downing, 2010; Tzohar-Rozen & Kramarski, 2014; Virtanen et al., 2017). Montalvo and Torres (2004) analysed research done by Zimmerman (2000) and Winne (1995) and identified characteristics of students with good SRL capabilities that include self-motivation, employing strategies that lead to academic success, belief that learning is a proactive process and acting as agents of their own behaviour (Montalvo & Torres, 2004). The characteristics of self-motivation and positive beliefs in own learning ability emphasise the role of motivation-emotion regulation in self-regulative learning (Tzohar-Rozen & Kramarski, 2014). Considering the relationship between SRL and metacognition (Zimmerman & Moylan, 2009), an investigation of the way an approach, such as the flipped classroom that strongly relies on SRL skills and

supports student metacognition, needs to take cognisance of the influence of motivational and emotional aspects in data collection and analysis.

Teachers firstly need to become skilled at self-regulation and then master the skill of self-regulated teaching (Kramarski & Kohen, 2016). Teachers who have SRL skills will be able to also instil these skills with their own learners (Virtanen et al., 2017). Artzt et al. (2008) highlight that in order to improve mathematics teaching, educators must get into the habit of reflecting on instructional practice and cognitions. Educator reflections should thus also focus on their own SRL and their successful support for improving the SRL of their learners.

Muis (2007) is of the opinion that metacognitive processes take place during all phases of SRL. Therefore, it is crucial that teacher education incorporates the kind of teacher training that enables metacognition that in turn will affect students' regulatory skills (Curwen et al., 2010). Strategies for teaching for metacognitive gains are explicated in §2.5.3. As one of the main foci of this study the literature was perused for consensus on the principles of this cognitive function which is discussed in the following section.

2.5 Metacognition

Metacognition is approached as a necessary requirement to support the development of 21st century skills such as SDL and SRL (Binkley et al., 2012; Chu et al., 2017) as well as a crucial skill required by teachers to facilitate meaningful learning (Aabla, 2017; Chu et al., 2017). There is consensus on the value of metacognition in academic learning (Apaydin & Hossary, 2017; Chytrý et al., 2020; Van der Stel & Veenman, 2010; Wang et al., 1990). However, although metacognition is important it is not sufficient for academic achievement (Gama (2004). A cognitive view of learning implies that learning is active in nature and consists of the mental processes of gaining, memorising and using knowledge (Woolfolk, 2014). Metacognition is a form of cognition (Alias & Sulaiman, 2017) and definitions on metacognition vary from basic descriptions to more complex explications. While Campione (1987) describes metacognition as the mere "awareness" of one's own thinking and Tarrant and Holt (2016) view metacognition as humans' knowledge about their thinking and learning, a definition by Flavell (1976), who initially devised this term, highlights the active role of humans in metacognition when he describes it as the active monitoring and regulation of any information processing activities as one has cognitive transaction with the environment. Reference in this definition to active monitoring and regulation of one's own learning processes clearly links metacognition with SRL (§2.4.3), where metacognitive regulation is a strategic process of controlling one's own cognitive activities (Apaydin & Hossary, 2017). Flavell's reference to transaction with the environment emphasises the active role of the learner in this cognitive

process, based on the meaning of transaction as “the process of doing something” (Oxford Advanced Learners’ Dictionary, n.d). This cognitive transaction between the person and the environment in metacognition is supported by Chinn and Sandoval (2018, p. 253), who postulate that “a full understanding of how people think requires close attention to how thinking occurs in interaction with the material and social resources present in all human activity”.

Students with well-developed metacognition are better able to select appropriate strategies to use in a given situation and this sound judgement is seen as an asset of metacognition (Paris & Byrnes, 1989). Learners who are aware that they are having trouble learning certain work or realise that they need help to understand a topic, engage in metacognition (Flavell, 1976) – if you sense that you must make a note of something since you might forget.

The South African Department of Higher Education emphasises that all student-teachers should be prepared as lifelong learners, thereby equipping them to continuously develop and improve their practices (Department of Higher Education and Training of South Africa, 2015). Haynie et al. (2012) emphasise the crucial role of metacognitive reasoning when processing change and when making the paradigm shift from a teacher-centred to a learner-centred approach to teaching and learning. The central role played by metacognition in self-regulated and self-directed lifelong learning necessitates a deeper look into the principles of metacognition with specific focus on the way this competence can be supported in mathematics teacher education programmes. A lack of metacognitive skills will influence SDL, SRL, and eventually lifelong learning that is a requirement for successful learning. Metacognition is highlighted here as an important 21st century skill, but since metacognition is at the centre of this study, it is discussed in more detail in this section (§2.5) with specific focus on metacognitive skills, teaching for metacognitive gains, assessing metacognition as well as considering Bloom’s taxonomy as framework for fostering metacognition in the context of mathematics education. The next discussion of the literature on metacognition in mathematics education acknowledges that metacognition has similar implications for the learning of mathematics at school level as well as at higher education level, where mathematics teachers are prepared for practice.

2.5.1 The role of metacognition in mathematics education

The support in the body of scholarship for the need of metacognition in mathematics learning cannot be overlooked (Baten et al., 2017; Biggs, 1988; Campione, 1987; Schoenfeld, 1992; Su et al., 2016). Joutsenlahti and Kulju (2017, p. 3) describe mathematical thinking as “an information process monitored by one’s metacognition”. It is generally accepted that university students will increase their performance if they understand the learning process better (Biggs,

1988; Downing, 2010). As mentioned earlier in §2.4, this view is shared by Bolhuis (2003) who argued that increased learning potential embraces the development of the aspects of "learning to learn". Moreover, as said differently by White and Frederiksen (1998), the most effective learners are the ones who engage in metacognition and who take control of their learning. Related literature thus serves as impetus to support metacognition in the teaching of mathematics to student-teachers to address the poor performance generally experienced in this subject.

Metacognitive monitoring and regulation (§1.7.2) play an essential role in mathematical problem-solving and serve as a purpose to foster and assess students' metacognition (Jacobse & Harskamp, 2012). De Corte (2012) and Campione (1987) echo the concern of Flavell, (1976), namely, that the lack of metacognition hampers the development of adaptive competence. This view has specific implications in the context of mathematics education. An ability to apply mathematics knowledge and skills flexibly in different context could play a significant role in the learning of mathematics since students will be equipped to employ their understanding to solve problems (De Corte, 2012). As stated differently by Pintrich (2002), when confronted with an unfamiliar problem, students need to rely on general strategies rather than relying on specific prior knowledge in order to solve the problem.

2.5.2 Metacognitive skills for meaningful learning of mathematics

As established, metacognitive skills are classified as important for the 21st century (Binkley et al., 2012; Fadel et al., 2015; Geisinger, 2016; Saavedra & Opfer, 2012). Metacognitive skills are required to regulate learning and these skills can be taught and developed (Alias & Sulaiman, 2017; Apaydin & Hossary, 2017; Callender et al., 2016; Flavell, 1976; Van der Stel & Veenman, 2010; White & Frederiksen, 1998). However, acquiring metacognitive skills takes time (Veenman et al., 2006).

Metacognitive skills are required in order to control and regulate learning (Brown & DeLoache, 1978) and are also known to support the development of critical thinking (Magno, 2010; Mariano et al., 2017). Metacognitive skills in support of mathematics learning as suggested in the literature include prediction, planning, monitoring and evaluation (Apaydin & Hossary, 2017; Lucangeli et al., 1998). Mathematics-specific metacognitive activities that require metacognitive skills include estimating the answer, drawing sketches to support problem-solving, designing an action plan, showing step-by-step calculations, monitoring the actions plans and drawing conclusions about the problem (Van der Stel & Veenman, 2010). Shen and Liu (2011), emphasise that metacognitive skills are at the core of SDL and suggest scaffolding

as strategy to foster metacognitive skills. Using appropriate scaffolding to support metacognition in mathematics is further explicated in §2.6.

Metacognitive skills involve adaptive competence and optimising learning outcomes (Azevedo, 2009). Also, evidence by Mevarech and Kramarski (2003) confirm that it is achievable as well as effective to incorporate metacognitive strategies into mathematics problem-solving instruction. For the development of metacognitive skills, knowledge should be provided as well as the opportunity to gain experience – the one without the other is deemed insufficient (Gama, 2004).

Including metacognitive skills development as part of mathematics teacher education can potentially influence their future pedagogical practice by equipping them to facilitate meaningful mathematics learning by reflecting on teaching and learning (Portilho & Medina, 2016). Supporting the development of metacognitive skills in mathematics activities will ensure learning with understanding and thereby contribute to these teachers' ability to also mediate this understanding to their own learners. Therefore, mathematics teaching and learning strategies that can be implemented to foster the development of metacognitive skills should be explored. I do acknowledge that metacognition is informed by students' current diverse metacognitive knowledge and skills, serving as basis for further development of their metacognition. The next section, reports on teaching and learning strategies in support of metacognitive gains that emerged from the literature.

2.5.3 Teaching for metacognition

Teacher metacognition is a key factor in developing their learners' metacognition (Alias & Sulaiman, 2017). Therefore, teacher-educators should pay heed to the way they support prospective teachers in their development of metacognitive skills. A study conducted by Wilson and Bai (2010) investigated master's degree education students' pedagogical understanding of metacognition, implying an understanding of how to effectively teach metacognitive skills to learners. A significant relationship between the three factors of metacognitive, conditional, declarative and procedural knowledge (§1.7.2), as part of teachers' pedagogical understanding of metacognition, became evident through this study, thereby confirming that student-teachers should be guided to focus on the three factors and how these factors relate to the usage of metacognition. The importance of explicitly teaching metacognitive knowledge is emphasised by Cunningham et al., (2018) as well as Ku and Ho (2010), who are of the opinion that without the support of metacognitive knowledge, metacognitive regulation will not be effective in enhancing critical thinking. These reported findings indicate that teacher education programmes will do well to create an awareness of

which instructional routines support student-teachers' metacognition, which can then in turn make use of these routines to support learners in practice.

There is concurrence in the literature on the role of metacognitive knowledge and the way this knowledge informs metacognitive skills (Alias & Sulaiman, 2017; Wilson & Bai, 2010) (§1.7.2). Related literature confirms the importance of fostering metacognitive skills for successful learning in general and for the mastering of mathematical knowledge and skills (Menz & Xin, 2016; Shen & Liu, 2011). Metacognitive skills have the potential to empower students to master new and challenging tasks (Paris & Byrnes, 1989; Safari & Meskini, 2016), and thus serve as impetus for a deeper investigation of the literature explicating how these skills can be fostered with learners/students as well as the role of assessment in the fostering of metacognitive skills.

Findings by Shen and Liu (2011) suggest that after metacognitive instruction, students' performance in problem-solving can be enhanced. In a study by Menz and Xin (2016), mathematics teachers were encouraged to promote thinking, learning and metacognition through creating the right classroom environment and explicitly teaching metacognitive strategies. Manasia and Pârvan (2014) highlight the value of teachers' contributions in supporting their students' metacognitive development and suggest that explicit exercise and appropriate tools need to be incorporated to support engagement in metacognitive reflection. Strategies emerging from the literature to support metacognition include supporting student reflection such as providing reflective prompts (Menz & Xin, 2016) and collaborative learning or peer tutoring (De Backer, 2015).

Jiang (2016) cautions that for teachers to teach and model metacognition to their students, they themselves need to be metacognitive. Alias and Sulaiman (2017, pp. 28-35) recommend strategies to improve metacognition among students in higher education, such as concept mapping, open-ended questioning that require good listening skills, and brainstorming, whereby learners solve problems by generating many ideas. Intrapersonal brainstorming requires metacognitive monitoring to challenge existing ideas (Alias & Sulaiman, 2017).

Menz and Xin (2016) state that for students to form new habits of thinking, teaching for metacognitive gains needs to be prolonged. These habits should include thinking about their thinking and learning and enabling students to plan tasks, monitoring understanding, assessing knowledge, and evaluating progress during mathematical learning. Alias and Sulaiman (2017) suggest that teaching for both content and metacognition should happen concurrently. This has implications for every classroom and consideration needs to be given

as to how instruction will be adjusted to foster metacognition. Teaching for metacognitive gains also raises the question of how to assess the use and/or improvement of metacognitive skills.

Although digital technology can serve as tool to support metacognition (Gama, 2004; Olive et al., 2009) (§2.4.1), Shen and Liu (2011) state that more research is required on how to design metacognitive instructions for online learning. Kirsh (2005) emphasises the role of digital visual design in supporting metacognition. He is of the opinion that online systems (such as learning management systems) has the potential to facilitate metacognition by explicitly organising the visual and interactive display to support learning. The organisation of visual cues and the way interaction is planned, for example topic sentences or visually prominent summaries, can influence the ease and effectiveness of metacognition. A growing recognition of the importance of fostering the development of metacognition within student-teachers is evident in related literature. If this 21st century skill can be guaranteed as outcome of teacher education programmes, an influx of reflective practitioners in schools who can teach metacognition back to their students, may become a reality. However, to improve support for metacognitive gains will require assessment of student metacognition.

2.5.4 Assessing metacognition

In order to assist students in their learning, it is important that educators are able to assess students' metacognition (Ibrahim & Watts, 2016), necessitating specific assessment strategies to determine when and how to foster this skill (Ozturk, 2017). Because learning is inferential (it occurs within the body) and cannot be observed directly, we therefore observe the outcomes of learning (Schunk, 1996). Therefore, since metacognition is not directly observable, assessment of metacognition is inclined to involve either an instrument for self-report questionnaires or performance on a task (Schraw & Moshman, 1995; Veenman et al., 2006).

There is a distinction between online and offline measurement of metacognition as described by (Veenman et al., 2006). Online measurement takes place during learning tasks and the learners' thinking process can be accessed when they verbalise their strategies. Off-line measurement takes place before or after learning experiences and examples can include interviews with students. According to Veenman et al. (2006), an efficient way of assessing metacognition is by thinking-aloud protocol observations. Jacobse and Harskamp (2012) state that using think-aloud protocols to assess metacognition has proven valid and provided rich data but is time consuming.

For mathematics educators, the possibility exists of assessing metacognition while observing students and during think-aloud protocols, particularly during peer tutoring when students verbalise thoughts during mathematics task performance (Baten et al., 2017). Menz and Xin (2016, p. 164) encourage educators to examine students' thought processes to gain greater insight into student learning. Such insight will enable educators to support students to be more aware of their learning and consequently develop as more successful learners. Another strategy to assess metacognition is by using metacognitive scaffolding instruments such as reflective diaries (Manasia & Pârvan, 2014).

Furthermore, metacognition can also be assessed by using questionnaires where students report their perceptions about their thinking (Downing, 2010). Some of the questionnaires used to measure metacognition are: Metacognitive Skills Scale (MSS) (Altindağ & Senemoglu, 2013), Awareness of Independent Learning Inventory (AILI) (Sleegers et al., 2013), Metacognition in Multiple Contexts Inventory (MMCI) (Allen & Armour-Thomas, 1993), Metacognition Self-Assessment Scale (MSAS) (Carcione, 2017), and Metacognition Assessment Interview (MAI) (Schraw & Dennison, 1994). A study by Craig et al. (2020) on the use of self-reports to measure metacognition cautions that aspects such as participant mood at the time of the report and central tendency bias with Likert scale responses can be problematic for metacognition self-reports. The authors do, however, acknowledge that metacognitive self-report questionnaires can still be used purposefully to obtain insight into participants' metacognition knowledge and regulation.

According to Blooms revised taxonomy (§2.5.5), metacognition is regarded as a higher-level cognitive skill (Krathwohl, 2002) and provides a benchmark for learning objectives that require higher levels of cognition aiming to support "deeper learning and transfer of knowledge and skills to a greater variety of tasks and contexts" (Adams, 2015, p. 152). This taxonomy therefore serves as framework to guide the development of cognitive functions towards metacognitive levels.

2.5.5 Bloom's taxonomy as framework for fostering metacognition

In 1956 Benjamin Bloom, in collaboration with educational psychologists, developed a categorisation of intellectual behaviour stages considered to be important in learning. Bloom's original taxonomy has six categories, each requiring a higher level of abstraction: Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation (Bloom et al., 1956). The taxonomy was revised in 2001 denoting relevance to 21st century skills: Remembering, Understanding, Applying, Analysing, Evaluating and Creating (Krathwohl, 2002). In the revised taxonomy, *knowledge* was renamed *remembering.* This lowest dimension includes

Factual knowledge, Conceptual knowledge, Procedural knowledge and Metacognitive knowledge. Learners are expected to develop from this dimension to reach higher levels of reasoning (Fadel et al., 2015; Krathwohl, 2002). Papaleontiou-Louca (2008) and Mariano et al. (2017) agree with Krathwohl that the development of metacognition can promote critical thinking in education that operates on the higher levels of Blooms taxonomy.

Therefore, metacognition is an important factor in achieving higher levels of thinking such as analysis and synthesizing (Alias and Sulaiman (2017). An aim of mathematics education in schools as specified by the CAPS document is "to develop problem-solving and cognitive skills" (Department of Basic Education, 2011). Professional teacher development programmes in South Africa should also prioritise the promotion of critical engagement, reasoning, and reflective thinking by teachers (Department of Education, 2000).

According to Van de Walle et al. (2010), verbs that should be used in the classroom to provide opportunity for higher levels of thinking and sense-making are *collaborate, describe, justify, predict, verify, invent, construct, conjecture, compare, investigate, explore and explain.* These action verbs describe typical evidence of active learning on the higher levels of Bloom's taxonomy and will evidently influence metacognition. In concurrence with authors such as Apaydin and Hossary (2017), Fadel et al. (2015) and Schoenfeld (1992), fostering thinking on these higher cognitive levels should form part of all spheres of education (either on primary, secondary or tertiary education level) if education aims to support meaningful learning. Consideration needs to be given to instructional methods that allow for students to reach higher levels of Bloom's taxonomy. The FCA, as a learner-centred approach that supports active and collaborative learning, holds potential to support learning on these higher cognitive levels.

2.6 The flipped-classroom approach for mathematics teacher preparation in the 21st century

This section firstly explicates the potential of the flipped classroom to be used as a vehicle of instruction to prepare mathematics teachers. Secondly, a detailed description is provided of the FCA principles and strategies, followed by an explication of the way these principles and strategies hold potential to foster metacognition. Lastly, literature that reports on both the benefits and possible challenges of the FCA are disclosed.

2.6.1 The potential of the flipped-classroom approach to prepare mathematics teachers for the 21st century

The Flipped Learning Network (FLN, 2014) defines the flipped classroom as:

> a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter. (p.1)

The FCA helps to prepare students for tomorrow's challenges (Stanciu, 2016) by supporting higher order cognitive levels. This value of the FCA is grounded in the principles of a social constructivist approach to teaching in the 21st century (Ahmed, 2016; Jarvis et al., 2014) (§2.3.2; §2.6), and prioritises active and interactive knowledge construction and problem-solving (Bergmann & Sams, 2014), while these learning activities support the development of higher levels of thinking (Biggs, 1996; Cobb, 1994; De Corte, 2012; Gravett, 2005). Ashwin et al. (2015) claim that deep learning takes place when a student expresses active interest in what they are learning, motivating the incorporation of certain learning processes to support understanding of the learning content, that will again strengthen lifelong learning. The active mathematical knowledge construction as a value of the FCA is also highlighted by a study conducted by Cevikbas and Kaiser (2020), showing that the FCA supports students in developing their own mathematical thinking when they learn through interaction with their lecturer and peers. Through supporting SDL strategies (§2.4.2) (McLean, 2016) and collaborative learning (Shahnaz & Hussain, 2016) through the integration of technology (Stanciu, 2016), the FCA not only holds the potential to prepare student-teachers for mathematics teaching practice in the 21st century (Lo et al., 2017), but also to support metacognition. However, several determinants can play a role in the way the FCA will foster metacognition and consequently also SDL. These determinants came to the fore in an exploration of the literature on the implementation of the FCA. This literature review reports on the two main components of an FCA that include the out-of-class and in-class components, as well as the educator roles in the implementation of both in- and out-of-class activities in an FCA. Lasty, design principles of the FCA that emerge from the literature are discussed.

2.6.2 Flipped-classroom implementation

Arguments for the implementation of the FCA for mathematics education are manifold (Bergmann & Sams, 2012; McLean, 2016; Stanciu, 2016; Zainuddin & Halili, 2016). Naccarato and Karakok (2015) stress that the flipped classroom is a pedagogical platform allowing educators to implement various teaching strategies based on their teaching goals, rather than seeing it as an all-inclusive learning model. The flipped classroom design principles therefore allow for adaption to match the specific context and student needs. Krouss and Lesseig (2020) agree that there is not only one correct way to implement the approach.

- **Out-of-class activities**

As mentioned in Chapter 1 (§1.7.3), the act of 'flipping' implies reversing what is regarded as the norm. In the case of education, the norm entails that new content is transferred from the educator to the learner during in-class activities, while drill and practice tasks, based on the new content, are completed as homework and viewed as out-of-class activities. The out-of-class activities in an FCA mostly use technology as tool for active SDL and do not consist of worksheets or readings but of videos that students should watch with the option to rewatch. The videos could be a combination of self-made videos as well as videos found on the internet. Videos generally are on specific topics according to course objectives (De Boer & Winnips, 2015). However, Krouss and Lesseig (2020) caution that designing a flipped classroom is more complex than just making online video lectures available to students.

Out-of-class activities rely heavily on digital literacy and ICT skills, as core 21st century skills (§2.4.1). Various authors report on the way videos should be used for meaningful learning in an FCA (Cevikbas & Kaiser, 2020; Elazab & Alazab, 2015; Naccarato & Karakok, 2015). Feedback by students in a mathematics undergraduate module suggested careful consideration when choosing visual material to ensure that the main focus of videos indeed correlates with the topic that is the focus of learning (Naccarato & Karakok, 2015). To have control in this regard, self-made videos by the lecturer are suggested (Cevikbas & Kaiser, 2020). Strycker (2017) found that when students asked questions after watching videos, it enabled the educator to identify trends in questions being asked by the students and additional material can be provided accordingly.

Ray and Powell (2014) recommend that student-teacher out-of-class work should include tasks completed before, during and after watching video recordings rather than student-teachers just viewing visuals and making notes afterwards. Tasks can include answering questions about what students already know about the concept, what was learnt in the video and what was an important idea or concept in the video (Ray & Powell, 2014). Including templates with generic prompts to support students to reflect on their learning and understanding (Ray & Powell, 2014) will directly have an effect on their metacognition (Kramarski & Kohen, 2016). These reflective prompts have the potential to foster metacognition since it can guide students to think about their learning process. Employing such metacognitive strategies is necessary in order to become more reflective (Manasia & Pârvan, 2014; Naccarato & Karakok, 2015) and in the case of teacher education, preparing reflective teachers will better equip them to foster metacognition with their students (Li et al., 2013; Naccarato & Karakok, 2015).

It should be stated that out-of-class activities play a crucial part in the FCA, specifically in the way these activities aim to support deep learning through fostering metacognition. It is essential that out-of-class activities align with activities applied in-class (McLaren, 2013; Zappe & Litzinger, 2017).

- **In-class activities**

In a flipped classroom, new knowledge is constructed by linking in-class activities to previous knowledge received in video format (Bergmann & Sams, 2012). In the FCA, the in-class component allows for opportunities to show understanding and to clarify concepts and the emphasis is on the collaborate reflection on previously viewed content (Ray & Powell, 2014). It is important that student-teachers can clarify concepts during these collaborative activities as this supports the constructivist view of learning in that new knowledge is built on correct understanding of a concept (§2.3).

The in-class component consists of activities that require both higher-order thinking and support (McLaren, 2013). An example of a higher-order thinking task requires one to evaluate knowledge and skills, implying metacognition (Krathwohl, 2002). These tasks used to be individual homework completed by students without lecturer or peer support. The FCA moves these higher order thinking activities to the classroom and now the potential exists for deeper learning and the fostering of metacognition through lecturer and peer support in the form of collaborative learning. Therefore, the FCA creates the opportunity for shared reflective discourse (Mezirow, 2003) when they talk about their thinking and learning and consequently supporting metacognition gains. Heinerichs et al. (2016) claim that active learning is crucial in fostering higher-order thinking (§2.3; §2.5). Consequently, teacher-educators need to be creative in finding ways to use in-class activities effectively to make sure that student-teachers are actively involved in clarifying concepts, reaching higher levels of thinking and applying their knowledge.

Successful implementation of an FCA can be time consuming (Elazab & Alazab, 2015; Tiahrt & Porter, 2016) and may require more time than is available, therefore time needs to be used optimally (Elazab & Alazab, 2015). It is vital to consider recommendations grounded on research findings that increase the probability of effective time use during class. Tiahrt and Porter (2016) recommend mini-lectures, group activities, promoting active learning and providing additional examples as strategies that maximise economic use of the in-class time. They also warn against re-teaching out of class content but recommends mini-lectures to provide additional support to the student. Mini-lectures are short lessons that should be no longer than 12 minutes, should emphasize important aspects of the pre-class video and

contain previously identified problem areas. Mini-lectures can also be in the form of a small assessment tool, whereby the student will assess their own understanding, such as a quiz that will not take long but help students identify their understanding, and in turn can support them in developing metacognitive skills (Tiahrt & Porter, 2016).

Group work as in-class activity enables students to work together to solve problems and discuss concepts. This ties in with social constructivism (§2.3.2) as described by Lev Vygotsky, where learning depends on social interaction (Richardson, 1997). De Corte (2012) notes that effective learning implies not purely self-contained activities but distributed activities, where students are guided to exchange ideas and strategies and to discuss opinions. Wood et al., (1991) also support this notion when they emphasise the value of social interaction as essential for mathematics learning. They furthermore argue that individual knowledge construction occurs through interaction, negotiation, and cooperation. Muis et al., (2016) highlight groupwork that supports learning based on the view that content is learned more deeply when explaining it to others. In support of metacognition, these intergroup explanations also support students to evaluate their own understanding and to identify gaps in their knowledge (Muis et al., 2016), while Smith and Mancy (2018, p. 29) confirm a "relationship between metacognitive talk and group interactions". These mentioned features of groupwork clearly support higher order thinking and the development of metacognition through cooperative reflection and evaluation of one's own learning. A study conducted by De Backer et al., (2012) found that students used more metacognitive skills by preparing to teach their peers. This may be attributed to the accountability factor where students realised their responsibility to teach for understanding which require that they first question their own understanding of the concepts to be explained to peers.

Promoting active learning requires strategies that motivate all students to get involved in the learning process. Since in-class sessions allow for the educator to connect with students, McLaren (2013) suggests that educators use questions like the following to get their less talkative students to engage: What have you done? Explain how you have done it? Posing questions that involve the student in the learning process have the potential to develop metacognitive skills since students are being made aware of their thinking and prompted to reflect on their own cognition (Campione, 1987; Gama, 2004; Kjellgren et al., 2008; Muis, 2007). A well-executed in-class session, relates to Vygotsky's (1978) ZPD where, in a community of inquiry (Lee & Kim, 2018), scaffolding for the development of metacognition is provided to learners (or student-teachers in the context of the current study) by both the teacher (or lecturer) and other learners that are on different knowledge levels while they are actively involved in their learning (§2.3).

Audrey McLaren (2013, pp. 99–122), an experienced mathematics teacher, shares valuable guidelines for in-class sessions based on her own experience with the FCA:

- face-to-face time allocated for in-class activities should not be isolated from the out-of-class part and that the lesson should start by referring to online comments made by students after they watched videos in preparation for class. This suggestion based on her own experience accentuates the constructivist grounding of the FCA where knowledge is constructed by linking onto prior understanding. Looking at student comments will also help to address common misconceptions and important questions.

- group activity tasks must involve student opinions, make room for brainstorming, have problems with more than one solution, and be too much for only one person to handle.

Although cooperative learning will not suit the learning style of all student-teachers (Gardner, 1993; Halili et al., 2019), it is important that prospective teachers learn how to learn and work cooperatively — this will equip them to participate as a community of inquiry (Lee & Kim, 2018) which, in the context of teacher learning, is known to strengthen practice (Shulman & Shulman, 2004). As stated by Shulman and Shulman (2004, p. 259), student-teachers who learned as part of a community of learners are "more capable and experienced in working as members of a functioning learning communities and/or of forming such communities in the settings where they work".

When implementing the FCA, educators should be concerned about both the in- and out-of-class activities and both should complement each other in supporting the learning objectives (Zappe & Litzinger, 2017). The context in which the flipped classroom is implemented, as well as the target student population, will have implications for the role of the educator (Brewer & Movahedazarhouligh, 2018; Kim et al., 2014). Literature with specific focus on the role of the teacher-educator in the implementation of the flipped classroom in a higher education context was explored as grounding for the case study which is the focus of my investigation. In the next section, the teacher-educator roles in the flipped classroom are thus discussed, with specific reference to the facilitation of both in-and out-of-class activities.

- **The educator role in the flipped classroom approach**

Cevikbas and Kaiser (2020, p. 1292) describe the role of the teacher in an FCA as less obvious, however, "teachers in this environment are much more important and frequently more challenged than in traditional classrooms. They should consistently observe students, provide support, give comprehensive feedback, and assess students' work."

Tiahrt and Porter (2016) advise that careful planning and implementation of the flipped classroom will ensure that time demands and workload do not increase for students in a well-implemented flipped environment, but that this approach rather entails a shift in the load so that work considered to be difficult is done in class. Teacher educators serve as facilitators and discussants and their role in the FCA is focal (Ray & Powell, 2014). This means that the FCA is student-centred and that the educator mediates SDL that is at the core of a successful FCA. Kim et al. (2014) highlight that the flipped classroom is about learner presence as well as self- and co-regulation of learning.

The important role of digital literacy and ICT in the FCA (§2.6.1) requires that teacher-educators make sure they have technical support and that they are well acquainted with the LMS used at their institution, in this case, eFundi (§1.2). Apart from technological support, ample and continuous training of teaching staff is important (Stanciu, 2016). Peppler (2013) advises teacher-educators to familiarise themselves with a tool before letting students use it. Video content created must be accessible on different devices and in any location (Peppler, 2013). Making use of screen captures to guide students in accessing the out-of-class activities, enables students to move through the process at the beginning of the implementation (Strycker, 2017).

Ray and Powell (2014) specifically investigated the use of the FCA in teacher education where educational videos, demonstrating the teaching of specific content from the curriculum, are used for out-of-class activities. They suggest that these videos will not only support student-teachers in their learning of content but also motivate critical reflection on effective teaching strategies based on the strategies used by the educators in the visuals. When using open educational resources[5], the educator needs to determine whether a video is reliable and produced by an expert (Ray & Powell, 2014). Hall and DuFrene (2016) recommend videos of no longer than 10 minutes in order for students to stay engaged whereas De Boer and Winnips (2015) made their recordings a maximum of 15 minutes per video. Willis (2017) states that developing and recording videos will be time-consuming while Ashwin et al. (2015) is of the opinion that, with helpful tools and software, video-recordings can be made with little time or toil. These different views are clear evidence that what works for one does not necessarily work for all. Prior to implementation the educator thus needs to critically reflect on the relevancy of the video content as well as the strategies to be used, with specific focus on the

[5] "Open educational resources are materials for teaching or learning that are either in the public domain or have been released under a license that allows them to be freely used, changed, or shared with others." (Sparks, 2017)

target student population and the course content, with specific consideration of the educators own technological competence.

Apaydin and Hossary (2017) are of the opinion that to enhance student learning, explicitly teaching metacognition (§2.5.3) should be a forerunner to any university module. When reflective prompts are used during in-class FCA activities it provides educators with valuable insight about their students' metacognitive skills and enable them to help students develop the language of talking about their learning (Menz & Xin, 2016). Various factors should be considered by the teacher-educator when planning and implementing flipped classroom strategies such as the current metacognition of students, context and background of student, content to be mastered, resources available, IT skills as well as teacher competence and experience. It is vital that flipped classroom activities should improve student learning without increasing pressure (Tiahrt & Porter, 2016) and in this regard, it is important to provide appropriate levels of scaffolding and support to students in order for them to indicate significant metacognitive gains for both out-of-class and in-class activities (Downing, 2010).

From the literature on the two main components of the FCA, namely in- and out-of-class activities, specific FCA design principles and strategies emerged. The following section reports on these principles and strategies that are important for the successful implementation of the FCA, with focus on their role in an FCA aiming to prepare mathematics teachers for the 21st century by fostering metacognitive skills.

- **Flipped classroom design principles**

Naccarato and Karakok (2015) describe the flipped classroom as a pedagogical platform allowing educators to implement various teaching strategies based on their teaching goals, rather than seeing it as an all-inclusive learning model. This implies that the flipped classroom design strategies can be adapted according to different contexts and student needs (§2.6.2). Kim et al. (2014) also emphasise that the specific context needs to be considered in the planning and implementation of the flipped classroom. However, based on findings from an intensive investigation, involving the implementation of the FCA in different contexts, they recommend broad design principles. These are directed at the teacher or teacher-educator who needs to provide the following learning opportunities:

1. an opportunity for students to first gain exposure to content prior to class

2. an incentive for students to prepare for class

3. a mechanism to assess student understanding

4. clear connections between in-class and out-of-class activities

5. clearly defined and well-structured guidance

6. enough time for students to complete the assignments

7. facilitation for building a learning community

8. prompt/adaptive feedback on individual or group works

9. technologies familiar and easy to access (Kim et al., 2014, p. 44)

From the above guidelines, the important role of the lecturer in effecting FCA principles is evident. A greater lecturer effort will therefore ensure a more student-centred approach. While Kim et al. (2014) suggest general FCA design principles, Lo et al. (2017) set out the following design principles specifically for mathematics education and grounded in empirical research, in order for the FCA to gain ground:

1. Manage the transition to the flipped classroom for students.

2. Manage the transition to the flipped classroom for instructors.

3. Present introductory materials and provide online support in video lectures.

4. Enable effective multimedia learning by using instructor-created short videos.

5. Use online exercises with grades to motivate students' class preparation.

6. Modify in-class teaching plans based on students' out-of-class learning performance.

7. Activate students' pre-class learning by using a structured formative assessment such as a quiz at the start of face-to-face lessons.

8. Require students to solve varied tasks and real-world problems.

9. Meet the needs of students through instructor feedback and differentiated instruction.

10. Facilitate peer-assisted learning through small group learning activities. (Lo et al., 2017, p. 62-65)

From these principles suggested above, the valuable role of the FCA in scaffolding SDL and SRL, as well as to motivate student active participation, is apparent. There is a clear correlation between the principles suggested as a general guideline for the FCA (Kim et al., 2014) and those suggested for an FCA in mathematics education (Lo et al., 2017). When the two sets of principles are compared, some general principles that seem to be central in an FCA emerge, namely, the important role of lecturer feedback, the role of the lecturer in mediating the student communities of inquiry through small group problem-solving activities, an incentive to prepare for class and an instrument to check for student pre-class preparation and understanding. An important principle mentioned by Lo et al. (2017) is the need to manage the transitioning to the FCA for both students and lecturers. This principle highlights the necessary mind shift by both the lecturer and the student towards a more student-centred approach to teaching and learning (§2.2.4; §2.3.4) Although Kim et al. (2014) put emphasis on constructivist principles (§2.3), such as the need for a clear connection between in-class and out-of-class activities and that the lecturer needs to provide enough time for students to complete tasks, they do not mention the specific kind of in-class activities. Lo et al. (2017), on the other hand, specially refer to the planning that should go into the learning tasks that need to include diverse and real-life problems, known to promote active participation in own learning.

The literature discussed in previous sections strongly supports the notion that metacognitive skills will equip students to be more reflective and in turn be more effective teachers who critically reflect on their practices that, in turn, also holds value for self-directed and lifelong teacher learning. The ways in which the FCA implementation can foster metacognition within student-teachers has been integrated explicitly and implicitly throughout the literature review. The next section reports specifically on the potential of flipped classroom principles to support metacognition.

2.6.3 Flipped classroom in support of metacognition

The potential of the FCA to foster metacognition cannot be disputed (Al-Samarraie et al., 2019; Limueco & Prudente, 2019; Van Vliet et al., 2015). However, as stated before, the way in which the FCA is implemented will greatly determine if metacognition is indeed a learning outcome (Van Vliet et al., 2015). Therefore, a flipped-classroom implementation needs to be well-planned and well-executed for meaningful learning and consequently, metacognition gains.

The crucial role played by active learning in fostering higher-order levels of learning like evaluation of knowledge and skills, is accentuated by Heinerichs et al. (2016). The ability to

evaluate own mathematics learning processes through metacognition (§2.5) involves an active role in own learning when learners not only take responsibility for their own learning, but also as self-directed learners (Knowles, 1975). Learners and student-teachers should therefore be guided to set their own learning goals and monitor their own progress to reach these goals through continuous self-evaluation and analysis of their own learning through critical self-reflection and creating strategies to reach set learning goals. Steen-Utheim and Foldnes (2018) note that one of the objectives of the FCA is to foster students' engagement and active learning. Analysis of the impact of flipped learning proved to be valuable and presented a positive impact on students' learning such as motivation and engagement (Botha-Ravyse & Reitsma, 2015; Zainuddin & Halili, 2016). A study done at British Colombia University in Vancouver on 250 physics students, found that students' degree of involvement improved by 40% as a result of the flipped classroom experiment (Stanciu, 2016). Findings of a study conducted by Steen-Utheim and Foldnes (2018) focused on students' perspective of the FCA, and indicated that the opportunity to ask questions, debate and collaborate with peers supports both their learning and engagement. Peer collaboration cultivates higher-order thought when peers compare strategies and determine which method is most effective (Pintrich, 2002). Moreover, students develop metacognitive thinking when it is modelled by peers, comparing their own thoughts with the thoughts of others, and then having to determine what to do with these thoughts (Conrady, 2015).

Thus, an FCA provides time for students to share their thinking and struggles (Naccarato & Karakok, 2015) and provides the opportunity for students to take responsibility for their own learning (Lai & Hwang, 2016; Rutkowski & Moscinska, 2013; Stanciu, 2016). When students are encouraged to take responsibility for their own learning it provides them with the opportunity to grow as self-directed learners. Conrady (2015, p. 134) states that the "sharing of thoughts and using those thoughts as objects of thinking" is central to developing metacognition. One way to encourage students to think about their learning is by integrating reflective prompts into both in-class as well as out-of-class components of the FCA, since reflection supports metacognition (Conrady, 2015; Menz & Xin, 2016; Yimer & Ellerton, 2010). Further activities to foster metacognitive thinking that can be accommodated into an FCA are modelling problem-solving, questioning, and identification and evaluation of errors (Pintrich, 2002). When student reflection is enabled and facilitated before in-class sessions, more time is available during class time for students to evaluate their understanding (McLean, 2016), problem-solving and collaboration for metacognitive gains.

Baytiyeh (2017) also found that the FCA supports students in becoming self-regulated. As shown in Chapter 1 (§1.3) and stated in §2.4.3, metacognition supports SRL. The crucial role

of self-regulation in learning is highlighted by Guglielmino (2013) who predicts that students who have been spoon-fed will resist taking responsibility for learning and adapting to material that is 'different' from what they are used to. Students may therefore struggle to comprehend or fail to peruse the out-off class activities of the flipped classroom because of their lack of self-regulation skills (Lai & Hwang, 2016). Therefore, providing scaffolding for out-of-class learning has the potential to support SRL where learners take responsibility for their learning. Scaffolding in the form of monitoring students' thinking processes and regulation is important for developing metacognition (Kim & Lim, 2019). Although the FCA clearly has the potential to support metacognition and consequently SRL and SDL (§2.4.2; §2.4.3), it is clear that students need to be guided and tools provided to support those who are less self-regulated to give them the opportunity to become more self-regulated, despite their lack of this aptitude.

Results from the study conducted by Lape and Levy (2014) indicated that students in a flipped classroom scored significantly higher on measures of adaptive competence (§2.3.4; §2.5) than students in the traditional setting. Where adaptive competence is viewed as crucial competences to adapt to the fast-changing education environment, these findings strengthen the case for the implementation of an FCA to support meaningful learning for 21st century skills and metacognition. Adaptive competence is evident of metacognitive skills while at the same time metacognitive skills support adaptive competence (Campione, 1987; De Corte, 2012). Consequently, metacognitive skills are developed when a student can apply their knowledge to different situations.

A major determinant of metacognition as benefit of the FCA, as compared to a traditional class, is the integration of technology. If technology is used effectively, it can be utilised for feedback, instruction, reflective prompts and checking for understanding by using, for example, quizzes (§2.2.2.4; §2.4.1; §2.6.2). In other words, through technology learning takes place beyond being in class with an educator. In an FCA context, where students can rewatch videos and control the pace of their learning, an increase in metacognitive self-regulation is expected (Lape & Levy, 2014).

Related literature reported numerous benefits of the flipped classroom. However, this fairly new approach to education also poses challenges to all role players and the teaching environment. Considering the benefits as well as challenges is necessary when planning a transfer to the FCA.

2.6.4 Flipped classroom benefits and challenges

Many of the benefits of the FCA have already been mentioned in the previous sections. This section therefore serves to summarise and highlight both the benefits and challenges of the FCA, as presented in the literature.

- **Benefits**

One of the most singled-out benefits of the flipped classroom is that it provides for students to acquire a new concept in their own time and at their own pace (out-of-class), while support by the lecturer is still provided when they apply their knowledge in class (Abeysekera & Dawson, 2015; Bergmann & Sams, 2014; Tucker, 2012). Video content that is accessible online allows for content to be revised at any time (Stanciu, 2016) and it provides opportunities for learners who learn at varying speed (Rutkowski & Moscinska, 2013). Ray and Powell (2014) recommend the FCA as a means to equip student-teachers in developing as technology users and educators (Strycker, 2017), which is crucial for the 21st century.

The value of collaborative learning in groups during in-class activities is regarded as one of the main benefits of the FCA (Rutkowski & Moscinska, 2013; Tiahrt & Porter, 2016). Should the flipped classroom model employ online learning platforms, the approach may also provide opportunity for immediate feedback to students (Darling-Hammond et al., 2020), that is also emphasised by Thai et al. (2017).

The FCA has the potential to enhance student-teachers' teaching practice in the 21st century (Kurt, 2017). Ray and Powell (2014) assert that making use of this modern instructional method, the FCA, as part of teacher preparation programmes has the potential to engage students' natural curiosity and to increase their interest in teaching. These values of the FCA also indicate support for intrinsic motivation that will in turn support SDL and lifelong learning (Bolhuis, 2003), as well as metacognition (Zimmerman & Kitsantas, 2005). Han and Yin (2016) also suggest that increased motivation increases the tendency to apply self-assessment which relates to metacognition.

Van Vliet et al. (2015) report a positive relationship between flipped-classroom pedagogy and metacognition through increased critical thinking, task value, and peer learning. However, to ensure sustained metacognitive behaviour, such a learner or student-centred approach should be implemented on a regular basis.

An extensive review on the advantages and challenges in an FCA was done by Akçayır and Akçayır (2018) and results showed the most common benefits were that of improved learning

performance, student satisfaction, the flexible nature of the flipped classroom and more efficient use of class time. One possible reason for student satisfaction as found by Hao (2016) is that students appreciate student-centredness of the FCA. Akçayır and Akçayır (2018) also reported on some of the challenges experienced.

- **Challenges**

Challenges in the use of the FCA also surfaced in the literature. According to Akçayır and Akçayır (2018), most of the challenges are related to out-of-class activities. A major challenge reported is the completion of student pre-class work and the time-consuming nature of creating pre-recording video lectures and preparing other flipped classroom material (Akçayır & Akçayır, 2018; McLean, 2016). Further challenges or even possible explanations for the aforementioned challenges in an FCA are those of technical and technological challenges, including the development of high quality out-of-class materials, technology inaccessibility, and a lack of digital literacy (Akçayır & Akçayır, 2018).

Apart from studies that showed no significant difference in student performance between flipped classroom and traditional classrooms (Davies et al., 2013; Lape & Levy, 2014; Strayer, 2012), researchers such as Kim et al. (2014) and Tanner and Scott (2015) found that students often had trouble with self-regulation and working collaboratively with peers during problem-solving activities in a flipped classroom environment. Hao (2014) investigated motivation in an FCA and discovered that students who were already motivated and had more self-regulation skills, were generally more satisfied with the FCA. Lape and Levy (2014) investigated learning outcomes of undergraduate engineering and mathematics students and, although their research findings indicated that students in a flipped classroom experiment scored significantly higher on some of the measures of knowledge transfer compared to students in a traditional classroom, their results on general metacognitive gain showed no difference between the flipped and the traditional groups. These authors ascribe the possible reason for the lack of metacognitive gains through the FCA to the traditional group also having access to the flipped material and that the two groups were maybe not distinct enough to measure a significant difference. These authors suggest modifications to their design of the flipped classroom to include reflective questions after video content to serve as focus of the next in-class session to improve metacognitive gains (Lape & Levy, 2014). On the contrary, research findings by Strayer (2012) indicate that students in a flipped classroom became more aware of their own learning process, which implies metacognitive gains.

Considering the strong support in the literature for the FCA, contradictory findings regarding the way the FCA supports metacognition raises questions regarding the specific prerequisites

for the successful implementation of the flipped classroom. The FCA should thus be implemented against the background of these benefits and challenges. From the literature it is clear that it is not the FCA itself but the way in which it is implemented that determines the successful learning in a flipped classroom, serving as motivation for the study to investigate how the FCA should be implemented to support metacognitive gains.

2.7 Conclusion

In this chapter, literature was perused to determine what the body of scholarship indicates with respect to design features of an FCA aiming to foster metacognition as a 21st century skill in student-teachers in their learning of mathematics. I started out by exploring the literature on aspects related to mathematics teacher preparation, including teachers' knowledge and beliefs concerning mathematics education. The literature confirms the relationship between the teacher's subject knowledge, pedagogical knowledge, knowledge of technology and metacognition, as well as the teacher's beliefs about mathematics teaching and learning and own competence, which are determinants of the way teaching and learning approaches, including the FCA, will be implemented.

As background to the focus on the FCA, constructivism as an underpinning for meaningful mathematics education in the 21st century was extrapolated from the literature. Even though existing critiques that constructivist principles are not implemented without challenges is acknowledged, strong support was found in the literature for the value of constructivism in context of mathematics education, and the learning gains as a result, makes the approach worth considering and investing in. The need for mathematics teachers who are equipped with the required 21st century skills, with metacognition identified as a critical skill, motivated an in-depth investigation into the way the literature reports on these skills in context of teacher education and specifically mathematics teacher preparation. Metacognition as a 21st century skill was further investigated by looking into the meaning of metacognitive skills, how to teach for metacognitive development and how educators can assess metacognition to support this core skill in their learning of mathematics. Finally, literature on the FCA was explored to identify the main design principles and strategies, the role of the educator, and activities to be considered for both the in-class and out-of-class components.

The potential of the FCA to foster metacognition within student-teachers in a conducive learning environment is apparent from the literature and both benefits and challenges reported in related literature were declared. The literature served as grounding for a case study implemented in a BEd programme for mathematics student-teachers offered by a South African HEI, to determine how an FCA should be designed to foster metacognitive gains with

mathematics student-teachers in preparation for practice in the 21st century. The background and methodology of this case study is explicated in detail in Chapter 3.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

In Chapter 1, the background and rationale for this research, grounded in the relevant literature, was motivated. Also, the aims and objectives as well as the research questions driving this study were discussed. The investigation was guided by answering the main research question as well as the secondary research questions:

> *How should a flipped-classroom approach be implemented for metacognitive gains to prepare mathematics student-teachers for the 21st century?*

The secondary research questions informed the research objectives:

1. *What does the body of scholarship indicate with respect to design features of a flipped-classroom approach aiming to foster metacognition as a 21st century skill in student-teachers in their learning of mathematics?*

2. *How do student-teachers and the lecturer experience the implementation of the flipped-classroom approach that aims to foster metacognition?*

3. *How can the flipped-classroom design be revised to improve support for metacognition?*

4. *To what extent do findings from the literature and the empirical study explicate critical elements that are required to be accommodated in a flipped-classroom approach to foster mathematics student-teachers' metacognition as preparation for teaching in the 21st century?*

The strong support found in the body of scholarship for the value of the FCA to support metacognitive skills was reported in Chapter 2 and served as grounding for the empirical investigation into the FCA with a specific focus on how an FCA should be designed to foster metacognition within mathematics student-teachers and thus prepare them as 21st century teachers. This chapter sets out the research methodology of the investigation to determine how an FCA should be designed to foster metacognition within student-teachers. I begin by explaining the research methodology with an in-depth exploration of the research design, motivated by the research paradigm, selecting the research participants and methods incorporated to collect data for the empirical investigation to answer the research questions. I then describe the methods of data analyses, ensuring the study's trustworthiness and consideration given to the ethical aspects of the research process.

3.2 Research design

This study follows a qualitative approach concerning participants' experiences of how the FCA for the teaching and learning of mathematics in the BEd programme, fosters the development of student-teachers' metacognitive skills. According to McMillan and Schumacher (2014), a qualitative approach contributes significantly to theory and practice, and the design can vary, depending on the theoretical framework. A qualitative approach was considered both appropriate and valuable to uncover the holistic reality of the participants' lived experiences (Merriam & Tisdell, 2016).

How the FCA design features foster metacognition was explored employing DBR. The study is regarded as a case study based on the premise that the participants are all bounded by the same contextual and institutional framework (Cohen et al., 2007). As described by McMillan and Schumacher (2014, p. 370), "bounded" means "to be unique according to time, place and participant characteristics". The case study involved two lecturers and students of a higher education institution associated with the Mathematics module for which the FCA was being implemented. One lecturer participant taught the Mathematics module two years prior to the data collection process (motivated in §3.4). The second lecturer participant who is the current lecturer for this Mathematics module, started teaching the module a year before this study was conducted when she also implemented the FCA for the teaching and learning of this module for the first time. The current lecturer planned to improve her flipped classroom strategies, serving as opportunity for participation in the DBR process. All student participants were enrolled for the Mathematics module in the year the data were collected. Thus, the case study is bounded by the institution, context, and time (McMillan & Schumacher, 2014). All participants are affiliated with the same university and registered for the same Mathematics module in one specific academic year.

DBR is defined by Wang and Hannafin (2005) as a flexible methodology (design, implementation, and iterative analysis), where researchers and experts work collaboratively to develop design principles to improve educational practices. Herrington et al. (2007) advocate for DBR and regard it as a useful model supporting the improvement of teaching and learning through technology. The authors claim that the aforementioned can be accomplished since design principles developed using DBR provide solutions to everyday problems. Hence, DBR can provide solutions to real problems experienced in teaching and learning mathematics in a specific context. Herrington et al. (2007) further surmise that the purpose of DBR is not to find reasons to blame or critique current design but to collaborate to improve design principles to transform education for the benefit of all.

The realisation of the two principal outputs of DBR, namely design principles and interventions underpinned by empirical findings (Pool & Laubscher, 2016), can only be accomplished if preliminary research, design development and design assessment is in place (Plomp, 2013). This view strengthens the case for DBR to investigate FCA design features as an innovative intervention to support students in developing metacognitive skills. According to Cobb et al. (2003), improving an initial design by testing and considering ongoing analysis of participants' experience, is a main goal for DBR. Cobb et al. (2003) further state that the size of the research team and the members' expertise vary depending on the type and purpose of the investigation and that it might be feasible for a single researcher to carry out one-on-one design research. Pool and Laubscher (2016) argue that DBR is not restricted to long term investigations and that shorter studies have the potential to produce effective design principles, bearing in mind that appropriate phases of DBR are followed. The DBR process is elucidated in detail in §3.6. Understanding the study within the context of my view of how the social world should be investigated requires an explication of the study's philosophical orientation.

3.3 Philosophical orientation

A paradigm represents a worldview and consists of our fundamental beliefs about the world and one's relationship to this world (Guba & Lincoln, 1994). A paradigm influences a researcher's perspective of ontology (what is real), epistemology (how you come to know something), and methodology (research design and methods) (Guba, 1990). A constructivist-interpretivist paradigm guided this study.

In line with an interpretivist constructivist paradigm, a subjectivist epistemology lead me to make sense of the data through my cognitive processes that were informed by interacting with participants; I acknowledged my own possible bias based on the fact that the environment had multiple possible realities (relativist ontology). To avoid researcher bias based on my own previously held assumptions and views of teaching and learning issues, I looked meticulously at the data to ensure that my findings are informed by the realities reflected by the participants' lived experiences (Cohen et al., 2007; Mack, 2010). The naturalist methodology that used interviews and discussions to collect the data enabled me to answer the research questions and to focus on what participants said and did (Creswell, 2007; Kivunja & Kuyini, 2017).

Therefore, the goal was to rely as much as was feasible on the participants' views of the situation and interpret what they see, hear, and understand, and that is also connected to their background and prior understandings (Creswell, 2007). Furthermore, in this paradigm, the researcher is not an objective outsider, and I made every effort to understand the phenomenon from within (Cohen et al., 2007). For this reason, while the study aims to foster metacognitive

skills of student-teachers of a specific higher institution, it was essential to interpret student-teachers' experiences of how FCA design features support them in developing metacognitive skills in light of their specific backgrounds, prior knowledge, and learning needs. Also, the experiences of the lecturer participant who implemented the FCA design should be considered, since she had first-hand experience of the FCA design principles and its potential to foster metacognition.

Considering that metacognition is an implicit personal process that is not explicitly observable, as is valid for a realist ontology (Guba & Lincoln, 1994), it would be challenging to investigate metacognitive gains through a quantitative design. Therefore, a relativist ontology was appropriate to investigate this problem since knowledge comes to light through individual interpretation (Lincoln & Guba, 1985). I accept that bias and previous experience might influence interpretations of the data since participants also have different interpretations of their learning and metacognitive skills development. I aimed to construct meaning from hearing participants' interpretations and my interpretation based on their views and/or experiences.

In the next section, the selection of the participants for the study is explained and motivated.

3.4 Participant selection

In qualitative studies, participants who are influenced by the research problem under investigation and that relate to the study's purpose need to be identified (Herrington et al., 2007). The previous lecturer of the Mathematics module was selected as an information-rich participant to provide valuable information about her experience teaching the content of this module and her input regarding designing an FCA for metacognitive gains for this module. Herrington et al. (2007) also emphasises that an important first step in DBR in education is to consult experts. Considering that the current lecturer only took responsibility for the teaching of this Mathematics module the year before, it was deemed necessary to first gain information from the previous lecturer who had more prior experience of teaching this module. Therefore, collecting data from the previous lecturer contributed towards the analysis and exploration of the problem as the first phase in the DBR.

The lecturer currently responsible for the Mathematics module implemented the FCA the previous year and indicated a keenness to improve her own FCA. She was therefore approached to participate voluntary in the DBR. She also provided access to valuable data about her previous experience of implementing the FCA during the previous semester teaching this module and the potential of the design to foster metacognition within students.

Furthermore, her input on planning and implementing FCA principles during the DBR process provided access to her lived experiences of the meaningfulness of the FCA design principles in supporting teaching and learning outcomes and her interpretation of students' experience of the FCA.

The study population included BEd (Further Education and Training Phase), full-time first-year students registered for the Mathematics module. After an independent person, who had no connection to the study, explained the research aims to the whole class and invited them to participate (§1.8.2; §3.4; §3.9), twenty-five students indicated that they were interested in participating in the research and provided their contact details.

Purposeful sampling was initially planned based on the possibility this method holds, to include diverse student-teachers from the study population who have different viewpoints about an issue at hand (Creswell, 2007). Therefore, this method was viewed as appropriate to select student-participants that vary in age, gender, and/or race to get diverse perspectives on the FCA design features with the potential to foster metacognition. The twenty-five students were contacted via email to verify their willingness to be considered for the investigation. Of the twenty-five students, through purposeful sampling, a diverse group of students would then be selected. However, only twelve students replied to the email indicating that they volunteered to participate in the study and were willing to provide informed written consent. Therefore, the focus-group interview sample consisted of twelve students from the study population who were willing to take part and who granted informed consent to participate. These twelve students were relatively homogeneous in terms of language, age group, and gender. Therefore, the eventual sampling rather resembles convenience sampling. Convenience sampling relies on participants who are willing to participate and meet further criteria such as availability, accessibility, and physical proximity (Etikan et al., 2016). This sampling method is also deemed appropriate based on the statement by Cobb et al. (2016, p. 23) that during DBR, generalisability does not lie in the sampling but rather based on "a process-oriented explanation of a single case". A representative sample was thus not required for this DBR that focussed on exploring guidelines for implementing an FCA for metacognitive gains for this Mathematics module.

I acknowledge that a diverse student-teacher study population could have contributed by acknowledging different viewpoints about the issue at hand (Creswell, 2007). However, in a case study the input, experience, and views of the student-participants, even if homogenous, contribute towards finding an answer to the problem within the specific educational context. This is supported by McMillan and Schumacher (2014), who profess that although a diverse sample holds benefits, it is preferred that participants in a focus group are homogenous in

traits since students are more likely to encourage each other to better reflect on the topic of discussion if they have shared characteristics. For the focus-group interviews, the willing student-participants were then divided into two focus groups. Instead of having one focus group with all participants, I opted for two separate focus groups to provide the opportunity to hear all student voices that could possibly have been a challenge in a larger group. The methods of collecting data are described in the next section.

3.5 Methods of data collection

Qualitative methods within the DBR process allowed for flexibility and an in-depth understanding of the FCA design implementation (Punch, 2014) (§1.8.4). The data collected for this research were readily available since the lecturer responsible for the module implemented the FCA on her own accord and was also interested in the way the approach benefits students' learning. Creswell (2007) emphasises the need to be sensitive to the people and spaces under investigation while collecting data in a qualitative research approach. Data were collected through semi-structured interviews, focus-group interviews, as well as lecturer and researcher journals (Table 3.1) (§1.8.3; §1.8.4). Appendix B provides the date and time of all data collected. Instruments for data collection in this qualitative case study were developed by myself, which allowed me to collect data to answer the research questions (Creswell, 2007).

3.5.1 Semi-structured interviews

In qualitative research, open-ended questions are used in semi-structured interviews to collect data on more intangible aspects such as assumptions, beliefs and experiences (Cohen et al., 2007). For the semi-structured interviews, an interview protocol with open-ended questions (Appendix E) was developed to collect data on aspects related to the research questions for this study. The flexibility of semi-structured interviews allowed for the elaboration and probing of important emerging information that may not have been anticipated before the FCA implementation (Gill et al., 2008).

A semi-structured interview was conducted with the previous lecturer of the module to collect data and gain access to her reflections about the Mathematics module, the students, and the FCA's potential to foster metacognition. A once-off semi-structured interview with the former lecturer of the specific Mathematics module served as a benchmark for the DBR and to gain better insight into the problem being studied. This was an important part of the analysis and exploration phases of the DBR and provided me the opportunity to collect valuable data from her (§3.4) as a practitioner working in the field under investigation. Data focussed on her

expertise concerning knowledge of the module content and the challenges in its teaching and learning, her insight into the student population, including her experience concerning student metacognition and SDL skills, and possible suggestions for solutions to problems encountered by herself and students during the teaching and learning situation.

Three semi-structured interviews with the current lecturer served as opportunity to collect data about her previous experiences implementing the FCA, for collaborative deliberation with her on the planned FCA design (Herrington et al., 2007) and to gain insight into the potential of the FCA design to foster metacognition within student-teachers, based on her lived experiences. The first interview focused on her experiences with the previous FCA implementation and then considered and discussed how the FCA would be implemented during the duration of this study. The second interview, conducted after meso-cycle 1 (Figure 3.1), was threefold: to mediate reflection by the lecturer on her experience of the FCA implementation, the way she perceived student experiences of the FCA thus far, and to consider and discuss how the FCA design can be improved upon for implementation in the second cycle. After completing the DBR, a third semi-structured interview was conducted with the lecturer to collaboratively reflect on her experience of the revised FCA design and her thoughts on how the design can be improved further to better support students in developing metacognitive skills. All semi-structured interviews were voice-recorded and transcribed. Pseudonyms were used to keep the identities of the participants confidential.

3.5.2 Focus-group interviews

A focus-group interview is where the researcher works with several people, a qualitative sampled group, at the same time, and it can be used in different stages of the research to obtain a better understanding of the investigation and findings (Coghlan & Brydon-Miller, 2014). For this study, there were two focus groups. The students were grouped into two focus groups based on their availability due to their class timetables, with eight participants in Focus group 1 and four participants in Focus group 2 (§3.4). All interviews lasted approximately 45 minutes. Limitations related to focus-group interviews is that students may try to portray themselves positively or they may not share their true feelings (Coghlan & Brydon-Miller, 2014). Therefore, the focus-group interviews were planned and executed with care to minimise participants' discomfort and enrich the data (Merriam & Tisdell, 2016; Nieuwenhuis, 2007). It was explained that honest sharing of their experiences would contribute to improving future FCA design principles to suit the students' specific learning context. The focus-group interviews were scheduled according to the students' timetable to ensure that everyone could attend during times that they were already on campus, to be respectful of their time. Both good questions and attentive listening are essential for case study researchers to lessen researcher

bias (Yin, 2014). For focus-group interviews, open-ended questions (Appendix E) that focused on answering the research questions were used (Creswell, 2007), focusing on fluency rather than rigidity. All focus-group interviews were voice-recorded and transcribed, and pseudonyms were used to keep the participants' identities confidential. Furthermore, students were ensured that the discussions would be kept confidential and that identification would be removed before sharing the data with the supervisors and before reporting the findings. Biographical information was collected from all participants since this had to be considered in interpreting data where aspects such as diverse student-teacher background and prior knowledge were acknowledged.

3.5.3 Lecturer journal

The journal kept by the lecturer is a document that reflects her views and observations (Merriam & Tisdell, 2016) (§1.8.3). Thorpe (2004) advocates that reflective journals can be used to inform and improve teaching practice. Considering this, the journal was therefore kept by the current lecturer-participant to document her thoughts and for me as researcher, to gain access to the lecturers' lived experiences. The journal serves as valuable data as the lecturer reflects upon her experiences and her perception of student-participants' experiences of the FCA to foster metacognition to inform and improve teaching practice. For the study, the lecturer was provided with some reflective prompts (Appendix E) that she could use to reflect upon the implemented design, her experiences, and her perceptions of the way student participants experience the FCA, based on her observations of their actions during in-class and out-of-class activities.

3.5.4 Researcher journal

The researcher journal is a diary where the researcher makes frequent entries as the research unfolds (Amankwaa, 2016) and is methodically accepted in the constructivist-interpretivist paradigm (Denzin, 1994). In these entries, the researcher accounts for the logistics of the study, decisions being made and why, as well as personal reflections (Amankwaa, 2016). Apart from its value to increase trustworthiness in qualitative research (Ortlipp, 2008) (§3.8), a researcher journal also provides a way to acknowledge the interaction of objective and subjective features openly and to incorporate them into a productive relationship (Newbury, 2001). Newbury (2001) describes the researcher journal as a combination of thoughts, prior experience and observations. As the researcher, my journal enabled me to "make my experiences, opinions, thoughts, and feelings visible and an acknowledged part of the research design, data generation, analysis, and interpretation process", according to Ortlipp, (2008, p. 703).

In the following section, a detailed description of how the DBR was implemented is explained.

3.6 Explaining design-based research for this study

The research specifically implemented DBR to investigate and understand how the FCA could support metacognition in the actual teaching and learning setting. As stated by Feng and Hannafin (2005, p. 15), “design-based research implementations need to be both purposeful and systemic”. DBR studies typically have two or more cycles, where changes are made to the learning environment to promote improvement to address the problem after the initial implementation and evaluation (Herrington et al., 2007). The DBR model, as suggested by McKenney and Reeves (2012), was implemented to determine how an FCA should be designed to foster metacognition in mathematics student-teachers.

Figure 3.1 below illustrates the cyclic nature of the DBR and provides a visual illustration. The whole DBR process formed a macro-cycle (Pool & Laubscher, 2016) that focused on answering the primary research question:

> *How should a flipped-classroom approach be implemented for metacognitive gains to prepare mathematics student-teachers for the 21st century?*

In most educational DBR, a macro-cycle involves various meso-cycles, and meso-cycles consist of micro-cycles (McKenney & Reeves, 2012), as shown below in Figure 3.1:

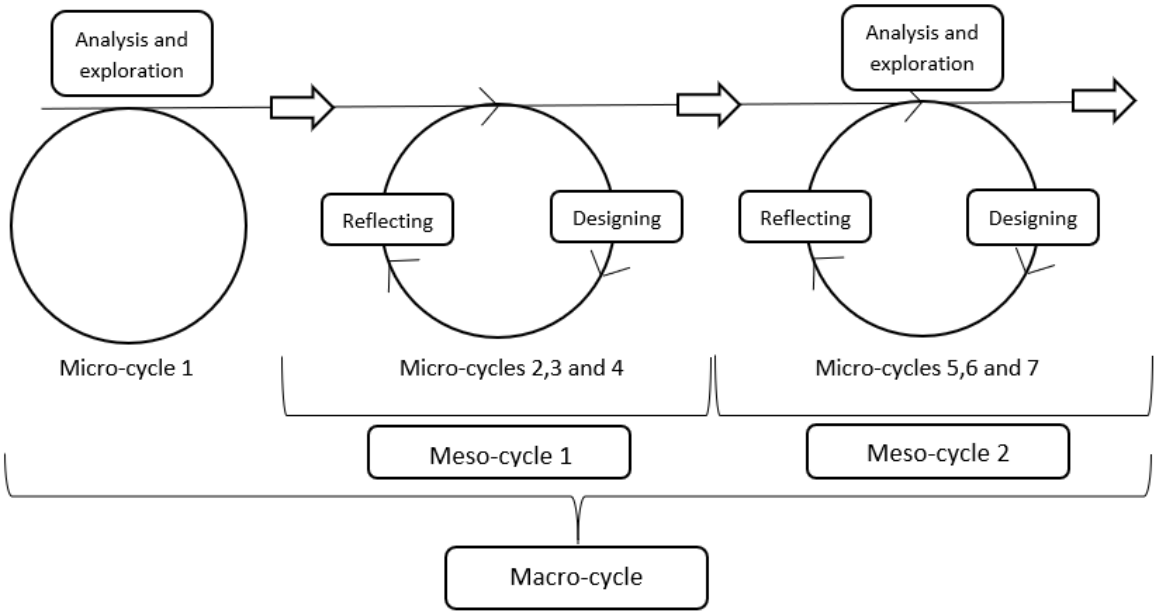


Figure 4.1 **A visual representation of the cyclic nature of the DBR adapted from McKenney and Reeves (2012, p. 78).**

Figure 3.1 illustrates how each meso-cycle has an input (a design based on theory and experience) and an output (reflecting on how the design met the aims and how it can be improved). In accordance with Table 3.1, the three core phases were implemented, namely analysis and exploration, designing and constructing, and evaluation and reflection. Each new cycle has to consider the findings of the previous cycles (Plomp, 2013). Table 3.1 illustrates how the DBR principles suggested by McKenney and Reeves (2012) were applied in this study and includes micro-cycle and the data sources (§3.5) that informed each micro-cycle, as well as the micro-cycles involved in each meso-cycle:

Table 3.1 **DBR application showing data sources per micro-cycle.**

Macro-cycle							Guidelines: Design principles
	Meso-cycle 1			Meso-cycle 2			
Micro-cycle 1	Micro-cycle 2	Micro-cycle 3	Micro-cycle 4	Micro-cycle 5	Micro-cycle 6	Micro-cycle 7	
Analysis and exploration	Designing and constructing	Evaluation and reflection	Analysis and exploration	Designing and constructing	Evaluation and reflection	Analysis and exploration	
Data sources				Data sources			
Semi-structured interview with the previous lecturer	Semi-structured interview current lecturer / Collaborating with the lecturer on design principles	Focus-group interviews	Content analysis	Semi-structured interview current lecturer / Collaborating with the lecturer on design principles	Focus-group interviews	Content analysis	
Journals kept by the lecturer and the researcher							

Table 3.1 illustrates that both the researcher and lecturer journals span over the whole macro-cycle and are not limited as data sources to any of the micro-cycles. The researcher journal holds reflections, as suggested by Cohen et al. (2007), on possible problems, reactions of participants and points of clarification throughout the research process. Therefore, the data from journals are integrated into all micro-cycles. The following explanation of each micro-cycle aims and requirements emphasise how each micro-cycle supported the research process in search of answering the main research question as the essential purpose of the macro-cycle.

3.6.1 Micro-cycle 1 (analysis and exploration)

This micro-cycle is not viewed as part of meso-cycle 1 (§1.8.4.1; §4.4.1), but rather served to analyse and explore the problem by gaining information about the specific Mathematics module, the student population, challenges concerning student metacognition and SDL skills, and possible suggestions to support the development of these skills within the students. The need to foster metacognition within mathematics student-teachers is a practical problem relating to preparing students-teachers as self-directed, reflective teachers with metacognitive skills equipped for the 21st century who are able to make a difference in the poor standard of mathematics in South African schools (Taylor, 2008) (§1.1; §1.3; §2.2.4). Therefore, at the outset of data collection, a semi-structured interview with the previous lecturer of the Mathematics module was conducted (§3.5.1). The interview allowed me to consider her expertise and insight into the topic being investigated (Cobb et al., 2003). The data collected provided me with the necessary background knowledge for meaningful analyses and exploration of the problem.

3.6.2 Meso-cycle 1

As shown in Figure 3.1, meso-cycle 1 consisted out of micro-cycles 2, 3, and 4. The aim of meso-cycle 1 was to implement the FCA design, collect data and analyse the data with a specific focus on how the FCA design features hold the potential to foster metacognition in student-teachers. How this aim is achieved is clarified in this section.

- **Micro-cycle 2 (designing and constructing)**

The purpose of this micro-cycle was to collaborate with the current lecturer on the designing and constructing of the FCA design features (§2.6.2) and therefore involved a semi-structured interview with her before the implementation of the FCA, since DBR requires research objectives between the researcher and the educator (Amiel & Reeves, 2008). The Mathematics module is a semester module, and the data were collected in the lecturer's second year teaching this module.

During the interview, the lecturer first reflected on her lived experiences of implementing the FCA in the previous year and its potential to foster metacognition. Plomp (2013) outlines that the purpose of the DBR is to assess and improve the initial design based on understanding how it works. Therefore, as grounding for the designing and constructing phase, this interview also informed the analysis and exploration of the problem and the data collected in micro-cycle 1. Based on her previous experience, we collaborated to design revised FCA strategies for the current year. The FCA design was implemented for four weeks before the first round

of focus-group interviews. Therefore, the data collected in micro-cycle 2 contributed to answering the main research question and secondary research questions 2 and 3 (§3.1).

- **Micro-cycle 3 (evaluation and reflection)**

The purpose of this micro-cycle was twofold, namely, to evaluate and reflect on the implemented design features of the FCA. Data focussed on student participants' lived experiences of the implemented approach and how it could be improved. Data were collected through open-ended questions (Appendix E) in two planned focus-group interviews with the student-participants as well as through the lecturer and researcher journals. The two scheduled focus-group interviews conducted with the student participants involved eight student-participants in one group and four in the other (§3.4). In the researcher journal, I reflected on my observations during the FCA implementation and its potential to foster student-teachers' metacognition. These reflections, together with data collected through the focus-group interviews, contributed to new ideas for improving the FCA design, and it enhanced the way the approach for the teaching and learning of this Mathematics module fosters metacognition. Therefore, micro-cycle 3 provided further data that contributed to answering the main research question and secondary research questions 2 and 3 (§3.1).

- **Micro-cycle 4 (analysis and exploration)**

The aim of micro-cycle 4 was to perform content analysis (§3.7). All data collected through focus-group interviews, the semi-structured interview and the lecturer and researcher journal in meso-cycle 1 were transcribed, coded, and analysed. Data from micro-cycle 1 were also incorporated in this phase of analysis. As maintained by Tseng et al. (2016), during design interventions, DBR provides an overview that enables a researcher to determine why certain factors result in positive learning outcomes or not. Furthermore, Plomp (2013) concluded that empirical data is needed to understand the quality of the initial design to make improvements. Therefore, empirical data collected thus far guided the process of refining the FCA implementation design in support of metacognition and led to an understanding of the important determinants involved in implementing an FCA in support of metacognition. The analysed data from meso-cycle 1 were used to inform and revise the initial design implemented in meso-cycle 2.

3.6.3 Meso-cycle 2

As shown in Figure 3.1, meso-cycle 2 consists out of micro-cycles 5, 6 and 7. The aim of meso-cycle 2 was first to utilise analysed data from meso-cycle 1 to make improvements to the FCA design with the potential to support metacognition. Secondly, this meso-cycle aimed

to further collect and analyse empirical data to focus on the implementation of the revised FCA design. Findings of both meso-cycles eventually contributed to inform guidelines for an improved FCA design to foster metacognition in mathematics student-teachers.

- **Micro-cycle 5 (designing and constructing)**

Since DBR is cyclic, micro-cycle 5 is a second designing phase in the design process to improve upon the initial design, based on data analysis in micro-cycle 4. Refining the FCA design also required further exploration of the literature (Creswell, 2007) and determining if intermediate goals were met that might affect the final goals of the DBR (Feng & Hannafin, 2005). Similar to micro-cycle 2, the purpose of this micro-cycle was threefold: to reflect upon the lecturers' experience of the FCA implementation in the first meso-cycle, lecturer-perceived student experiences of the FCA thus far, and to discuss and collaborate on how the FCA design can be further improved upon for metacognitive gains. Lesson content was planned collaboratively with the lecturer, based on empirical findings from meso-cycle 1 and literature to inform the revising of the FCA's design to further support metacognitive gains in this meso-cycle (Herrington et al., 2007). Therefore, similar to data collected in micro-cycle 2, the data from this micro-cycle further contributed to answering the main research question and secondary research questions 2 and 3 (§3.1).

- **Micro-cycle 6 (evaluation and reflection):**

The purpose and data collection strategies of micro-cycle 6 concur with that of micro-cycle 3, when two focus-group interviews with the same two groups of student-participants, as explained for micro-cycle 3, were conducted. Again, data collected through focus-group interviews, the researcher journal as well as reflections by the lecturer as part of her journal regarding her observations, that formed part of this evaluation and reflection phase, contributed to new suggestions of improving the FCA design and its potential to foster metacognition for the Mathematics module. This micro-cycle provided additional data to answering secondary research questions 2 and 3 and subsequently the main research question (§3.1).

- **Micro-cycle 7 (analysis and exploration)**

All data collected in meso-cycle 2 through focus-group interviews, a semi-structured interview, and from the lecturer as well as researcher journal, were transcribed, coded, and analysed. Content analysis (§3.7) was again performed in micro-cycle 7. During this phase of data analysis, empirical data from meso-cycle 1 and meso-cycle 2 were considered to inform and

revise the FCA design for metacognitive gains and to further understand the important determinants involved in implementing an FCA in support of metacognition.

Finally, after retrospection on analysis of data collected from the macro cycle (Figure 3.1) and the last reflection interview with the lecturer (§3.5.1), findings were reported, and guidelines suggested (§5.2.2) on the implementation of an FCA for metacognitive gains to prepare mathematics student-teachers for the 21st century.

3.7 Methods of data analysis

Qualitative data analysis is the process of coding, sorting, and organising data to explain the study of interest (McMillan & Schumacher, 2014) and thereby condensing a significant amount of data to manageable and understandable proportions (Cohen et al., 2007). For this qualitative study, content analysis was used for data analysis. As further stated by Cohen et al. (2007), content analysis summarises the data and then reports the main findings. In agreement, Patton (2002) describes content analysis as a process where the researcher makes sense of the data and identifies key meanings by analysing copious amounts of data. All data collected through interviews were analysed within and across micro-cycles, and non-verbal cues, such as gestures or refraining from participating, were also captured (researcher journal, §3.5.4) and analysed. I asked probing questions of participants who showed non-verbal behaviour, to clarify whether they agree or disagree with other participants, and why or why not. I also paid attention not to show support or disapproval or project my views as suggested by Cohen et al. (2007).

Qualitative data collected through focus-group interviews with students, semi-structured interviews with the lecturer as well as the researcher and the lecturer's journal, were typed in Microsoft Word for inclusion into the combined qualitative data set in ATLAS.ti™ (version 8.0). ATLAS.ti™ is computer software that allows for in-depth, sophisticated qualitative data analysis (Friese, 2019). Toolsets of the program include coding tools, visualising tools and making connections between codes in meaningful ways. Merriam and Tisdell (2016, p. 199) describe coding as follows: “Coding is nothing more than assigning some sort of shorthand designation to various aspects of your data so that you can easily retrieve specific pieces of the data.” Coding is the ascription of a category label to a piece of data, either decided in advance or in response to the data collected (Cohen et al., 2007).

The combined approach of deductive and inductive coding was deemed appropriate since the study investigated a specific problem and wanted to be open to finding unexpected aspects of how the participants experience the FCA to foster metacognition (Gale et al., 2013). Also,

McKenney et al., (2006) suggest that both inductive and deductive coding can be applied for data analysis for the researcher to be better able to monitor the study's methodical nature. During the analysis of data, I used inductive coding and deductive coding to find patterns and/or themes, which is a common feature of qualitative data analysis (Creswell, 2007). The methodical search for patterns enabled me to interpret the phenomenon under study as suggested by Gale et al. (2013). Themes and categories emerging from the data were organised and compared to conclude how the data answers the research questions. Both thematic and deductive coding were used to analyse data. Thematic coding involved a balance of deductive coding, where themes and codes are derived based on perused literature to answer the research question, and inductive coding, where themes emerged from open coding of participants' discussions to make meaning of the data (Fereday & Muir-Cochrane, 2006).

Creswell (2007) confirms that computer programmes can help the researcher organise data and provide speedy access to data. The concept map feature enables the researcher to visualise relationships amongst codes and themes. The computer software (ATLAS.ti™) was used for deductive and inductive coding of transcribed qualitative data and for interpretation of any observed patterns, insights or concepts concerning how FCA design features can foster metacognition. Data were also used to scrutinise constraints in the design features and references to possible solutions to challenges that may hamper the development of student-teachers' metacognitive skills.

Data were analysed throughout the DBR and focused on identifying and refining FCA design principles with the potential to foster metacognition. Data were analysed concurrently with data collection and coding to improve the design (during meso-cycle 1) (Feng & Hannafin, 2005). After that, comparative analysis was done to compare data collected in meso-cycle 1 with data collected in meso-cycle 2 (Cobb et al., 2003). The comparative analysis led to a need to consult more of the literature as suggested for DBR (Creswell, 2007). As mentioned by Boeije (2002), a comparative analysis is supported in different ways, such as memo writing, reading and revisiting transcriptions, coding, and making use of visual displays. Memo writings can capture "your reflections, tentative themes, hunches, ideas, and things to pursue that are derived from this first set of data" (Merriam & Tisdell, 2016, p. 196). For this research, memo writing was captured as part of the researcher journal (§3.5.4). A holistic retrospective analysis was done after the DBR, focussing on all aspects of the study (Gravemeijer & Van Eerde, 2009). For the retrospective analysis, I considered the lecturer-participant's expertise to lessen researcher (single person) bias (Cobb et al., 2003), and this was done during the reflection interview with the lecturer participant after the DBR.

3.8 Trustworthiness

Trustworthiness is a critical component in the qualitative research process (Amankwaa, 2016). The trustworthiness of qualitative research is measured on the detailed descriptions of the reality of the context of the study, whereas quantitative research is more concerned with internal and external validity (Nieuwenhuis, 2007). Golafshani (2003) notes that in quantitative research, validity and reliability are dealt with separately, whereas, in qualitative research, trustworthiness encompasses both. As suggested by Sarma (2015) the trustworthiness, transparency, and subsequent dependability were enhanced by describing the sampling, data collection and methods for data analysis of the study in detail. I also strived to apply the following criteria suggested by Lincoln and Guba (1985):

- **Credibility**: the confidence that can be placed in the truth of the study findings. Triangulation was used to strengthen the conclusions and enrich the analysis and understanding (Berg, 2004). Qualitative methodological data triangulation was incorporated whereby data were collected through various methods and from multiple sources (Creswell, 2012), and captures a more holistic picture of the study (Jick, 1979). Data triangulation means using a single method but multiple sources of the method (Johnson, 1997). For this investigation, data were collected at different times and from different people as suggested by Denzin (1970). For within-method triangulation, various methods to collect data (§3.5) (Denzin, 1970) were employed. The different data collection methods provided different perspectives to the problem: semi-structured interviews with the lecturers (view of the designer and educator of the FCA); focus-group interviews with students (views of the partakers of the implemented FCA design); a lecturer journal to access the lecturer's thoughts as the process was unfolding; and the researcher journal to capture all aspects of the research process. The combination of the data collecting methods provided a deeper understanding of the data.

- **Transferability**: external validity is the extent to which findings can be generalised (Bless et al., 2013). A detailed description of the context and background was given (§3.4; §4.2.2) to allow comparisons to be made in similar contexts and possibly implement the guidelines in similar contexts. In a study where comparative analysis (§3.7) is used, it can strengthen external validity: "when the sampling has been conducted well in a reasonably homogeneous sample, there is a solid basis for generalising the concepts and the relations between them to units that were absent from the sample, but which represent the same phenomenon" (Boeije, 2002, p. 393).

- **Dependability**: this is a way of showing that if the study were to be duplicated within the same context, methods, and participants, that similar findings would emerge (Shenton, 2004). To support dependability, I kept a journal as audit trail[6] during the research process and recorded significant activities, including dates, time and thoughts as they occurred, that may be valuable for the research process, to support authenticity and consistency and provide other researchers the opportunity to duplicate the study in the same way. As stated by Halpren (1983) (as cited by Nowell, Norris, White, & Moules, 2017), an audit trail is created when the researcher keeps track of all raw data, transcripts and notes to create a system that eases the method of reporting on the study. As suggested by Anney (2014), the code-recode strategy was used and the data were coded more than once to see if the coding stayed consistent.

- **Confirmability**: According to Guba and Lincoln (1989), when the aims of credibility, transferability, and dependability are all reached, it means that confirmability is established. Application of within-method triangulation and data triangulation therefore also strengthened confirmability. In compliance with the constructivist-interpretivist paradigm (§3.3), it is acknowledged that the possibility exists of interpreting what I see, hear, and understand according to my prior understandings. However, I strived to keep my focus on understanding the phenomenon from within as well as gaining the participants' view and experience of the FCA implementation and its potential to foster metacognition, rather than the meaning that I, as researcher, bring to the research to avoid researcher bias (Creswell, 2007).

3.9 Ethical aspects of the research

Research ethics is “focused on the specific contexts of planning, conducting, communicating, and following up research” (Punch, 2014, p. 36), and particular ethical considerations emerge when people are studied (Yin, 2014). McKernan (1996) suggests that the researcher must be fair and honest throughout the whole research process. Cohen et al. (2007) highlight that adhering to routine required by the institution involved is not sufficient. As the researcher, I strived to abided by ethical practices during all phases of the research study.

Cohen et al. (2007) caution that a researcher cannot assume and expect access to an institution, in this case, a university, without adhering to its procedures and requirements. For this study, since human participants were involved, ethical clearance was required, and the

[6]A transparent description of the research steps taken from the start of a research project to the development and reporting of findings (Shenton, 2004).

process of the Research Ethics Committee of the Faculty of Education of the NWU was followed. An ethical clearance certificate (NWU-00630-17-A2) was issued and the study adhered to the NWU guidelines.

Permission to approach student-participants enrolled at the higher education institution was attained from the gatekeeper of the institution. In the research setting, gatekeepers are those who have the power and authority to grant or deny access to the researcher to a set population, usually considered vulnerable (Bound, 2012). Within this specific educational context, students may be regarded as vulnerable; therefore, the gatekeeper had to give permission before participants were approached (Bless et al., 2013). Therefore, permission to do the research was sought from the North-West University's Research Data Gatekeeping Committee (Appendix C) as well as the Faculty of Education's Executive Dean (Appendix C). There were no known risks associated with this study, and the project commenced only after ethical approval was obtained.

For the recruitment of participants, the aims of the research and what was to be expected of the prospective participants were explained by an independent person, disclosing any possible risks. Students had the opportunity to ask questions after they were provided with the information about the study. After that, all participants signed a written informed consent form stating that they understand the study's aims and agree to participate (Creswell, 2012). For this study, there were three separate consent forms: a consent form for student-teachers that partook in focus-group interviews, a form to obtain consent from the current lecturer responsible for the delivery of the Mathematics module, and a consent form for the previous lecturer of the Mathematics module (Appendix D). All participants were informed that they may terminate participation in this study at any time they request (McMillan & Schumacher, 2014). They were also told that participation was voluntary and that they could withdraw at any point during the study. Also, participants were not compelled or coerced to participate and the investigation in no way affected students' marks for the involved Mathematics module.

Considering a person's right to privacy, participants had the right not to answer a question if they did not wish to do so (Cohen et al., 2007). Anonymity implies no connection between the participant and the collected data (McMillan & Schumacher, 2014). While the use of interviews does not allow for anonymity, confidentiality was ensured concerning data reporting. Even though the study was considered low risk for participants, all data were handled confidentially and the privacy of the participants was respected. In other words, the participants were ensured that all collected data and information would only be used for this research study. For all collected data, when referring to participants' statements and responses, pseudonyms and codes were used when reporting the findings. If the participants used names during focus-

group interviews, names were replaced with pseudonyms to ensure confidentiality. This means that only the researcher has access to the names that are connected to the data. The current lecturer-participant had committed herself to the FCA's successful implementation and advancement for the specific Mathematics module, and therefore had a personal interest in exploring ways to improve FCA design principles. Data in the form of transcriptions of focus-group interviews, transcriptions of semi-structured interviews with the lecturer participants, and journals of both the researcher and the lecturer participant will be stored safely by the supervisor for seven years.

Participants did not receive any compensation for participation in this study. However, Herrington et al. (2007) opine that a benefit of DBR is that it enhances the professional development of all involved. Therefore, student-teachers who participated in focus-group interviews will also benefit from participating as members of a community of practice (Shulman & Shulman, 2004).

3.10 Conclusion

For the investigation, the impetus for the DBR was to investigate how an FCA should be designed for metacognitive gains to prepare mathematics student-teachers for 21st century teaching. In this chapter, the research methodology, grounded in the research paradigm and its execution have been explained and motivated. The chapter provided a detailed description of the participant selection and data collection methods as well as methods of data analysis. The DBR process and methods to ensure trustworthiness and ethical consideration for the study, were also explained. Chapter 4 reports on the analyses of all data collected in each of the DBR cycles explained in Chapter 3, focusing on the potential of the FCA to foster metacognition in mathematics student-teachers to prepare them for the 21st century.

CHAPTER 4: DATA ANALYSIS AND FINDINGS

4.1 Introduction

As orientation to the study, Chapter 1 stated the research problem and questions that directed the aim and objectives, with focus on the way an FCA should be implemented in a mathematics teacher education programme to support metacognitive gains. The body of scholarship reported in Chapter 2 strongly supports the value of the FCA and the role of metacognition as a 21st century skill in mathematics education (§2.6), that consequently supports the self-directed learning (§2.4.2). In Chapter 3, the research design that was implemented to find answers to the research question was explained, methods used to collect and analyse data were described, and the process of ensuring trustworthiness throughout the study was motivated. This chapter gives a detailed account of the data analysis and findings of the planned research described in Chapter 3 and sets out to find answers to the research question:

> *How should a flipped-classroom approach be implemented for metacognitive gains to prepare mathematics student-teachers for the 21st century?*

The following secondary questions directed the investigation:

1. *What does the body of scholarship indicate with respect to design features of a flipped-classroom approach aiming to foster metacognition as a 21st century skill in student-teachers in their learning of mathematics?*
2. *How do student-teachers and the lecturer experience the implementation of the flipped-classroom approach that aim to foster metacognition?*
3. *How can the flipped-classroom design be revised to improve support for metacognition?*
4. *To what extent do findings from the literature and the empirical study explicate critical elements that are required to be accommodated in a flipped-classroom approach to foster mathematics student-teachers' metacognition as preparation for teaching in the 21st century?*

The first secondary research question was answered in Chapter 2 that reported on the exploration of the body of scholarship for evidence of the potential of the FCA design to foster metacognition in student-teachers and specifically in this mathematics education context. Chapter 4 sets out to report the analyses of the data collected from the participants through the DBR cycles to answer sub-questions two and three. Chapter 5 specifically sets out to

answer sub-question four, where findings from the DBR and the body of scholarship reported in Chapter 2 together inform suggested critical elements be accommodated in an FCA for the learning of mathematics to foster student-teachers' metacognition. In Chapter 5, these vital elements are thus summarised and presented as guidelines for implementing an FCA for metacognitive gains to prepare mathematics student-teachers for the 21st century.

This chapter reports on the way the original data were categorised into meaningful themes to permit a holistic examination of the data and the consequent interpretation of its meaning. Firstly, the participant profile derived from the data is described, whereafter the themes, categories, and codes that emerged during the data collection and analysis are explained. Lastly, the analysis of the data and the findings, based on data collected through the DBR cycles are reported.

4.2 Participant profiles

Information on the profile of participants informs the interpretation of data and can suggest "relationships, potential direct (or indirect) causal chains, and pieces of the puzzle that may be missing" (Suter, 2012, p. 358). Therefore, data on the participants' background collected during individual semi-structured interviews and focus-group discussions (§3.4) were coded, analysed, and reported as contextualising of the discussion of the data with a focus on the FCA. Also, pseudonyms are used when referring to all participants.

4.2.1 Lecturer-participants

As explained in §3.4, the study participants consisted of the previous lecturer of the Mathematics module (pseudonym, Sarah), the current lecturer of the Mathematics module (pseudonym, Petra), and students enrolled for the Mathematics module during the second semester of 2018. Petra took over recently, and therefore some information was needed from Sarah, who was responsible for the module for some time. Information gathered from Sarah focussed on her teaching approach used for the specific content and her experience of what worked and what did not work. Sarah's background knowledge was deemed important for the meaningful interpretation of later findings on the FCA implementation. Sarah taught mathematics at various high schools for 11 years. She had been a lecturer at this specific higher educational institution for 19 years, and one of her research focus areas is metacognition for SDL. During the interview with Sarah (§4.4.1), it became apparent that she had some knowledge of the FCA and implemented principles of a flipped classroom while presenting this module. She referred to active learning, group-learning, and students taking responsibility for their learning – three key elements in an FCA.

Petra, who is the current lecturer responsible for the Mathematics module, is an experienced teacher. She taught high school mathematics for 20 years, after which she took a position at this higher educational institution. For the last 15 years, she was responsible for mathematics modules within various teacher education programmes offered by this higher educational institution, including the Mathematics module for which the FCA was implemented. Petra has also been responsible for mathematics modules within distance learning professional development programmes for teachers offered by this higher education institution. Since 1994 various provincial departments of education enrolled thousands of under- or unqualified teachers for these programmes to improve the standard of education in South Africa. During the initial interview, Petra acknowledged that she was not well versed in the use of the LMS (eFundi) since this technology was not implemented for the distance learning programmes she was involved with before taking up this module (Appendix F, MC 2, line 152-155). She also acknowledged that she did not have an in-depth knowledge of the FCA. After being invited to be a participant in this study, she started implementing some FCA principles for this Mathematics module in the previous year. Therefore, the study started with Petra's current FCA as an initial benchmark and explored how to improve the flipped classroom design principles to foster metacognition in the student-teachers in mathematics learning.

4.2.2 Student participants

Convenience sampling was applied, and the group of twelve student-teachers who opted to participate were relatively homogeneous in terms of language, age group, and gender. All participants were female, and while ten participants started their tertiary studies at the higher institution the year after high school, one student took a gap year after school while another participant had two years' work experience before starting her tertiary studies. Of the twelve participants, ten indicated that they were 19 years old, one was 20, and one 22 years old. All but one indicated that this BEd programme was their first year of tertiary studies. While one participant indicated that she was English speaking and used Afrikaans as her second language, 11 participants were Afrikaans home language speakers using English as their second language. All students went to Afrikaans-medium high schools and are computer literate.

De Vos (2011) warns that a homogenous sample can influence the data's authenticity, especially when participants know each other well. On the other hand, De Vos (2011) mentions that an advantage of a homogeneous group is that participants spend less time explaining themselves to others which leaves more time to focus on the issue. McMillan and Schumacher (2014) affirm that when participants in a focus-group interview are homogenous in traits, they are likely to encourage each other to reflect on the discussed topic. However,

many of the students in this study knew each other, and some were friends. Familiarity could thus have had an influence on the findings since friends could have influenced each other's opinion of the FCA. Based on their availability due to their timetables, the students were grouped in two focus groups with eight participants in focus group 1 and four participants in focus group 2 (§3.4).

Only one participant indicated that she attended the Reception and Orientation (R&O) information session offered at her student campus residence as support to first-year students in using the LMS (eFundi, §1.2). Even though most of the participants lived in a campus residence, they chose not to attend the orientation session. Refraining from attending the information session might indicate that the students felt confident in their technological skills and ability and did not see the need to attend the LMS training. However, none of the student-teachers used online platforms in high school for educational purposes, such as submitting academic work and doing research. Therefore, all but one student had no formal training in using the LMS.

For this Mathematics module, student participants indicated that they relied on their previous technological experience and knowledge gained of the LMS during the first semester when used for other modules. Furthermore, none of the student participants had ever heard of the FCA before they were recruited for the study, and two indicated that they did some reading about the approach after recruitment. None of the student participants were familiar with the term *metacognition*.

4.3 Analyses of data collected through the design-based research cycles

In this section, findings based on data collected through the DBR are reported. Before doing so, themes, categories and codes that emerged through the data analysis process are explained. Even though the analysis is presented as a step-by-step procedure, the process was reflexive and iterative (Fereday & Muir-Cochrane, 2006).

4.3.1 Themes, categories, and codes

Deductive and inductive reasoning was used during the data analysis process (Chapter 3). The inductive approach allowed for themes to emerge from the data, and the deductive approach employed was a way to keep the analysis grounded in the principles of a meaningful FCA (§2.6) as well as teaching and learning strategies that foster metacognitive gains (§2.5) that emerged from the literature. As suggested by Fereday and Muir-Cochrane (2006), inductive coding strengthened deductive coding. It provided new insights into determinants that may affect the flipped classroom's implementation as experienced from the different

viewpoints and accommodates the specific context in which the phenomenon was studied. Below is a summary (Table 4.1) representing the two themes that emerged from analysing the data and the categories that form part of each theme namely Theme 1: *Flipped-classroom design for metacognitive gains* and Theme 2: *Determinants that may either hinder or support metacognitive gains in an FCA*. Appendix A provides a codebook with more information regarding the codes that form part of each category and includes descriptions of each code and motivations for linking text to these codes. Because of these concepts' interrelatedness, it was inevitable that quotations linked to codes and categories sorting under Theme 1 were also found to strongly relate to the codes and categories sorting under Theme 2. To organise data and report the data findings, I sorted the codes and categories based on relationships emerging from the data and logical reasoning informed by the literature.

Table 4.5 **Themes with their categories that emerged during the coding process and data analysis**

Implementing an FCA for metacognitive gains to prepare mathematics student-teachers for the 21st century	
FCA design for metacognitive gains	**Determinants that may hinder or support metacognitive gains in an FCA**
•Flipped classroom design •Flipped classroom knowledge •Flipped classroom in-class •Flipped classroom out-of-class •Flipped classroom strategies •Flipped classroom benefits •Flipped classroom challenges •Technology	•Motivation •Knowledge, skills and beliefs •Mathematics content •SDL •Metacognition

The following networks created through ATLAS.ti™ (Figure 4.1 and Figure 4.2) illustrate the categories and codes per theme and provide frameworks for reporting the data analysis and findings theme.

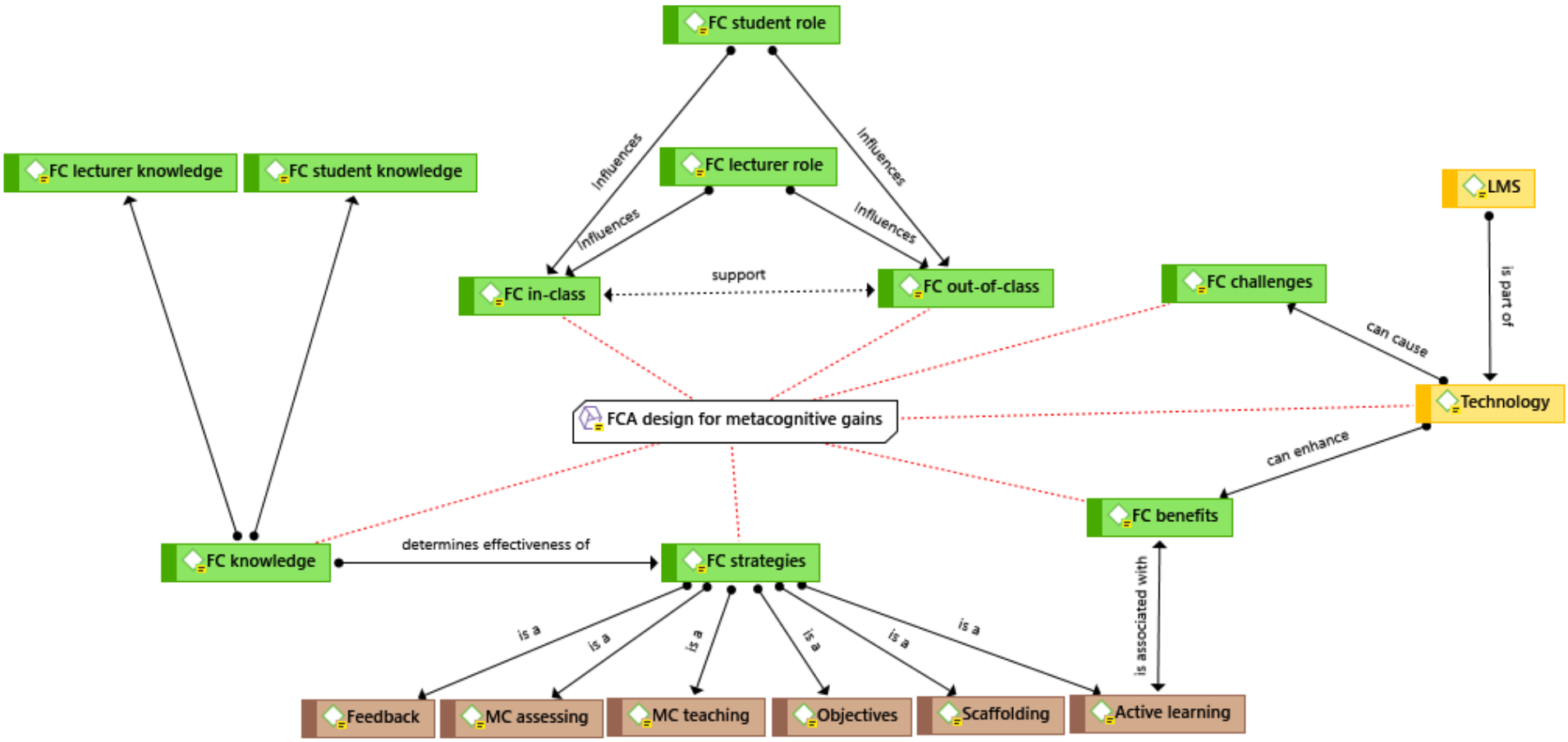


Figure 4.1 Network of categories that form part of Theme 1: FCA design for metacognitive gains

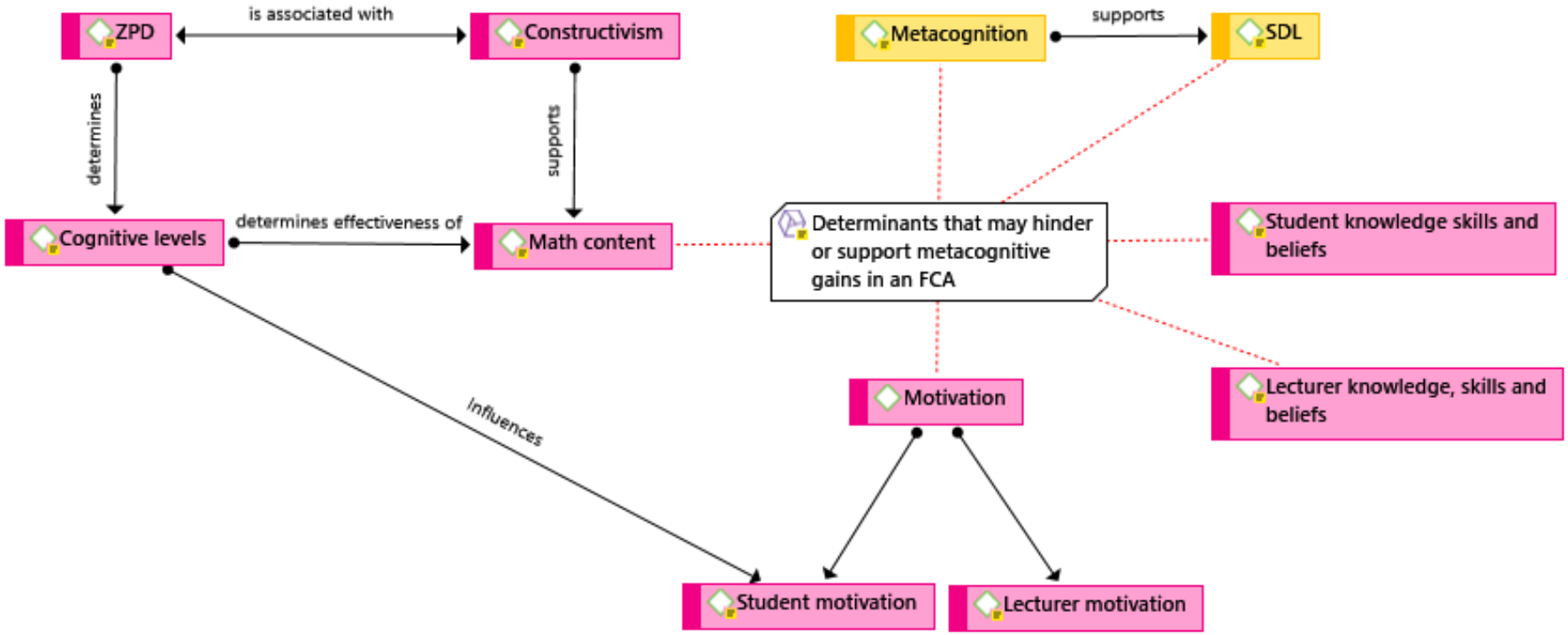


Figure 4.2 **Network of categories that form part of Theme 2: Determinants that may hinder or support metacognitive gains in an FCA**

4.4 Data findings through the design-based research cycles

DBR involves the developing and testing of theory simultaneously, during which the researcher gains insight and understanding into how and why something works or not (Bakker & Van Eerde, 2015). In this section, the macro-cycle, which consists of two meso-cycles and seven micro-cycles (Figure 3.1), is elucidated. Each meso-cycle has an input (a design based on theory and experience) and an output (reflecting on how the design met the aims and how it can be improved).

For the study duration, both myself as the researcher and the current lecturer kept reflective journals. The lecturer's journal (§3.5.3) served the purpose of supporting her reflection on her implementation and experiences of the FCA to improve her strategies and add to the meaningfulness of the available data on the flipped-classroom implementation (§2.6.2).

Prompts were provided to the lecturer (Appendix E). The prompts encouraged the lecturer to reflect on her expectations and her experiences about the FCA implementation and students' responses to the FCA implementation, with specific or implicit reference to aspects related to metacognition and SDL. She was requested to complete an entry after each in-class session, and references to her journal entries are integrated throughout the data's reporting to support findings in different micro-cycles. The researcher's journal (§3.5.4) served the purpose of an ongoing reflection on the FCA design, lessons learned, and strengthens trustworthiness (§3.8) by openly acknowledging the interplay between researcher objectivity and subjectivity and through documenting observations, thoughts and questions as they occurred, to encourage reflective thinking (Newbury, 2001).

Table 4.2 below provides a summary of the method of data collection as well as participants involved (pseudonyms) per micro-cycle. Abbreviations for each data source are provided and used for quotations used from transcriptions to ground the findings in the data.

Table 4.2 Summary of abbreviations used for participant quotations as found in the transcribed data sources

		Micro-cycle	Abbreviation		Data collection	Participants
Macro-cycle		Micro-cycle 1	**MC 1**		Individual semi-structured interview	Sarah (previous lecturer)
	Meso-cycle 1	Micro-cycle 2	**MC 2**		Individual semi-structured interview	Petra (current lecturer)
		IMPLEMENTATION				
		Micro-cycle 3	**MC 3**	**FG 1**	Focus group 1	Vera; Rachelle; Elise; Nina; Michelle; Zara; Lisa; Anet
				FG 2	Focus group 2	Hannah; Jade; Ann; Henda
	Meso-cycle 2	Micro-cycle 4	**MC 4**		Content analysis	
		Micro-cycle 5	**MC 5**		Individual semi-structured interview	Petra
		IMPLEMENTATION				
		Micro-cycle 6	**MC 6**	**FG 3**	Focus group 3	Vera; Rachelle; Michelle; Anet
				FG 4	Focus group 4	Jade; Angela
		Micro-cycle 7	**MC 7**		Content analysis	
		Reflection interview	Individual semi-structured interview		Petra	
		LJ	Lecturer journal		Petra	
		RJ	Researcher journal		Researcher	

As cautioned by Merriam and Tisdell (2016), I continually guarded against projecting my own experience and/or views onto the data. To accomplish this, I frequently considered the philosophical orientation of the investigation, and aimed to understand and rely on the participants' view (Creswell, 2007).

4.4.1 Micro-cycle 1

This micro-cycle focussed on the experiences of the previous lecturer of the Mathematics module (Sarah), and the interview schedule (Appendix E) was informed by the literature based on the elements involved in an FCA (§2.6.2) with the potential to support metacognition (§2.6.3). Since Sarah was not involved throughout the designing process of this DBR but merely shared her previous experiences about the specific Mathematics module and the student population, this micro-cycle was not regarded as part of meso-cycle 1 (§3.6.1). Sarah also shared her experience of the student preparedness for the FCA and possible problems faced regarding student metacognition and SDL skills and possible solutions to these problems as setting for the DBR process.

During the interview, it came to the fore that Sarah previously implemented SDL strategies that resemble some FCA principles for the teaching and learning of this module. This knowledge provided an unexpected opportunity to collect data on the lecturer's experiences of this teaching approach with specific reference to the FCA principles as identified in the literature. All quotations in this section (§4.4.1) are from Sarah and the researcher's journal. Data collected through her reflections on this module's teaching and learning are discussed per theme (Table 4.1; Figures 4.1 & 4.2). Even though Sarah's teaching strategies were an unintentional implementation of the flipped classroom principles, the data findings are categorised under the same themes as the data that emerged during the intentional FCA implementation in the two meso-cycles, considering how the data from this micro-cycle contributed to answering the research questions. During the analysis of the data collected through this interview, I was continuously on the lookout for implicit and explicit mentioning of the role of metacognition and the potential of the FCA to foster metacognition.

4.4.1.1 Flipped-classroom design for metacognitive gains

Codes in this transcript were sorted under the following categories: FCA design; FCA knowledge; FCA in-class; Technology in the FCA; FCA challenges. Firstly, the way Sarah's teaching and learning approach for the Mathematics module resembled an FCA design is reported.

As mentioned earlier, Sarah's rationale behind her teaching approach for this specific module did not intentionally focus on an FCA's principles but rather aimed to shift the responsibility for learning to the student, which is an objective of the FCA (§2.6.4). From Sarah's explanation of the learner-centred strategies that she implemented for the teaching of this module, the following design features of the FCA as emphasised in the literature were mentioned.

Sarah's teaching strategies resembling that of an FCA:

1) Active learning was prioritised, both in-class and out-of-class.

2) The transmission of content was done via technology.

3) Content to be prepared before class was not retaught to students in class.

4) A class test was administered to check for student preparation.

5) In-class sessions were used for collaborative problem-solving.

From the way she implemented this student-centred approach, Sarah displayed some knowledge of the FCA principles with specific reference to the in-class and out-of-class actions of the lecturer and the students (§2.6.2), as well as the role of technology in the FCA, such as the LMS (§2.4.1; §2.6.2.)

- **Flipped classroom out-of-class activities**

Students were expected to prepare for class using videos made available to them as DVDs as part of their study material. Videos before attending contact sessions served the purpose of preparing students for active learning (§2.6.1) during contact sessions:

"it will require more from them than just coming to class and sitting arms folded. But the learning gains from it will be so much more if they come to class with the prior knowledge to ask meaningful questions because then you can just apply and do problem-solving, which then eventually leads to higher cognitive levels." Sarah

From Sarah's reflections, it seems as if the students lacked knowledge and understanding of their role in an FCA. This is evident from their dissatisfaction with assessing their content knowledge at the beginning of class before any explanation of the content by the lecturer (Appendix F, MC 1, lines 71-74). Since students' application of SDL during out-of-class activities plays an integral part in the FCA and is requisite for metacognition in learning, the lecturer will have to ensure that students have the necessary knowledge of their responsibility and an understanding of the value of SDL. Sarah reflected on this aspect as follow:

"Yes, sure, they will have to know what is going to be expected of them, but still, I think they are going to have to manage their own time. They will need to know what it entails; they need to know what it will take." Sarah

The quotation highlights the importance of the student's role in an FCA, with specific emphasis on metacognitive gains as a benefit. By knowing precisely what is expected and the possible learning gains, students might buy into the FCA benefits to teaching and learning (Zack et al., 2015). The quotation furthermore mentioned the importance of students managing their time in an FCA. This raised the questions as captured in the researcher journal:

"It is clear that students need to become better at managing their time to be successful in a flipped-classroom. Regulating their learning requires metacognitive skills. How can they be supported in this regard? Which strategies need to be in place?" RJ (27 April)

The quotation by Sarah and the reflection in my journal emphasise the need to support students in developing better metacognitive and SDL skills to ensure that the out-of-class activities indeed serve the purpose of active and metacognitive learning (§2.5.1; §2.5.2).

- **Flipped classroom in-class activities**

On entering the classroom, students wrote a multiple-choice test, after which a summary was provided by the lecturer on the work that they were required to prepare. The anticipation was that content would not have to be retaught in class, leaving more time for active and collaborative learning by the students during contact sessions. After the multiple-choice questions, the rest of the contact session time was to be spent on collaborative problem-solving, where students worked in groups to complete assignments based on the work demonstrated on the DVD. While completing the collaborative in-class tasks, students were supported by Sarah and two honours students who acted as student assistants. These contact sessions provided students with active learning opportunities (§2.6.2) and peer collaboration (§2.4; §2.6.3) of group assignments. Answers were then shown on the screen serving as immediate feedback, making them aware of flaws in their understanding, and to learn from mistakes as explained by Sarah:

"I put the memo on the screen, and I always told them the purpose was twofold; first, they had to assess, so they had to learn from it and to provide immediate feedback. So, they could see right away if they did it wrong, and how they should have done it." Sarah

Even though the lecturer did not specifically mention metacognition as a motive, the literature supports the notion that displaying possible solutions and providing feedback could create an opportunity to observe metacognitive skills (§2.5.4). However, merely showing the possible solution will not have influenced metacognition but could have created an opportunity to access student thinking if the lecturer motivated discussion of solutions or problem-solving methods in groups or pairs (§2.5.4). Such a discourse on different solutions or methods could

have provided the lecturer access to student thinking and the opportunity to determine if students display metacognitive skills or not. Furthermore, it could have created the opportunity to ask questions and facilitate the conversation to foster metacognition (§2.5.3). Further exploration of the literature and DBR will show ways to foster metacognition such as peer-assessment strategies, reflective prompts and a well-set-up online environment (§2.5.3).

- **The use of technology in the FCA**

For this unintentional flipped-classroom model, the technology incorporated included DVDs with recordings of video lessons created by Sarah and the LMS utilised for online assessment and student communication. As the flipped-classroom model evolved, the lecturer implemented online tests. The implementation of online tests was partly due to student resistance to writing a test at the onset of in-class contact sessions and reducing paperwork. The evolving implementation entailed that students were still expected to prepare specified content for class by watching videos on the DVD, which prepared them for group assignments to be completed and self-assessed in class while writing an online test after class.

In South Africa, power failures may hamper reliable access to technology such as the internet and the use of a computer. Sarah reported that some students complained about the fact that they were unable to submit online tests on time due to electricity failures (Appendix F, MC 1, lines 286-289). The online test could help a lecturer determine before class whether students prepared and if general misconceptions exist that should be addressed during in-class activities (Boitshwarelo et al., 2017). The online test can furthermore serve as a reflective prompt (§2.5.3; §2.6.2; §2.6.3) and has the potential to support metacognition (Kramarski & Kohen, 2016). The goal is for students to acquire and apply SDL skills to regulate their learning autonomously so that they would be able to support their learners one day to acquire these skills (§2.4.3). Sarah commented on the potential and challenges of technology such as the LMS:

"I have told a class before that they should tell me on eFundi what they are having problems with, but then you have to go read it before class, and it takes a long time, you cannot, you do not have time to do it. But if you want a quick chat, eFundi can do that. … it [technology] can be such wonderful learning opportunities, but it requires a lot from a lecturer in terms of how you implement it, your time, and it will make your life easier for you at some point." Sarah

Sarah highlighted the time-consuming nature of introducing online tools but acknowledged the benefits of technology in the long run for both the lecturer and the student. The literature confirms that effective use of technology for education promotes effective institutional

functioning (Kaur, 2016), enhances student engagement (Herrington & Parker, 2013), and improves student conceptual understanding (Bray & Tangney, 2017).

I also reflected in my researcher journal concerning the time-consuming factor of technology:

"What tools are available to make online communication with students less time-consuming and practical?" RJ (24 April)

Sarah reported that creating content for the DVDs was extremely labour-intensive and time-consuming. What increased the workload even more, was that the lecturer made DVDs in English and Afrikaans[7]. This labour-intensive technological resource may have been one reason for replacing the DVDs with URLs to videos placed on a document and made available to students on the LMS. Finding solutions to all these challenges could be a focus for future investigations.

When I posed the question of whether students should not have the responsibility to find relevant video content online, she expressed her concern as follow:

"I think it's quite dangerous. Because the way you do not want the content presented might be captured. You can tell them go Google it but, yes, as I say, I will be careful if one wants to promote particular skills." Sarah

Her concern about the students' ability to find the most relevant material on the internet relate to constructivist principles and specifically to the important role of the lecturer in providing the necessary theoretical scaffolding (Bergmann & Sams, 2012; McLaren, 2013) (§2.6.2) to enable students to link new knowledge to their existing knowledge framework (Cobb et al., 1992; De Corte, 2012; Schrader, 2015) (§2.3).

However, instructing students to find open access video content may save the lecturer considerable time searching for open-access material or producing their videos. It can also serve to get students actively involved in their learning. Furthermore, an assignment to find open access video content on the internet and discerning and evaluating sources might provide students with a valuable learning opportunity to foster metacognition (Sandoval, Greene, & Bråten, 2016). I also hypothesized concerning this issue in my journal:

[7] Although eleven official languages are recognised in South Africa, the current language policy of the higher education institute accommodates both English, Afrikaans and Setswana as languages of teaching and learning.

"She does not like the idea of students finding the video sources and called it dangerous. She found sources on YouTube low-budget, and you must first make sure the content is good. She suggested that it might be good to let students search for video content and evaluate if it is good or bad – critical evaluation. This is a good suggestion to foster metacognition. It can also support students in their teaching practice." RJ (27 April)

Integrating technology into the learning experience can use time optimally and fostering metacognition if implemented well and efficiently. For a successful FCA implementation, the effective use of technology for teaching and learning depends on technological competence and access to technology (§2.4.1; §2.6.1) and therefore requires that the lecturer and the students have the necessary knowledge and skills to use technology for learning effectively. Also, as mentioned, the time-consuming nature of the initial planning and implementation of an FCA that integrated technology can be a challenge. In the following section, FCA determinants are discussed.

4.4.1.2 Determinants that may either hinder or support metacognitive gains in an FCA

Quotations from this interview, sorted under Theme 2, were linked to the roles of *mathematics content, SDL, the role of metacognition, motivation, and of knowledge, skills, and beliefs in the FCA* categories.

- **Mathematics content**

Discussing the Mathematics module content, Sarah initially indicated that the module's course content lends itself to the FCA (Appendix F, MC 1, lines 189-191). Later in the interview, Sarah made a contradictory comment on the relevancy of the module content for the FCA, and the way the content served to motivate student SDL:

"I would say the motivation of students. In other words, they do not necessarily see the value of the subject, and that means they are not preparing." Sarah

Sarah's experience that students regarded the module as irrelevant could be due to changes in the programme and the curriculum structure. She explained that previously the module did not form part of the curriculum for mathematics specialisation but was rather a generic and compulsory module completed by all student-teachers. However, due to degree specifications, this module was included as part of the mathematics specialisation programme that prepares student-teachers, specifically mathematics teachers. The students' makeup changed drastically; it may have influenced student motivation for self-directed out-of-class learning,

specifically when student-teachers failed to see the meaningfulness of the module content. Sahar reported that this Mathematics module is on a basic introductory level and draws on students' Grade 8 and 9 mathematics knowledge (Appendix F, MC 1, line 11-12). While, on the one hand, Sarah viewed the Mathematics module to be on a basic introductory Geometry level, she also referred to gaps in students' knowledge that hindered the mastering of content (Appendix F, MC 1, lines 22-23):

This contradiction may be an indication that content is mastered through rote learning in schools without deep understanding. Such superficial learning may create a false sense of mastery and a lack of retaining content studied at school, which further serves to motivate the need for the development and use of metacognitive skills, also at school level. Dunlosky and Rawson (2012) suggest that metacognitive regulation (§1.7.2) may improve learning and retention. When content is viewed as 'old news,' it may further demotivate students and lecturers to strive for higher levels of Bloom's taxonomy (§2.5.5) during the teaching and learning process. In line with the literature (§2.2.2.2), deep learning is associated with SDL, critical thinking, problem-solving, and collaboration to develop a deeper understanding of mathematics (Bellanca & Boss, 2015). Module content, therefore, must lend itself towards such student-centred learning strategies while at the same time serving as motivation for students to engage with the content by applying metacognitive strategies (§2.5.2) through SDL.

- **Self-directed learning**

SDL involves both "a way of thinking" and "a way of working" (§2.4.2). Self-directed learners are more aware of their thought processes (metacognition) (§2.5), take ownership of their learning processes, and monitor their progress through self-regulation (§2.4.3). Sarah clearly showed frustration with students' lack of motivation to take ownership of their learning by preparing for in-class learning as self-regulated learners and reflected that *"ten or twenty per cent prepares [for class]"* (Appendix F, MC 1, lines 89).

Based on the relationship between SDL and SRL (Loyens et al., 2008) (§1.3), students' motivation to prepare for in-class learning will also have a bearing on their SDL traits as described by Knowles (1975), namely to set their own learning goals as well as their capacity to evaluate their learning outcomes and to consequently choose and implement appropriate learning strategies to improve these outcomes if and when necessary. Even though SDL implies more student control concerning the topic of learning (Loyens et al., 2008), students who do not demonstrate the SRL skills required to implement the learning tasks as required by a course or an instructor will also miss the opportunity to discover what they do not know

concerning learning outcomes. Awareness of own knowledge gaps serves as motivation to apply SDL strategies to find the most relevant resources to fill these gaps. Entering the in-class learning environment without the basic understanding of the topic as expected by the lecturer will jeopardise the opportunity for metacognitive gains during collaborative problem-solving activities based on this topic.

Sarah mentioned that four years after implementing this unintentional flipped-classroom model, the use of the DVD was replaced with URLs to these videos that were placed on the LMS as part of the out-of-class teaching component. The lecturer found that this alternative, relying even more on SDL skills (requiring them to access the materials in their own time), was ineffective. In the following quotation, she hypothesises what possibly goes on in the mind of students when they have the responsibility to search for relevant sources on the internet:

"But the moment I have to do something myself, I now have to go to a link myself, I have to go and find a source myself somewhere other than what fell in my lap." Sarah

The above quotation reflects a lack of SDL skills compared to Knowles's (1975) description of SDL involving students taking the initiative to diagnose their own learning needs and identify resources to meet those needs (§2.2.2.2). She attributed the failure of the revised strategy to a lack of SDL on the part of the students and failure to take responsibility for their learning, partly as a result of being used to being spoon-fed (Appendix F, MC 1, lines 76 and 600-602).

These quotations again emphasise the role of student motivation to make the paradigm shift towards a more student-centred approach to education such as the FCA. Based on the lecturer's observation, it may be necessary first to equip students with the necessary SDL skills to benefit from the value of the FCA for metacognitive gains.

- **Metacognitive skills**

The FCA design's potential to foster metacognition is grounded in the literature (§2.6.3). There is support in the literature that students with better metacognitive skills will be better able to cope in a flipped-classroom environment. Metacognitive skills specific to mathematics require prediction, planning, monitoring and evaluation (§2.5.2) (Lucangeli et al., 1998). Sarah's experience was that students lack metacognitive skills, implying that before the implementation of an FCA, students may need support in developing these skills, as shown in the following quotations:

"One has to give them guidelines; you cannot just expect them to be self-regulated now that they are at university. They are not going to know where to start, so there really should be guidelines. This is the challenge; a lecturer will have to plan very carefully." Sarah

Findings reported by Kim et al. (2014) indicate that students require timely support and structured guidance from the lecturer to develop metacognitive skills and emphasise the need for scaffolding (§2.6.3). As mentioned in §2.6.3, Guglielmino (2013) predicted that students who have been spoon-fed would resist taking responsibility for learning and adapting to material that is 'different' from what they are used to. When students lack metacognitive skills such as the ability to predict, plan, monitor, and evaluate their learning processes (Lucangeli et al., 1998), it may also hinder their ability to plan and regulate their learning as self-directed learners (Knowles, 1975) for the out-of-class component of the flipped classroom.

A lack of active involvement with the content and refraining from preparing for in-class activities also implies that students will miss out on the opportunity to develop metacognitive skills. Sarah's expressed the value of active in-class student engagement:

"… it's still valuable that they work themselves and are busy because the moment they have a pen in their hand they realise 'I thought I knew but I don't actually know how the Pythagorean theorem works.'" Sarah

Engaging students in their learning process creates an opportunity to develop metacognitive skills, where students question their understanding of the topic. Realising own misconceptions or incorrect perception of own understanding may serve as motivation to apply different out-of-class strategies such as viewing the video again or using other metacognitive strategies. Apart from challenging content level, active participation by the student in their own learning is central to an FCA aiming to foster metacognition. Metacognition in an FCA is also dependent on student motivation (Han & Yin, 2016; Hao, 2014) (§2.6.4).

- **Motivation**

While a teacher-centred approach makes use of the transfer of knowledge (Ramocki, 2007), a successful FCA can support SDL by creating a student-centred learning environment (Zainuddin & Perera, 2018) (§2.4.2). However, principles such as student motivation (§2.2.2.2; §2.4), SDL (§2.4.2), and metacognition (§2.5) will play a determining role in the learning outcomes of an FCA. To meet the requirements of successful teaching and learning in the 21st century (§2.2.4) through the FCA, both the lecturer and the student will need to be motivated to make the necessary paradigm shift.

Sarah reported resistance amongst students to prepare for contact sessions by viewing the videos in advance. This resistance can be directly related to a lack of motivation to apply SDL strategies, such as taking responsibility for their learning by setting their own learning goals and finding resources on the learning topic. The relation between motivation and SDL (§2.4.2) is emphasised by Sarah's experience of students refraining from taking responsibility for their learning using the resources provided for this purpose. Sarah expressed her disappointment in students' lack of motivation:

"Many complaints were also because they have this negative attitude and like why should they write a test before I explained it to them, but in the meantime, they had to prepare (by viewing the relevant video) so that they could write the test, but they generally felt they must first be explained to before they can write." Sarah

The lack of student motivation to take responsibility for the out-of-class activities could impact the cognitive level of in-class activities and the lecturer's ability to plan these activities on an anticipated level of prior knowledge. The literature pronounces that not all content lends itself to an FCA (Sommer & Ritzhaupt, 2018) and this needs to be taken into consideration. The relationship between the level of learning content and student motivation is confirmed by the literature (Bolhuis, 2003; Krathwohl, 2002) as illustrated by Vygotsky's ZPD (§2.3.2; §2.3.4).

In the following section, knowledge, skills, and beliefs as part of an FCA are discussed.

- **Knowledge, skills, and beliefs**

Although the FCA principles support successful teaching and learning in the 21st century (§2.6.1), both the students and the lecturer should have the necessary knowledge of flipped-classroom principles and understand their roles for a successful flipped-classroom implementation, and more specifically, metacognitive gains through the FCA.

Sarah is well qualified with a doctoral degree in mathematics education and has sound knowledge of mathematics. Although Sarah reported various barriers experienced in implementing the unintended flipped-classroom model, she demonstrated knowledge about metacognition, the role of SDL, and understanding of her role as a facilitator in the FCA rather than a mere provider of knowledge. This deep understanding of Sarah enhanced the trustworthiness of her observation that students lack metacognitive skills:

"I don't want to give it [the solution] to them, but I'd rather ask them: explain to me what you did there… why do you say that? Then I find out... they do not think metacognitively at all, those skills are underdeveloped." Sarah

Sarah demonstrated a belief in the role SDL and metacognition can and should play in learning for understanding in mathematics but is also realistic about the role of the lecturer in terms of thorough planning and facilitation to support these elements of learning in a student-centred approach:

"So, one must still escalate it in terms of what you give them to do. You have to do less and less, but you will have to plan very carefully initially around the strategies they need to implement." Sarah

Therefore, it is evident that students should know exactly what is expected of them, implying the importance of both lecturer and student knowledge in the successful implementation of the FCA. The quote also emphasises the paradigm shift required from both the lecturer and the students to a more student-centred approach, affecting the beliefs held about meaningful mathematics teaching and learning.

Sarah also showed knowledge and skills concerning strategies to foster SDL and metacognition in the implementation of the flipped classroom, and specifically in incorporating reflective learning:

"…. and maybe ask questions, reflective prompts, and say 'I'm sure of this' or 'I'm still struggling with that aspect. What am I going to do to help myself with this? Am I going to consult the lecturer, am I going to consult a friend in class, am I going to consult an additional source? What did I do to overcome this problem?' I think we need to include these reflective prompts." Sarah

Through the unintended FCA, Sarah gained valuable insight into the FCA principles and determinants that may play a role in this student-centred approach. The interview also demonstrated some of the challenges that need to be considered when designing an FCA to foster metacognition within mathematics student-teachers.

From Sarah's reflections on her flipped-classroom strategies, it is clear that for a conducive environment, lecturer (or teacher) preparedness in terms of knowledge, experience, and motivation and making the paradigm shift towards this student-centred approach is vital to the success of an FCA. The data collected in micro-cycle 1 also emphasised the importance of the lecturer's and students' knowledge and understanding of their role in an FCA and a belief in the value of active student participation in their learning. The interview with Sarah further provided valuable information regarding the student population of the Mathematics module, the potential and possible challenges of the FCA, and specifically the integration of technology as an essential aspect of the FCA to foster metacognition.

Findings on micro-cycle 1 served as setting for the analysis of data collected in the following micro-cycles as part of meso-cycle 1.

4.4.2 Meso-cycle 1

Meso-cycle 1 consists of micro-cycles 2, 3 and 4 (Figure 3.1). Micro-cycle 2 entailed the collection of data through a semi-structured interview with the current lecturer of the Mathematics module (Petra). This interview firstly collected data on her lived experiences of implementing the FCA in the previous semester. Secondly, based on her experience, this interview also served as opportunity to collaboratively plan on how to revise the design principles of the FCA to be implemented in the current semester to improve learning with specific focus on metacognitive gains. After this interview, Petra implemented the revised FCA while keeping notes of her experiences in her journal. Micro-cycle 3 aimed to facilitate student-teachers' reflections on the implemented FCA in the form of focus-group interviews. I also noted down my observations during interviews and focus group discussions in my journal. Micro-cycle 4 involved analysis of the data that emerged thus far, through content analysis (§3.7). Therefore, in this section, data collected from micro-cycle 2 (interview with Petra), micro-cycle 3 (the two focus-group interviews with student-teachers), and both the researcher and lecturer journals, as analysed in micro-cycle 4, are reported.

Considering the value of the FCA to support metacognition, the findings from this meso-cycle are reported in an integrated manner per theme, namely Theme 1: *Flipped-classroom design for metacognitive gains* and Theme 2: *Determinants that may either hinder or support metacognitive gains in an FCA* (Table 4.1). The categories are interrelated within and across themes but are discussed separately as organised in Figure 4.1 and 4.2. Data sources are indicated throughout the discussion of the analysis and findings.

4.4.2.1 Flipped-classroom design principles and strategies for metacognitive gains

Categories under Theme 1 that emerged through the analysis of meso-cycle 1 include planning for FCA, FCA in-class activities, FCA out-of-class activities, FCA strategies and the role of technology in the FCA (Figure 4.1).

The flipped-classroom benefits, challenges and strategies are highlighted throughout the discussion wherever it presented itself. Although the role of lecturer and student knowledge in the FCA are discussed in more detail as a possible determinant of metacognitive gains in an FCA under Theme 2, the potential impact of knowledge on the FCA design is highlighted in the discussion of the FCA design. Firstly, the planned FCA design, grounded in Petra's prior experience, is reported.

- **Planning of the flipped-classroom design**

Petra is an experienced teacher and lecturer (§4.2.1) and took over the module from Sarah the year before the implementation of this study, at which time she decided to explore the FCA for the first time. Petra understood the student's active role for a successful FCA implementation and the importance of student preparedness for in-class learning by watching videos as part of out-of-class learning. Since this Mathematics module is a second-semester module, she arranged with the lecturer that taught the same group of students during the first semester to use a few minutes of their class time to explain the FCA to the students. Informing students about the FCA and their roles in such a student-centred approach is in line with the first FCA implementation principle suggested by Lo et al. (2017, p. 22) (§2.6.2), namely to "manage the transition to the flipped classroom for students*."*

Petra demonstrated a good knowledge of her role in the FCA:

"But what you asked, my role is, I mean, I think composing the videos, compiling the content of the videos, because I already thought I actually want to do my videos the same way in which I teach. I don't want it to be like a formal video they must watch." Petra, MC 2

During the initial implementation in 2017 (the year before data collection), Petra did not experience the approach as being more time-consuming than a traditional teacher-centred approach. She found that the most time-consuming element was getting acquainted with the LMS (§4.2.1) and identifying the most relevant open-access videos on the internet. She understands an FCA requires extra input from the lecturer but feels strongly that it should be managed in such a way that it is sustainable for the lecturer in terms of workload (Appendix F, MC 2, lines 78-80).

Petra was asked to reflect on her FCA experiences during the previous year and suggest which strategies she experienced as successful for re-implementation and which strategies need to be revised to improve the FCA. The following design principles and strategies to be implemented in the module's teaching and learning were documented (Appendix F, MC 2).

Successful strategies to be implemented again in a similar way during meso cycle 1:

- Explaining the FCA to the students beforehand to prepare them for the teaching and learning of the Mathematics module.

- Videos provided on the LMS to view as preparation for in-class learning.

- Completing worksheets during in-class learning making use of lecturer and peer support.

Suggestions for revised FCA design to enhance learning:

- By creating self-recorded videos to be viewed as part of the out-of-class component of the FCA. Petra envisioned self-manufactured videos as an informal approach that will resemble an authentic lecture like real-time lectures in class.

- By providing students access to all videos from the onset, students can view them as part of the out-of-class learning.

- Due to time constraints, Afrikaans and English will be used alternatively (languages of teaching and learning) for the videos.

- By implementing a quiz before in-class activities, one can check for student preparation during out-of-class activities.

The above-mentioned FCA strategies thus formed part of the planning of the FCA to be implemented by Petra for the Mathematics module. Data collected in meso-cycle 1 emphasised the role of knowledge in FCA design as discussed under Theme 2: *Determinants that may either hinder or support metacognitive gains in an FCA.*

- **Flipped-classroom in-class activities**

The advantages of social learning that come with group work are among the greatest assets of in-class learning as principle of the FCA (Tiahrt & Porter, 2016). Students reported a positive experience of the group work. The following quotation indicated the potential of group work to support students in developing metacognitive skills:

"And to learn from each other's mistakes. Then I say: I also made that mistake, or I thought about it this way." Hannah, FG 2

Hannah appreciated the opportunity for collaborative learning, comparing strategies and students explaining their thinking to each other. Realising misconceptions through collaboration can foster metacognitive knowledge and regulation (§2.5.3). Metacognitive conditional knowledge (Flavell, 1979) can be developed where students explain strategies they employed to one another and self-assessment and awareness of comprehension can foster self-monitoring, thereby supporting metacognitive regulation (Schraw & Moshman, 1995). Metacognitive skills can be taught and developed (Van der Stel & Veenman, 2010),

and the in-class learning component of the FCA created the opportunity for students to employ and/or develop their metacognitive skills. Therefore, the active group work activities as part of the in-class learning in an FCA are crucial for metacognitive gains.

Group work as in-class activity is a benefit of the flipped classroom and was also positively perceived by Petra (Appendix F, MC 2, line 372-374). Petra described her role during in-class learning as providing support to students. Ray and Powell (2014) also emphasise that in-class learning activities provide the opportunity to clarify concepts through collaboration based on previously viewed content. When asked when and how she knew if students reached the learning objective, Petra explained the way the FCA created the opportunity to access student thinking during in-class group work:

"Something I might notice, if I walk through … the kind of questions they ask me … then I know: 'this guy clicked that, but not this.' You know, that's how that [is] helping throughout."
Petra, MC 2

This experience confirms the view of Alias and Sulaiman (2017) that the FCA holds value for the development of metacognition on condition that a lecturer or teacher uses opportunities evolving from in-class discussion to foster metacognition. However, it should be noted that the way a lecturer uses this knowledge about student metacognition will determine how this value of the FCA will optimally benefit learning. Viewing the videos as part of out-of-class learning will create an awareness of their own learning needs and further promote metacognitive learning opportunities during in-class activities. Therefore, when implementing an FCA, there should be a connection between the in- and out-of-class activities, and both must be aligned with learning objectives (Zappe & Litzinger, 2017).

- **Flipped-classroom out-of-class activities**

Content knowledge required to complete the in-class learning in the FCA (§2.6.2) was made available in video format to students to prepare for in-class lessons as part of the FCA's out-of-class component. Flexible learning through the integration of technology, and students taking responsibility for their learning, are important aspects of the out-of-class components of an FCA geared to metacognitive gains. As described by Kim and Lim (2019), providing scaffolding for out-of-class learning can enhance students' self-regulation by guiding them to take more responsibility for their learning and consequently provides the opportunity to grow as self-directed learners. The integration of technology and students' opportunity to determine their own learning pace has further implications for metacognition (Lape & Levy, 2014).

At the time of the focus-group interviews conducted in meso-cycle 1, the Mathematics module has been running for four weeks. During focus-group interview 1, students were asked about their experience of watching videos as preparation for in-class learning. While some students (FG 1) indicated that they are aware of the URLs to open-access videos on the LMS, some were oblivious of this resource:

Michelle: *"No, videos are not prescribed, and we are not told to go watch videos.*

Interviewer: *I am asking about the Mathematics module?*

Lisa: *Yes, there aren't videos. I think if you go and look for videos, you might find them.*

Elise: *There are videos that you can watch.*

[Zara nodding]

Interviewer: *Zara, do you agree?*

Zara: *Yes. There are videos, I saw it earlier.*

Michelle: *I didn't know about the videos.*

Six of the eight participants then indicated that they had not watched videos for the Mathematics module. In focus-group interview 2, the students also revealed that they had not watched videos for this module and some students said that they were not aware that there were videos provided on the LMS (Appendix F, FG 2, lines 167-173).

However, Petra made the following entry in her journal:

"They [students] said that the class was easy because of the stuff they've watched before class." LJ (15 Aug)

The fact that some students watched videos during out-of-class learning and some did not, as apparent from the data, could be ascribed to technology skills, where some were able to locate the URLs to the videos placed on the LMS, or an indication of students' lack of motivation, SRL and/or SDL (§2.4.2; §2.4.3). Loyens et al. (2008, pp. 417-418) argue the relationship between SRL and SDL in that "both activate metacognition", while both are dependent on "metacognitive awareness". These authors emphasise that without intrinsic motivation as a volitional aspect, "it is not likely that learners will be successful in tasks requiring SDL or SRL." Grounded in the argument of Loyens et al. (2008), as well as Knowles's (1975) definition of SDL (§1.2), students with SRL skills as well as those with SDL skills would have set their own

learning goals and would have chosen to exhaust all avenues, including viewing the videos on the LMS or inquiring assistance from the lecturer if they could not find the videos, to optimise own learning and to meet own learning goals. Students not taking responsibility for their learning was also a concern of Sarah in micro-cycle 1 (§4.4.1). However, the possible lack of SDL does not fully provide a conceivable explanation as to why some students did not know about the videos or why Jade could not find the videos on the LMS. I reflected on this mystery in my researcher journal as follow:

"It could mean that some students missed out on the session where the lecturer explained the FCA and the use of videos to them, and they were not aware of the videos on the LMS. That can explain why some students knew about the videos and others did not." RJ (10 September)

Investigating this further, students were asked how they then prepared for in-class learning for this module if they did not watch videos to prepare. Vera explained her strategy as follow:

"You just follow the module plan that was uploaded." Vera, FG1

From the above quotation by Vera, it became apparent that although some students did go onto the LMS to prepare for in-class learning, not all of them saw the necessity to view the videos by following the links provided or to ask for assistance if they could not find the URLs on the LMS. The reasons for this could be that, firstly, students felt confident in their knowledge of the topic based on their knowledge gained in high school (§4.4.2.2 *mathematics content*), or secondly, they referred to their textbooks for knowledge on the topic (§4.4.2.2 *metacognition*) or thirdly, they used a Google search for the topic (§4.4.2.2 *metacognition*) to get the necessary information.

During the focus-group interviews, some challenges regarding the FCA out-of-class activities became apparent that could have demotivated the viewing of videos. Students were not allocated a specific video to watch as part of the out-of-class component, as noted in the researcher journal:

"There doesn't seem to be a clear understanding of what exactly needs to be completed during out-of-class learning. Students perceived preparing as optional if they can do the in-class work. There weren't clear instructions and expectations of out-of-class objectives. Some students said that it feels like s a self-study module." RJ (10 September)

My speculation in my journal that students wrongly perceived the FCA as students having complete authority of their learning was also experienced by students in a study by Zack et al.

(2015, p. 807), who commented that students viewed the FCA as a self-study and some even felt like “they did not have a teacher for the class”.

The information that many students did not make use of video content provided on the LMS had implications for investigating how the FCA's out-of-class learning component influenced metacognitive gains. This crucial principle of the FCA plays a determining role in preparing students for in-class activities. The focus should be on collaborative and reflective sharing of solutions and problems in support of metacognitive learning. Therefore, the absence of out-of-class learning could have jeopardised the value of the FCA to foster metacognitive gains. However, it emphasised the opportunity to investigate how this component of the FCA design can be revised, as I indicated in my journal:

“It seems that students knew <u>what</u> to prepare (the topic), but not <u>how</u> to prepare.” Scaffolding.” RJ (10 September)

The benefit of the FCA, where students control their own learning pace by watching videos and pausing and rewatching (Abeysekera & Dawson, 2015), had not actualised at the time of these focus-group interviews.

- **Using technology as a strategy in the flipped classroom**

The integration of technology is an important principle for a successful FCA and has been shown to promote teaching and learning by using text and video for rich communication and tools as opportunity to create and express (Kaur, 2016). For the FCA implementation, the out-of-class component relies significantly on using videos placed on the LMS to support learning.

During focus-group interview 1, the discussion also focussed on student experiences of the way the LMS is used for learning, and led to the following quotation by Michelle:

“Other lecturers will for example, if they post something on resources … you get a notification that says new information has been put up or the ‘announcement’ says the ‘assignments’ date then you know there is an assignment. For the Mathematics module, you do not know what is going on there. You do not know where she put it, under what she put it, or it's put in between a bunch of other things so you miss new things. I guess that's why we do not know about videos.” Michelle, FG1

During the initial interview with the lecturer, Petra acknowledged that coming from a paper-based teaching and learning environment, she needs time to master the LMS functions (§4.2.1). It is clear from Michelle’s comment that Petra still needs development in using this technological learning management tool and emphasises the importance of lecturer and

student technological competence in a successful FCA, especially when metacognitive gains are expected as learning outcomes.

This need for structure and order of lecturer instructions and content placed on the LMS to help students keep track of learning tasks in their different modules is justified by Kirsh (2005), who emphasises that such structure helps students cope in a learning environment where they have numerous tasks to complete, requiring of them to plan continuously, monitor and evaluate. Good navigation of the LMS by lecturers is crucial in an FCA that aims to support metacognitive gains. Vera and Rachel also mentioned the importance of good navigation of learning on the LMS through clear emphasis on important information concerning learning tasks:

"I feel, for Mr X's class, our other lecturer, he will, for example, put in red capital letters: very important, remember this or this is also going to be asked." Vera, FG1

In my journal, I noted a consensus amongst the participants for more guidance on instructions placed on the LMS:

"The students all nodded and said that the format is important to draw their attention to know that it's important. What the students are saying again is that they need clear guidance perhaps." RJ (10 September)

The LMS plays an integral part as a communication tool between the lecturer and the students. Kirsh (2005) cautions that poor visual design on the LMS can hamper meaningful learning. Student-teachers' plea for a more structured layout of the content placed on the LMS for this module to support their learning can indicate that poor visual design could have hampered out-of-class learning and consequently also preparation for in-class learning, as well as the opportunity for metacognitive gains. The importance of good navigation by the lecturer on the LMS to improve metacognition in an FCA can therefore not be overemphasised. The following section elaborates on strategies for a successful FCA that emerged during data analysis.

- **Flipped-classroom strategies**

Since many factors play a role in metacognitive development (§2.5), and because metacognitive learning is not easy to observe, ascribing metacognitive gain to a specific strategy is not feasible. However, quotations referring to strategies that hold value for learning, including SDL, SRL, or student thinking about own learning, were regarded as supportive of metacognitive gains and therefore linked to this code. When students were asked about the value of an online quiz as an out-of-class activity, Michelle responded positively:

"I think an online quiz will help because then the kids can immediately say: I don't understand the part of the video, or I lost the [presenter in the video], like that… then the lecturer can know in class right away, okay, the kid who is the furthest behind in the class is there so I can explain this quickly [so] that you then use optimal time." Michelle, FG1

Michelle acknowledged that such an online reflection quiz before class can help the lecturer check for student preparation and understanding and thereby plan the in-class activities accordingly. Regarding video content, most students said that they would prefer lecturer-produced videos (Appendix F, FG 1 3, lines 435-437).

In the following section, determinants that may either hinder or support the development of metacognition, as found in meso-cycle 1, are discussed.

4.4.2.2 Determinants that may hinder or support metacognition in a flipped classroom

Various factors that could play a determining role in the FCA's successful implementation emerged from the data. Categories that emerged under Theme 2 from the analysis of data collected in meso-cycle 1 include mathematics content, SDL, the roles of metacognitive skills, motivation and knowledge, skills, and beliefs in the FCA (Figure 4.2). The concepts in the network are interrelated but discussed separately as far as possible.

These determinants are not FCA principles and strategies but played a role in implementing the FCA in one way or the other. Although metacognition was included as category in this theme, it is considered more in context of how the student-teachers made use of metacognitive skills or failed to do so and therefore viewed as a determinant for an FCA.

- **Mathematics content**

In agreement with Sarah (§4.4.1), Petra believes that students are probably familiar with most of the module's content. She furthermore mentioned that students might have been able to complete classwork without preparing for class (Appendix F, MC2, lines 190-191).

As mentioned by Kunnathodi and Sarabi (2017), a learning task should be on the relevant, challenging level to ensure the task fosters learning, relating to Vygotsky's (1978) zone of proximal development (ZPD) (§2.3.4). The familiar content and the fact that students were probably able to do in-class activities without preparing had implications for this study. In an FCA, the type and level of content of a module proved to be an important determinant of a successful FCA aiming to foster metacognitive skills.

During both focus-group interviews, the discussion kept reverting to the basic level of the content of the Mathematics module. Students were clearly frustrated with the module's content that possibly hindered the opportunity for metacognitive gains. Content is therefore considered an important determinant of the FCA aiming to foster metacognition. However, when asked if the students thought that the FCA would work for a module with unfamiliar content, Nina stated that she does not believe the FCA will work with new and challenging content (Appendix F, FG1, lines 421-425). On the other hand, Michelle thought that it could work for new and more challenging content and other students nodded their heads in agreement.

Lisa and Jade mentioned that the content overlaps with one of their other mathematics modules and she was clearly frustrated with the content:

"But for those of us with [module X], for me, it's a waste of my time." Jade, FG 2

"We do the same work in (module X) as in this Mathematics module, and so I feel we are all at a higher level than this by now." Lisa, FG 1

Apart from the overlapping of content that should be addressed on faculty level to better align programme content across modules, data collected from all sources pointed out that the mathematics content was possibly on a too basic level. The Mathematics module's content level created a challenge for Petra since students indicated that they wanted her to spend time instead on more challenging and new knowledge (Appendix G, LJ, lines 33-34 and line 49).

As referred to above, these quotations and journal inscriptions are evidence that the level of learning content plays a determining role in the success of an FCA and, for obvious reasons, also for the opportunity to foster metacognitive gains. As explained in the literature (§2.5.5), tasks requiring learning on higher cognitive levels, as illustrated by Bloom's taxonomy, are dependent on the level of module content.

Cognitive levels

As stated by Lester (2013, p. 246), "most mathematics educators agree that the development of students' problem-solving abilities is a primary objective of instruction and how this goal is to be reached involves consideration by the teacher of a wide range of factors and decisions". Data collected in meso-cycle 1 revealed that the way that the module content provided the opportunity for learning on higher cognitive levels presented itself as a challenge for the successful implementation of the FCA with the aim to foster metacognition.

As discussed in the previous section with focus on *mathematics content,* the lecturer reflected in her journal that the students required more challenging content (Appendix G, LJ, line 85-86). Michelle confirmed that they asked for questions to be more challenging:

"We'd asked her to make it harder, and she says she has, but it's still the same." Michelle, FG1

However, during the discussion, students did not experience the in-class work being more challenging (Appendix F, FG1, lines 544-545).

During focus-group interview 1, none of the students said that the in-class learning activities challenged them to act on higher-order cognitive levels. As the researcher, I detected a discrepancy between the lecturer's perceptions of student experiences and their actual experiences of the difficulty level of the in-class activities, as noted in my journal:

"There seemed to be a disconnect between the experience by students and the perceived student experiences by the lecturer regarding the cognitive level of the work." RJ (10 September)

The students' experience of the Mathematics module's cognitive level had implications for investigating some of the design principles of an FCA since it had a possible effect on student motivation to prepare for class, as explicated further in this section under *motivation*. Learning is best fostered when students are being challenged appropriately (Kunnathodi & Sarabi, 2017).

However, it could also be argued that including tasks that demanded the application of the familiar content to more complex real-life problem scenarios could have provided a more challenging cognitive level of learning by involving "deeper learning and transfer of knowledge and skills to a greater variety of tasks and contexts" (Adams, 2015, p. 152). Strategies to raise the cognitive level irrespective of the module's familiar content or difficulty level could be investigated in follow-up research.

- **Self-directed learning**

It is acknowledged that SDL has been referred to explicitly and implicitly throughout the study. In this section, data revealing the participants' views of SDL are discussed.

Petra had a positive experience regarding the in-class group work where students worked together and explained each other. She noted that she was not really a 'checker' of homework (Appendix F, MC 2, 191-192). Since thorough preparation for class is crucial in an FCA

(§2.6.3), determining if students are prepared should be about making sure that students have the required knowledge and apply this knowledge during in-class learning on a more challenging level. Testing knowledge gained through out-of-class activities adheres to Principle 7 of the FCA as suggested by Lo et al. (2017). Lo et al. (2017, p. 65) recommend that instructors should "at the beginning of the lessons, activate students' pre-class learning by using a structured formative assessment such as a quiz." Such a pre-test not only serves to motivate class attendance but also promotes student performance by prompting them to recall new knowledge gained during out-of-class learning and provides the lecturer the opportunity to determine student readiness for the in-class learning activities (Lo et al., 2017). Assessment of students' knowledge could, therefore, also have provided the opportunity for Petra to determine the relevant cognitive level on which to pitch the in-class activities to support metacognitive gains. It seems that Petra's lack of experience in the implementation of the FCA may have contributed to this missed opportunity. The possibility also exists that if students did not experience the content as challenging, and if the lecturer did not apply innovative measures to raise the cognitive levels by designing activities within the students' ZPD, students would not have been motivated to apply SDL strategies to obtain the learning outcomes.

The lecturer acknowledges that it is a challenge to make the necessary mind shift to trust students with out-of-class work in the quotation below. She attributes her mindset to previous experience, which reflects the reality of education in the South African context:

"Traditionally in a mathematics class, if I think about where I taught at school and now here. Actually, I teach the whole time because there is so much to give or pass on to them and because when I think about my other classes, my other students, it always feels to me where they are, they do not have people to help them with math, so I want to explain the math to them." Petra, MC 2

With "other classes" she is referring to the distance learning student-teachers (§4.2.1) enrolled for mathematics modules in diploma or certificate programmes. These student-teachers often lack much needed foundational knowledge of mathematics (Bansilal et al., 2015; Jojo, 2019; Pournara et al., 2015) and with limited time for teaching in these distance learning programmes, Petra felt compelled to spend all face-to-face teaching time on explaining rather than focussing on an approach to teaching that fosters SDL, such as the FCA – she thus acknowledged the need for her to make a paradigm shift to a more learner-centred and problem-based environment.

In a country that is rated second from last on the TIMMS achievement scale (Reddy et al., 2017), and where there is a shortage of good mathematics teachers (§2.2), teachers often rely on direct teaching approaches as measures to teach to the test. Even in the case where a teacher or lecturer is competent and passionate, the drive to ensure that the curriculum is completed within the time frame is often stronger than the motivation to support strategies that would lead to deeper understanding and lifelong learning (Leong & Chick, 2011), that in turn may lead to missed opportunities to identify gaps in students' mathematics knowledge and skills due to previous ineffective teaching practices. These authors also express concern that when teachers (or lecturers) are pressed for time, it often does not allow them the luxury of student-centred approaches and time-consuming activities such as active learner participation in collaborative problem-solving activities (Leong & Chick, 2011) that are supportive of SDL. As mentioned in §4.2.1, Petra's experience of having little time to cover a lot of content with students enrolled in distance learning programmes, possibly contributes to her struggling to make the necessary paradigm shift, from assuming that students are reliant on the transmitting of knowledge by the lecturer while negating the need for activities that rely on students' SDL abilities. Such a clinging to direct teaching might hamper a meaningful implementation of the FCA and consequent support for SDL and metacognition.

The following quotation gives insight into how students perceive their self-directedness and the SDL skills of learners in general:

"… if you were going to tell a high school kid to prepare for tomorrow's class, you were not going to do it, you were going to say you did it even if you did not." Michelle, FG1

The low expectation of learner SDL reflected in the above quotation can be influential in how this prospective teacher will view her future learners and resembles the same underlying assumption that may have hindered Petra from trusting students with more challenging tasks involving more student control over their learning. The following quotation shows the low expectation of their SDL skills:

"My view of the flipped classroom is that the fact that the work we're doing now is not new to us. But suppose we go back to last semester where we did mathematics induction, it's the first time I did something like that, and if I, if Mr X told me, go home and see what mathematical induction is and try some sums if I had looked at the first sum like that I would have left it. I would have said I do not know what is going on here. Nina, FG1

Where SDL entails student control over own learning processes (Loyens et al., 2008), Nina most probably would not have been motivated to apply SDL even if the content if the module did meet the relevant challenging level.

- **The role of motivation in the flipped-classroom approach**

Motivation is a critical component in learning (Kloosterman & Stage, 1992; Pintrich & Schunk, 2002) and specifically in SRL (Pintrich, 1999) as well as in SDL (Loyens et al., 2008; Nenniger, 1999).

During the FCA implementation, the familiar content might have influenced student motivation to essentially prepare for class and the consequent need for self-assessment. This is demonstrated by Nina, who clearly lacked motivation to apply SDL skills to explore the mathematics content during out-of-class activities:

"For me, these are not really new concepts, because in both the subjects we have now, in Mathematics, we do the same basic, and that's what you did at school. So, it's not that we're learning new concepts, I don't think it feels like I've had the flipped classroom feeling yet because I never went and found things out on my own, it's just… ah! I did this at school, so I understand what's going on here." Nina, FG1

The interrelatedness of module content, motivation, and metacognition is confirmed by Vera:

"But we have to make the subject more interesting, and harder ... that you want to attend, and want to ask extra questions." Vera, FG3

Based on Nina and Vera's quotations, the mathematics content and the level of the problems to be solved were frustrating and had a negative effect on their motivation to attend class and actively engage with the content.

Petra had a positive experience implementing the FCA for the first time the year before and she was highly motivated to do it again (Appendix F, MC 2, lines 21-22). Based on Petra's reflections on the previously implemented FCA, she mainly experienced the FCA as contributing to meaningful learning based on an excellent student pass rate (Appendix F, MC 2, lines 96-98). Although a pass rate may be influenced by improved understanding through SDL and application of metacognitive skills in an FCA, deep, sustainable learning as the aim should be foremost.

Although Petra mentioned that class attendance was good, factors such as the quiz implemented in class that carried marks, could have served as extrinsic motivation to attend

classes (Thompson, 2016). I also reflected on possible alternative reasons for class attendance:

"Even though the content is related to their field of work, which should hopefully lead to more motivation to master the content, the purpose was not didactics. Extrinsic motivation of marks and having to pass could be why some students come to class." RJ (12 September)

Petra confirmed that the quiz administered at the beginning of the in-class learning counted one mark as an attendance mark and counted towards their term mark. The need for extrinsic rewards to motivate class attendance raises serious concerns regarding student SDL. Although the FCA is a means to facilitate students' mastering of the content, marks should not be the aim of learning but rather deep learning through the SDL skills that will become more important for teaching practice in the 21st century (Care et al., 2018).

- **The role of metacognitive skills in a flipped-classroom approach**

This study investigates explicitly how an FCA should be designed to foster metacognition within mathematics student-teachers. Therefore, all data were scrutinised through a metacognitive lens and reporting of the findings is explicitly and implicitly linked to support for metacognition through the FCA. Students' metacognitive skills can, however, also play a determining role in successful learning in the FCA, as reported in this section. The claim made by Ibrahim and Watts (2016) (§2.5.4), that educators must be able to assess students' metacognition to improve student learning, served as motivation for my reflection on this aspect in my journal:

"Assessing for metacognition employment seems much more challenging to implement than teaching strategies for metacognitive gains." RJ (30 April)

Veenman et al. (2006) highlight that since metacognition is not observable, assessment of metacognition is made possible by reflecting on a task or a self-report questionnaire. While reflecting on out-of-class learning (§4.4.2.1), students explained how they prepare for the in-class learning. Hannah employed metacognitive and SDL skills by identifying her learning needs (visual learner) and exploring different sources to prepare for class. She took responsibility for her learning and showed an understanding of the student-centredness of the FCA:

"…you teach the way you were taught. A teacher teaches me [a] specific subject as they were taught. I do not necessarily respond the same to how he explains to me, and what he tells me, as I may now be a visual learner or a more auditive learner. But I have experienced with the

flipped classroom, I find ways for myself to 'figure out' and understand. And when I'm in class, even though the teacher or the facilitator explains it as they please, I understand it because I have my own way, as I went to do my own preparation to understand it." Hannah, FG2

Hannah's experience showed the potential of the FCA to foster metacognition within student-teachers. It also might lead Hannah and other students to critically reflect on their own teaching practice one day as they will be in the classroom with students with diverse learning needs. Ann also explained how she uses the internet to look for information that she may be lacking, demonstrating metacognitive skills as part of SDL:

"I will… hmm… Google it or I will look in my textbook, and if I do not understand what is going on in the textbook, then I will go google it. I will use my textbook first and then google." Ann, FG 2

Although the above quotes show that some students do have metacognitive skills, there is also evidence that not all students have this skill, as demonstrated through the following quotations:

So if your lecturer makes the video herself then it will help because then you will do it in the right way for what you are going to get marks for, but it will not help you to have higher cognitive thinking to follow the different paths to get to the answer." Michelle, FG1

"… if Mr X told me, go home and see what mathematical induction is and try some sums, if I had looked at the first sum like that, I would have left it. I would have said I do not know what is going on here." Nina, FG1

Even though there are contradicting findings concerning the way student-teachers applied the out-of-class component and how and if students prepared for class, there is evidence that the FCA holds value to foster metacognition within student-teachers. However, determining what should be changed to improve student metacognition will require more planning, reflection, and continuous FCA redesigning. In this regard, strategies to check for student preparation to determine their learning needs and providing related problems in-class within their ZPD (§2.3.4) and their ZPD of metacognition will need to be considered. An evident lack of SDL skills reflected by some students also calls for a more substantial scaffolding to support this vital competence supported by metacognition (Loyens et al., 2008).

- **The role of knowledge, skills, and beliefs in the flipped classroom approach**

Both lecturer and student knowledge, skills, and beliefs are considered in this section as found in meso-cycle 1.

Lecturer knowledge, skills, and beliefs

Lecturer knowledge, skills, and beliefs – not only of mathematics but also of the FCA principles – is a determinant of the successful implementation of the FCA (FLN, 2014). Based on the quotation below, the possibility existed that Petra was not yet well-versed in some of the principles and strategies of the flipped-classroom design:

"Yes, I have to say I read a bit about it, but I actually also have a lot… I almost want to say, you know it's just… [I] read a bit and then I make my own opinion of how I wanted to implement it. And I implemented it my way last year without much reading and it worked for me, I feel it worked the way I did it." Petra, MC2

Although the lecturer demonstrated enthusiasm for the FCA, the literature confirms knowledge of the design principles and strategies is a requisite to the successful implementation of such a student-centred approach (§2.6.2). However, Petra showed an understanding of the student-centredness of the flipped classroom when she explained the importance of student preparation for in-class learning as a crucial principle of the FCA (Appendix F, MC2, lines 102-104).

Petra was also aware of the connectedness between out-of-class and in-class learning, where in-class activities build onto the learning that took place during out-of-class activities. Although Petra has ample teaching experience (§4.2.1), she has only taught this mathematics module for one semester prior to the investigation, and it was only her second year being involved in the BEd programme. This lack of experience in teaching BEd students could have contributed to her failing to raise the level of tasks to meet a more challenging cognitive level when it became clear that some students were familiar with the content.

The lecturer exhibited knowledge about metacognition as a determinant of the successful implementation of the FCA — as is shown in the quotation below:

"Let's say it's a bit of a more difficult concept, and they did not understand it well on the video, I think the fact to be able to know: 'I did not understand this, I now have to think carefully about what I must ask. 'For me, that is metacognition." Petra, MC2

In the above quotation, Petra mentioned an important benefit of the FCA: students needed to employ metacognitive skills to plan, monitor, and evaluate their learning process during out-of-class learning. Petra showed further insight into the need for a paradigm shift to a student-centred approach to foster metacognition:

"… perhaps changing from traditional [learning approaches] and their attitude to buying into this approach, is also a metacognitive skill." Petra, MC2

Processing a change, in reality, requires metacognitive reasoning (Haynie et al., 2012). In this case, 'reality' implies an awareness of the need for metacognitive reasoning to make the mind shift from a more traditional approach to teaching and learning to a more self-directed FCA. In reaction to Petra's response, I reflected as follow in my researcher journal:

"Therefore, you must have metacognitive skills to adjust to the approach better. So, supporting students in developing metacognitive skills and assessing for metacognition, might be key in implementing a successful FCA." RJ (8 September)

It became clear that successful implementation of the FCA and consequently also the fostering of metacognition through the FCA, require a certain amount of metacognitive skills to be in place. If these skills are not present, it may have to be taught to students before the FCA's onset (Ku & Ho, 2010) (§2.6.2).

Petra had her first experience with an LMS on tertiary education level when implementing the FCA the previous year and she acknowledged her weakness in this area and mentioned that she needed support (Appendix F, MC 2, lines 158-160). Technological support and continuous training are vital in an FCA implementation (Stanciu, 2016). When asked if she would consider putting a quiz on the LMS so that students can answer a quiz before class, she indicated that she is not sure if this can be done with the LMS as noted in my journal:

"I suggested that they do a quiz on the LMS even before class to check for student preparation and a trend in student answers. She said it's a good idea, and she thinks it is possible on the LMS, but she doesn't know it that well. This is an indication that her exposure and her experience with the LMS is limited and the features were not used to its full potential." RJ (10 September)

Since the LMS is the primary source of communication with students for out-of-class learning, lecturer expertise in this area will determine the FCA's success. The lecturer's confession to the students that she was not very confident with using the LMS may have influenced the way they valued the material placed on the LMS:

"Okay, but she says every time on her slides in class, be patient. I do not know how eFundi works. So, why should I go to the trouble and look at eFundi if I know she does not know what is going on?" Nina, FG1

Such a student attitude as displayed by Nina, can be detrimental to the FCA's success and demonstrates the interrelatedness of teacher knowledge, skills, and beliefs and that of the students.

Student knowledge, skills, and beliefs

Although the lecturer has a significant impact on the students' knowledge, skills, and beliefs, their prior knowledge, skills, and beliefs will impact their approach to learning. Evidence of a strong focus on results and grading emerged. In response to the question of whether students think it will contribute to their learning if their lecturer makes videos for the out-of-class learning herself, Michelle demonstrated her belief that success in mathematics is measured by marks attained:

"Mathematics is something that has so many answers. Everyone will come up with the answer 8, but like the way you get to it is so different. So if your lecturer makes the video herself, then it will help because then you will do it in the right way for what you are going to get marks for, but it will not help you to have higher cognitive thinking to follow the different paths to get to the answer." Michelle, FG1

Michelle believed that it would be beneficial for learning if the lecturer makes the videos herself, enabling her to replicate the mathematics as demonstrated by the lecturer and thereby ensure higher marks. A belief that the lecturer's way is the only way will hamper SDL and metacognition. Although Michelle acknowledged that there are various strategies to solve mathematical problems and, by exploring them, one might reach higher cognitive thinking, she also implied that using own strategies may not earn good marks. Michelle might have had experiences in the past where different approaches to mathematics were not encouraged or marks not awarded for different approaches. This belief may also be grounded in a lack of SDL skills and metacognitive skills. Moreover, the following statement by Henda confirms this results-orientated approach to learning:

"I understand I have to learn because I have to pass." Henda, FG2

During the focus-group interviews, it became apparent that students might have been subjected to transmissive and content-based teaching and learning in their academic careers that might hinder metacognitive gains in an environment that entails new demands from students, as highlighted by Candy (1991). In the next section, data findings from meso-cycle 2 are reported.

4.4.3 Meso-cycle 2

The goal of the DBR is to improve on the initial design through testing and revising and consequently to improve educational practice (§3.2). Through analysis of data collected in meso-cycle 1 and reflection on teaching and learning outcomes, the eventual FCA design is informed by the emerging need for changes to be made to design features to meet specific educational goals. Therefore, this section reports on emerging needs for changes, the redesigning and implementation of these adaptations and participants' experiences of the revised design.

Meso-cycle 2 consists out of micro-cycles 5, 6, and 7. In micro-cycle 5, data were collected through another semi-structured interview with Petra. The purpose of this cycle was firstly to gain access to her reflections on the FCA design principles and strategies as experienced in meso-cycle 1, with a focus on the potential of these strategies to support metacognition. Secondly, this cycle served as an opportunity to collaboratively plan for possible improvement and redesigning of the previous FCA as informed by reflections on meso-cycle 1, with the expectation that these design features will strengthen the support for metacognition. Micro-cycle 6 facilitated student-teachers' reflections on the implemented FCA through two focus-group interviews. In micro-cycle 7, data that emerged thus far were analysed through content analysis (§3.7) to make sense of the data. As with meso-cycle 1, reporting of the analysis and findings based on data emerging from this meso-cycle is again discussed for each of the two themes, namely *flipped-classroom design for metacognitive gains* and *determinants that may hinder or support metacognition in an FCA* (Table 4.1). The interrelatedness of concepts again requires cross-referencing in reporting findings related to the two themes (Figure 4.1 and Figure 4.2). The cyclic nature of the DBR also requires referencing to findings from micro-cycle 1 and meso-cycle 1. Therefore, how the design evolved throughout the investigation is considered and highlighted. The Mathematics module had ten classes scheduled for the semester, one class per week. This data collection phase started (lecturer interview) after the Mathematics module had been under way for five weeks and lasted till the end of the semester (focus-group interviews).

4.4.3.1 Flipped-classroom design principles and strategies for metacognitive gains

This section reports on changes made to the FCA by the lecturer as informed by reflections on meso-cycle 1 and participants' experiences of how these adaptions supported learning. Changes to the FCA applied to both out-of-class activities and in-class activities.

- **Flipped-classroom out-of-class activities**

Students' challenges concerning the out-of-class learning emerging from meso-cycle 1 included the way technology was employed for out-of-class activities and a need for stronger guidance in out-of-class activities. Barriers to metacognitive learning that emerged from meso-cycle 1 include a possible lack of student SDL and a lack of motivation to prepare for in-class activities through SDL that was partly due to students' familiarity with the content of the module, resulting in activities experienced as not being challenging. Therefore, the interrelated themes that emerged in this meso-cycle focus on how the design was adapted to address these challenges.

The use of technology for out-of-class activities

From data collected in meso-cycle 1 it became apparent that some students did not watch or did not know about video content placed on the LMS. Students applied different strategies to prepare for class such as referring to their textbooks instead (Appendix F, FG4, lines 50-53; Appendix F, FG3, lines 95-98). In my reporting on meso-cycle 1, I considered the possible lack of student SDL skills to find sources on the LMS, the LMS layout that might have been difficult to navigate for students, or the lack of student motivation based on the familiarity of the module content.

Although Petra explained that she provided the students with URLs to the open-access videos on the LMS, students again indicated during the second round of focus-group interviews that they still either had not looked for videos on the LMS or hadn't found the videos yet:

"There are sources but no videos … I have not found the videos yet." Jade

"I do not know of videos." Angela, FG 4

There could be various reasons why students still did not find these links on the LMS. Firstly, it could be that the familiarity with the content did not require them to explore further or employ different strategies to prepare for in-class learning and that their prior knowledge and strategies for preparing for class sufficiently equipped them for in-class learning. Secondly, it may be that the organising and layout of the video resources on the LMS were still not user-friendly and did not navigate students to the relevant sources. It can also be that students expected to see videos prepared by the lecturer herself and did not recognise the URLs link to the open-access sources as a video.

When students were prompted to reflect on their out-of-class learning strategies, Rachel indicated that she only makes use of the videos if she does not understand the concept as explained in the textbook:

"I first look in my textbook. So, and if I do not get it, then I'll go search for videos on YouTube, but it has not happened yet." Rachel, FG3

Even though some students indicated that they do make use of videos when necessary, the Mathematics module's content level possibly did not require Rachel to seek alternative strategies to prepare for class (further explored under *mathematics content*). However, she does know which resources to use that work for her and her learning needs that is an indication of metacognitive skills. Reliance on textbooks may also indicate that she has not made the paradigm shift towards a more self-directed approach to her learning to expand her knowledge beyond the textbook.

Jade indicated that she found her own videos as shown in the quotation below:

"I must go and search or find videos myself. We also did not know how to get it, and it was not attached to the information." Jade, FG 4

From the above quotation, it seems that the LMS layout was problematic for Jade and that she needed more direct guidance on how to access the videos. Searching in vain for an 'attached' video also implies that she may have anticipated actual videos of presentations to be posted on the LMS. However, Jade displayed some SRL skills by searching for her own videos if necessary. As mentioned in meso-cycle 1, giving students the responsibility to search for related videos on YouTube that meet their own learning needs can be viewed as an opportunity for students to implement more self-regulation and develop their SDL skills. However, Naccarato and Karakok (2015) warn that videos should be thoroughly checked to ensure that the relevant material is covered (§2.6.2). I reflected on possible implications of such a shift in responsibility in my researcher's journal:

"Some might argue that students should go look for their own videos and that that will be a way to support SDL and metacognition. I agree with Sarah (MC 1), who mentioned that it is dangerous to let them just find their own videos on the internet. Not merely because of bad quality, but if you just have a topic from a module plan, for example, the area of a circle, you will get millions of sources when you just type it into Google, where will you start … and where do you stop? How will you monitor and evaluate learning? I searched: area of a circle on Google, in 0.39 seconds, there were 129 000 000 results. Scaffolding is proving to be crucial

for the design of a flipped classroom with the potential to support metacognition." RJ (20 October)

The concern noted down in my journal is echoed by Angela where she seems uncertain about one of the topics that she had to prepare for class:

"Now there are … now it's exterior angles of shapes … okay, regular or irregular? Which shapes? Up to how many angles should we be able to go to?" Angela, FG4

Angela displayed the need to set specific lesson objectives and more precise guidance on the topic to focus on when applying technology for learning activities to better prepare for in-class learning. Moreover, students did not all necessarily watch the same videos for class preparation as not one specific video was allocated, but rather a variety of videos to choose from were provided as some students also referred to the internet to find their own videos. Since there were no rigid instructions on which video to watch and what aspect to focus on in a specific video, it appeared that not all students had a similar learning experience. Thus, there is no guarantee that all students were on the same page with regards to questions and problems experienced during the out-of-class learning. Michelle further shared her need to ask the lecturer specific questions based on specific videos that she watched (Appendix F, FG3 lines 253-257). Viewing different videos lead to different learning experiences. In contrast, if they viewed the same videos, students could benefit more from meaningful dialogue on shared learning experiences based on concepts illustrated in these videos. On the other hand – if the lecturer gave students the opportunity in class to share or explain the content of the different videos they viewed, it could have provided a metacognitive learning opportunity where students, for example, could compare the teaching approaches or problem-solving approaches that they observed in the videos.

From the data it is apparent that, although the FCA is a student-centred approach, the lecturer plays a crucial role in managing the use of technology such as the LMS and in giving strong guidance to students on the use of technology such as the Internet for the out-of-class learning to ensure that the FCA fosters metacognition.

Worksheets as an out-of-class activity

It is essential that out-of-class activities align with activities applied in-class (McLaren, 2013; Zappe & Litzinger, 2017) (§2.6.2). When students do not use out-of-class activities optimally, it results in a lack of preparedness for in-class activities that hamper metacognitive development during out-of-class activities and jeopardises the value of in-class activities for further metacognitive development. For additional guidance and clear objectives of what is

expected, students asked for an assignment to be put on the LMS before class (implemented during meso-cycle 2), as discussed during the interview:

"*What they suggested was that I already put an assignment for them on eFundi and not just the links. It is now the third week that we have this. And they told me it worked well for them.*" Petra, MC 5

The same sentiment was noted in Petra's journal as well:

"She (student) feels I must post an activity worksheet on eFundi so that they can do it before class." LJ (22 August)

Students' request for a worksheet to be available before the in-class session might further imply the need for a clear learning objective and stronger scaffolding of SDL. To address this challenge the students were provided an out-of-class task in the form of a worksheet to guide their preparation for in-class learning. Angela experienced this resource as meaningful:

"But with self-preparation, what helps me a lot is when she does that … that pre-class assignment because then I see what is required of me. So, for me to prepare and know what's going on makes a big difference for me." Angela, FG4

Although worksheets can be viewed as a teacher-directed resource, such a resource may serve as a necessary scaffold when students need stronger guidance in their out-of-class tasks (Çevikbas & Argün, 2017). The lecturer, therefore, must reflect continuously on her students' ZPD when making decisions for support. Guiding out-of-class activities to make sure students are well prepared for in-class learning could provide the opportunity to raise the level of required metacognitive thinking for in-class problem-solving activities.

- **Flipped classroom in-class activities**

Students commented in meso-cycle 1 (§4.4.2.2 *mathematics content*) that they were already familiar with the module's content. In an FCA, the content must challenge and motivate students to use the out-of-class resources to explore new topics (Kim et al., 2014). To address this issue, Petra planned to raise the complexity of in-class-activities and not to review the content again if students did not specifically ask for more explication during question time. Since it remains important in an FCA to clarify content and deal with misconceptions that might exist (Ray & Powell, 2014), and because not all students are on the same level of understanding, she conducted a simple diagnostic test to check for understanding and if students prepared for class, after which she gave the opportunity for questions about the work

they had to prepare. After student feedback, Petra did not reteach the content they had to prepare:

"If they do not ask, I actually go on because that's how I understand the whole idea of the flipped classroom, then I'm not going to bore them and reteach." Petra, MC5

Tiahrt and Porter (2016) also warn against re-teaching work to be prepared as out-of-class learning. Still, they suggest that this time be spent on interactive problem-solving activities (§2.4.2 *in-class-activities*). After the 'diagnostic test' and the opportunity to ask questions based on prepared work, Petra provided students with in-class activities:

"..*then I give them a more challenging assignment in class and then give them about 10-15 minutes depending on how much it is and in that time I walk through, and then they ask me, you know, and then we mark that assignment in class, and then usually we talk about how they experience the class and then the lesson is done.*" Petra, MC5

Petra's thus demonstrated an understanding of strengthening the FCA's potential to foster metacognition by ensuring that in-class sessions consist of higher-level questions and problem-solving with peers. Also, she highlights that the in-class sessions provided her with the opportunity to support students with activities by moving between groups. The literature confirms that moving around between groups provides an opportunity to access student thinking, assess for metacognition, or ask questions that can foster metacognition (§2.6.2 e*ducator role*).

Despite Petra's attempt to raise the difficulty level, students still found the in-class activities to be easy:

"She's just giving us easy stuff." Vera, FG3

I also made the following inscription in my journal:

"There seem to have been a disconnect between the experiences by students and the perceived student experiences by the lecturer regarding the content level of the work." RJ (20 October)

One of the benefits of the FCA's in-class learning is the opportunity to provide students with meaningful learning tasks (Rajaram, 2019). For the successful implementation of an FCA with the potential to foster metacognition, more reflection and revising will be necessary to ensure tasks challenge student thinking.

In the above quotation, Petra indicated that students are given a timeframe of 10 to 15 minutes for the in-class activity. Each in-class session is 1 hour and 15 minutes. In my journal, I reflected on how time could be managed more economically to provide more time for interactive problem-solving:

"I was left with the question as to why so little time is either provided or allocated to the in-class activity. What might be a time-consuming part of the in-class session is the 'diagnostic test.' Perhaps it would be worth revising the strategy of how to check for student preparation that is less time consuming that subsequently would free up more time that can be utilized for problem-solving during in-class activities." RJ (10 October)

For an FCA to foster metacognition, "student-teachers must get the opportunity to assess the task at hand, to evaluate their strengths and weaknesses, to plan their approach, to try and judge various strategies, and to reflect how far every approach and technique they purposefully experiment is working" (Kunnathodi & Sarabi, 2017, p. 27). As suggested by Kunnathodi and Sarabi (2017), the opportunity to foster metacognition and provide in-class learning might require more than 10 to 15 minutes. Reflection on time management and strategies to ensure students and the lecturer benefit optimally from in-class activities will show how the in-class activities can be managed more effectively, including reflections on the difficulty level of the problems to be solved in class.

Adhering to student requests for more challenging problem-solving activities, Petra provided students with a problem-solving question that could be solved in multiple ways as an in-class activity during meso-cycle 2. Below is a copy of the problem:

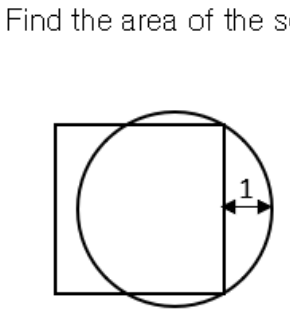


Figure 4.3 Copy of the in-class problem-solving activity.

I attended this lesson to observe in-class activities. Students started the activity in-class, after which they were busy with the problem for about 15 minutes before they were dismissed. After the class, Petra shared a Google Form as an email announcement. The Google Form

contained reflective prompts to guide students to answer questions about their experience of solving the problem in class (Figure 4.4). Students were asked what their solution to the problem was. Below is a screenshot of students' responses; on the right are the possible solutions for the problem that they could choose from:

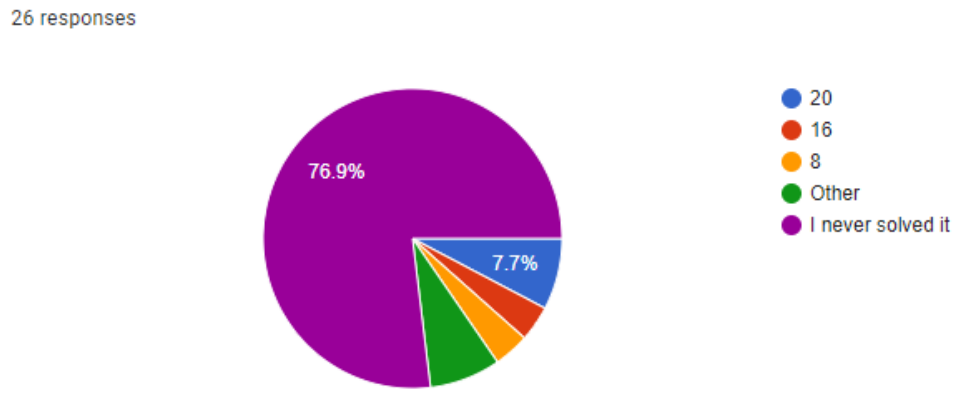


Figure 4.4 Student responses based on the problem-solving in-class activity

As shown above, twenty students (76,9%) did not solve the problem. Therefore, six students (23,1%) did solve the problem based on the feedback, either in class or after class. One student got the correct answer.

Although integrating technology for reflective prompts is known to create an environment for deep learning and higher-order thinking (Lee & Choi, 2017), weak participation may be because of many determinants. Firstly, lack of participation could be ascribed to a lack of metacognitive skills, since Gurat and Medula (2016) claim that students are more likely to solve a problem if they employ metacognitive strategies by assessing their progress and exploring different available paths. Secondly, poor participation could be ascribed to a lack of SDL skills and motivation. Zimmerman and Martinez-Pons (1986) describe students as employing SDL skills when they are active in their own learning in the area of motivation. The fact that they were expected to continue the problem-solving as an out-of-class activity shifted the responsibility to complete the task to the student and would have required the application of self-regulation and SDL. Thirdly, suppose students lacked the necessary skills, knowledge or beliefs of meaningful learning of mathematics in a student-centred learning environment, in that case, it could have influenced their ability and/or motivation to solve the problem (explicated further under *student knowledge, skills, and beliefs*). Gurat and Medula (2016) also warn that factors such as time limits, attitudes, and beliefs can hamper problem-solving. The time limit of 15 minutes that students had to spend on this problem in-class could have led to their failure to solve the problem. Students might hold the belief that if you cannot solve a

problem in a short period of time, you should just give up (Schoenfeld, 1988). Schoenfeld conjectured that students might develop and hold this belief as a result of their previous mathematics experiences Lastly, the lack of clear instruction on the part of the lecturer encouraging students to solve the problem or to provide helpful hints or guidance, could also have had an impact on their participation (explicated further under *lecturer knowledge, skills and beliefs*).

Reflection by the lecturer on factors that may have hindered active student participation may show how to change own actions, such as clear instructions and time management, to benefit from the FCA. Student participation in problem-solving activity illustrated in the pie chart raises questions. Students asked the lecturer for more challenging problems but failed to engage fully when she adhered to the request. A possible explanation might be that if work is not completed in class, they do not show a keen interest to learn by completing the question out-of-class. On the other hand, students might lack the perseverance to solve the problem, again indicating a possible lack of self-regulation and SDL, where SDL entails determination when learning is challenging (Bolhuis, 2003). Moreover, the problem-solving question did not carry marks, and therefore students were not motivated to solve the problem could be further evidence for students' lack of SDL.

- **Flipped-classroom strategies**

Flipped-classroom strategies enable the implementation of a successful FCA (Figure 4.1) while students' metacognition is influenced by themselves, the activities provided by an educator, and teaching strategies (Flavell, 1979). In this section, findings on participants' experience of flipped-classroom strategies and suggestions for improved strategies to refine the design of the FCA to improve support for student metacognition that emerged from this meso-cycle are emphasised.

Strategies supporting learning objectives

During focus-group interviews, the discussion revolved around whether students prepared for class and how a lecturer can determine whether students reached the out-of-class lesson objectives. Angela suggested that a test posted on the LMS may inform the lecturer of the way students prepared and determine where some students struggled to address it in class (Appendix F, FG4, lines 445-447). Checking for understanding before students come to class can alert the lecturer to aspects with which students need support and plan activities within their ZPD (Vygotsky, 1978), while also informing clear objectives for the in-class activities. Clear learning objectives can support metacognition development since it informs students

what they need to know (Boysen, 2016). Meaningful learning happens in the ZPD and can support cognitive development and, consequently, metacognitive gains (Çevikbas & Argün, 2017).

Scaffolding

Scaffolding and clear objectives are closely related. A strategy implemented by Petra, adhering to student requests (§4.4.2.1 *FCA out-of-class activities*), was to allocate a specific video for students to prepare for the next lesson. Michelle found it helpful when Petra sent an email with the specific URLs to the video to view as preparation for the next class:

"*What I liked about that particular lesson is, we got a notification that here are the 'links' and that you should prepare for next lesson instead of … you do not always have the time to go open every single link and look, okay, where am I now, you know…."* Michelle, FG3

This quotation, together with previous references in meso-cycle 1 reflecting a need for stronger student guidance, emphasise the vital role of the lecturer in providing scaffolding and making sure students are supported through identifiable student activities laid out on the LMS (further explicated below under *technology use in the flipped classroom*). Confusion regarding which activities needed to be completed as part of the out-of-class components might hinder the development of metacognition on the basis that in order for students to develop the skill of self-assessing their learning as part of metacognition, clear expectations had to be set. Kirsh (2005) advocates for a well-set-up online environment for metacognitive gains since students should be aware of the knowledge expectations that underline a major aspect of metacognition: realising what you need to know.

Feedback

Feedback plays an important role in the FCA implementation (Callender et al., 2016; Çevikbas & Argün, 2017; Lo et al., 2017) and contributes to fostering metacognition by correcting misconceptions and organising new knowledge (Apaydin & Hossary, 2017). During the focus-group interviews, I prompted student-teachers about their thoughts and experience on the problem-solving question (Figure 4.3), leading to the following reference to the role of feedback:

"She never provided the answer for the problem (other students agree). I still do not know how to work out the sum." Vera, FG3

Albeit there is an apparent discrepancy in students' prior reporting that the level of the module is 'too easy', students' responses imply a lack of feedback on the problem and possible

solutions. However, based on Knowles's (1975) definition of SDL (§1.2), a lack of SDL skills, such as diagnosing own learning needs and identifying resources to improve own learning, could have played a role in the missed opportunity for metacognition. A self-directed learner would have been motivated to evaluate their own learning and approach the lecturer for support after diagnosing their lack of knowledge and skills. Either one of these scenarios has implications for the development of metacognitive skills. Callender et al. (2016) suggest that feedback is an important influence in improving student's metacognition. Reflection on how to improve and revise feedback strategies to support cognition and metacognition is therefore crucial. However, the role of student SDL (or the lack thereof) in student metacognition and how to support this crucial 21st century skill through student-centred strategies such as the FCA should not be ignored.

Michelle put herself in the lecturer's shoes when suggesting alternative feedback strategies:

"…*I (lecturer) put the memorandum on eFundi. If you still do not understand, come see me in extra hours if … if there is no time in class."* Michelle

"*Would you have done that?"* Interviewer

(Students said yes)

"*Yes, if I had known I was going to get feedback (students agree), then I would have put more effort into extra sums."* Michelle, FG3

Providing the feedback in the form of solutions after the students grappled with the problem could have allowed them to assess their answers and motivated them to ask for further clarification if needed. However, care should also be taken not to deprive the students of the opportunity to solve the problem in their own way and thereby foster metacognition before providing solutions. Students should become aware that there may be different ways to solve a problem (Boaler, 2016; Zimmerman, 2000) and that they need not apply similar strategies as demonstrated in the memorandum (§2.2.2). Asking students to rather present their solutions and strategies to the whole group as feedback strategy could have served as an ideal opportunity for self-evaluation and metacognitive thinking when comparing different ways of thinking through collaborative learning (§2.3; §2.4) (Shahnaz & Hussain, 2016). Although Petra should pay heed to the students need for constructive feedback, improved SDL skills could have led students to take the initiative and make use of appropriate resources, including the lecturer, in order to set, evaluate and reach their learning goals (Knowles, 1975), instead of blaming their lack of understanding on the lecturer. Such a scenario is strengthened by Petra's (§4.4.2.2) and Sarah's (§4.4.1.2) perceptions that students lack the motivation to be

actively involved in their learning of this module. A further quotation by Michelle serves as further proof of the possible lack of student responsibility for their learning:

"*Yes, because I think feedback is going to help quite a lot because at the moment it feels to me if you did not figure out the answer yourself, then … you hope it's correct and that it won't be in the exam.*" Michelle, FG3

Michelle insinuated that if you did not figure out the answer yourself, you are left to your own devices. She did not indicate that she saw it as her responsibility to find the solution to the problem even though the lecturer provided question time during in-class activities. The hope expressed that such questions are not asked in the exam furthermore illustrates the results-orientated approach to learning rather than a strive for deep sustained understanding. This focus on the answer rather than the process of getting to the solution is evidence of a lack of genuine interest in what mathematics is and can do (Van de Walle et al., 2013). Engaging in tasks merely to receive rewards or to pass the examination is an indication of extrinsic motivation rather than perseverance in solving problems driven by intrinsic motivation (Lucariello et al., 2016). When learning is motivated by marks only, supporting metacognition through feedback might be hindered since assessing understanding appropriately necessitates that one does not merely consider answers but also thinking and reasoning (De Corte, 2004). Thinking and reasoning both have the potential to foster metacognition since metacognition involves the process of being aware of your thinking (Campione, 1987) and thinking critically (Magno, 2010). Critical thinking through reasoning involves students explaining and justifying their solutions and making sense of others' explanations (Plomp, 2013). A lack of student involvement will hamper these valuable opportunities for metacognitive gain.

It might be worth considering revised strategies for providing feedback on the LMS based on students' experiences. Below is a suggestion made by a student as they exhibited a need for guidance and feedback:

"*I think maybe we can have a conversation on eFundi ... to say, who does not understand here? or who has an idea where to start? or… or the lecturer might say: okay, I see you are struggling with this, here's the first step you need to take, or to give a clue, and then to try figure it out again, and then say, okay, I got this far or I'm stuck here, but also to limit it so that no one gives the answer before everyone has not come to that point*." Michelle, FG3

Michelle's suggestion for using the LMS for feedback and collaboration also links up with suggestions by Denton et al. (2008). Motivated to find solutions to the numerous challenges

to provide meaningful and timely feedback to students, these authors investigated the use of technology as a learning tool and their findings are based on students' experience of videos as the out-of-class component as well as using the LMS as a communication tool. Lecturers implementing the FCA can learn from their findings where they concluded that online formative assessment "can be returned more quickly and is used to synthesise relevant information that is both fair and balanced" (Denton et al., 2008, p. 486). In the next section, participants' experiences concerning the use of technology is explained.

- **Technology use in the flipped classroom**

Although Petra planned to make video recordings of her own presentations, this did not materialise due to time constraints. Because of the time-consuming nature of preparing video lessons, Bergmann and Sams (2012) suggest using readily accessible instructional open access resources (§2.6.2). However, an educator needs to ensure the videos' quality and reliability (Ray & Powell, 2014). Petra indicated that she used the same video sources (URLs to open-access videos) provided to students on the LMS the previous year.

Participants provided feedback based on how they experienced the way these visual resources were shared on the LMS. Rachelle suggested that instead of providing all links to videos pertaining to the Mathematics module separately on the LMS, the link(s) for the specific videos that students need to watch for the next lesson should be available on the module plan where the topic for the lesson is provided.

"*Or maybe she can just for example hmmm … where you get the work, there where she puts the study units and summaries, putting the video there, instead of just listing videos, that what you need for that section… that the videos are with it."* Rachelle, FG3

This was reiterated by Michelle, who said she found it helpful when Petra once sent an email indicating the specific video that they had to prepare for the next lesson:

"*What I liked about that particular lesson is, we got a notification that here are the 'links'"* Michelle, FG3

It became clear that similar to experiences reported in meso-cycle 1, organising the resources on the LMS was not experienced as student-friendly. They found a list of URLs to open-access videos, time was wasted to view all videos to determine which is relevant to the topic they had to prepare for in-class learning. There was a suggestion for more guidance on what to look out for concerning a specific video:

"*In other words, one video might be better, and you know everyone watched it. The lecturer watched it… you watched it?"* Interviewer

"*Yes, because like then when I say: Mam… the sum about the cup on the ball… the volume, and then the diameter (someone laughs softly) and whatever is asked… I have no idea how to get started. I have, like, they have now shown me how to start there, but how am I going to have to think to be able to deduce it or whatever."* Michelle, FG3

Ley et al., (2010, p. 76) warn that "the absence of appropriate instructional support has been found detrimental for learning." The extra strain caused by a poorly structured LMS may detract from the metacognitive effort required to apply SDL skills. Such cognitive overload may distract students from their main learning objective (Ley et al., 2010). It can be concluded that scaffolding enhances SDL and metacognitive gains.

Incorporating technology for learning such as an LMS, which is considered a benefit of the flipped classroom, can also prove to be a challenge if both lecturer and student are not skilled at using the online tools that are utilised for the implementation of the flipped classroom (Akçayır & Akçayır, 2018). After the focus-group interview, I reflected in my journal on the importance of the integration of technology of an FCA with the aim to foster metacognition:

"Making sure that both the lecturer and students can navigate the LMS well is very important for an FCA implementation to foster metacognition. Using it for announcements to mention test dates etc., is completely different to using it for mediating learning like with the flipped classroom where the out-of-class component is crucial and the bedrock of in-class sessions." RJ (16 October)

As mentioned earlier in this section (*flipped classroom in-class activities*), a well set up online environment can support students in taking more responsibility for learning (Bray & Tangney, 2017). Online tools such as the Google Form provided students with reflective prompts and gained access to student thinking without being physically present in class and can lead to an environment for deep learning (Lee & Choi, 2017). Apart from FCA design principles and strategies, other determinants that may hinder or support metacognitive gains in an FCA again emerged from the data and re-emphasised the findings from meso-cycle 1.

4.4.3.2 Determinants that may either hinder or support metacognitive gains in an FCA

Categories under Theme 2 that emerged through the analysis of meso-cycle 2 include mathematics content, the role of motivation, metacognition and knowledge, skills, and beliefs in the FCA. Similar to reporting on meso-cycle 1, it is not possible to discuss these concepts in a segregated manner due to the interrelatedness of the determinants and the relation between these determinants and FCA strategies and principles.

- **Mathematics content**

During meso-cycle 1, it became apparent that the Mathematics module's content caused frustration on the part of the student-teachers. Based on the lecturer's experience of this meso-cycle, the cognitive level of content focussed on during in-class activities was raised.

While discussing Petra's experience of student involvement in the FCA thus far, she offered the following explanation why students might not engage and be interested in the learning process of the module as she has hoped, and as she experienced the year before:

"Maybe it could be because it's actually pretty easy, and they didn't expect to have a whole module on these easy things." Petra, MC5

The content level of the module could have therefore influenced the level of students' cognitive engagement. Student active engagement is an objective of the FCA (Steen-Utheim & Foldnes, 2018) and is key in developing metacognitive skills (Limueco & Prudente, 2019). When students are not motivated to engage with the content, it will hamper metacognition since metacognitive behaviour is demonstrated through the regulation of own mental processes (Wilson & Bai, 2010) that are only possible when one is actively involved in one's own learning.

Although students struggled with the problem-solving question (Figure 4.3), they indicated that they still found the in-class activities easy (§4.4.3.1; *flipped class in-class activities)*. Prompting students about how they go about preparing for in-class learning, Jade indicated that she did not need to watch videos since the content was simple enough as per the quotation below:

"The Mathematical module is still simple enough that I do not have to watch a video." Jade, FG4

Consequently, the basic level and familiarity of the content still might have played a role in both student involvement and their desire to learn. This implies that the module's mathematics level had had an impact on student motivation, as also reported under *motivation*. As reported

in §4.4.2 (meso-cycle 1), the familiar content and the fact that students could complete in-class learning without preparing had implications for this study and investigating whether the flipped-classroom design fosters metacognition, or not.

- **The role of motivation in the flipped classroom**

As mentioned in the paragraph above, motivating students to regulate their learning in an FCA is challenging. A key benefit of the FCA, opposed to traditional lectures, is the emphasis on student engagement and active participation (Fredriksen, 2020). Asked what her experience has been thus far regarding student engagement and motivation in the FCA implementation, Petra noted that the students were not as involved as she hoped (Appendix F, MC5, lines 3-6).

When prompted why she thought that they were not as involved, she said that students are focussed on questions that will be in the exam only and not about understanding the work:

"… *they are set to know typical exam questions. In the end, they want to pass … that's what … it does not feel to me as if they think they should understand this work really well.*" Petra, MC5

Even though Petra did not find the students to be very involved or display a keen interest to learn, she noted that students did attend class. One of the student-teachers, Anet (FG3), claimed that the class test written in the beginning of each lesson (diagnostic test) motivated her to attend class, confirming Petra's suspicion that students' motivation is to pass and not to learn to understand. Such an objective for learning tends to lead to less sustainable understanding and knowledge gain (Elliot & Dweck, 1998).

As mentioned before (§4.4.2.2 *cognitive levels)*, the familiarity of the course content and the basic level had implications for student motivation. This was further confirmed by Petra's experience about the lack of student engagement. The following quotation supported the implied effect of the basic level of the module on student motivation by Vera:

"She's just giving easy stuff right now. It's boring." Vera, FG3

It is acknowledged that positive and negative emotions affect learning in academic environments (Özcan, 2016). The next section again reports how the data collected in this meso-cycle provided evidence of student metacognition as a consequence of the FCA design.

- **The role of metacognitive skills in the flipped classroom**

While the literature confirms the FCA's value in fostering metacognition, a measure of student metacognitive skills as part of SDL is required for successful learning in an FCA. When Petra was asked if she noticed students employing metacognitive skills, she indicated that both the diagnostic test and the in-class group work activities are likely to support students in determining what they know and what they do not know – which relates to declarative metacognitive knowledge (Flavell, 1979):

"They will say it helps them to see what they know then and what they do not know then and then they can, in that group with their group mates now even if they do not understand something, ask someone." Petra, MC5

She also wrote in her journal that a male student (not a participant in the study) experienced the FCA as supportive of learning:

"It's good and works for him because he can figure out what he knows and what not. He also learns from peers at his table." LJ (22 Augustus)

This reflection confirms the potential of active learning during in-class sessions as important FCA principle as well as a strategy to foster metacognition, as explained by Krouss and Lesseig (2020, p. 620): "When students are required to explain their reasoning to their peers, they must actively reflect on their own thinking, which supports metacognition."

To check for further employment of metacognitive skills, as part of the Google Form mentioned earlier (Figure 4.4), students were asked if they would be able to explain the content of the in-class session to someone else. The purpose of the question was to identify students' confidence level with the learned content since accurate judgement about one's knowledge is conceivably an indication of successful metacognition (Callender et al., 2016). Below is a screenshot of the question provided to students in the Google Form:

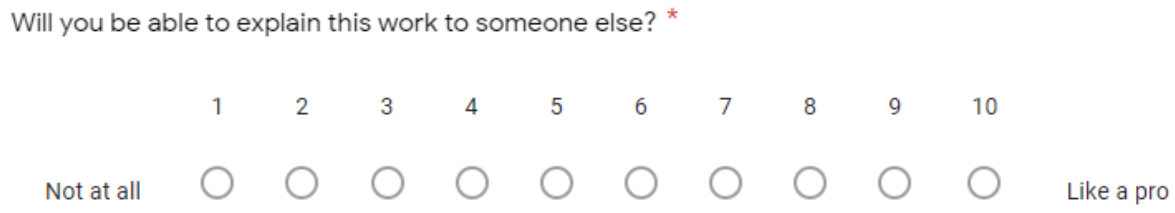


Figure 4.5 Screenshot of the question posed to students

Below is a screenshot of student responses:

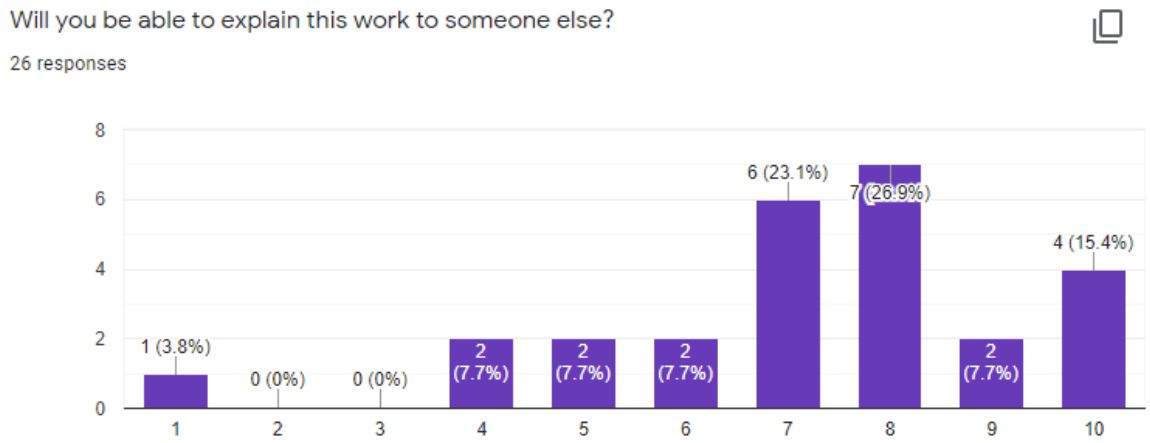


Figure 4.6 Screenshot of data on student responses

Bearing in mind that the student-teachers are prospective teachers, quite a few students did not seem comfortable teaching the content to someone else. One student did not feel confident, while half of the students only evaluated their competence as seven or an eight. It was expected that students would be more confident in explaining the work to someone else, hence, having confidence in their knowledge. Especially also since students have been expressing how easy the content was. Anet made a keen observation about the skill it took to be able to explain mathematics to someone else:

"If you analyse it, then it's simple, but getting to the point where you can analyse it in such a way that it seems simple is another challenge." Anet, FG3

The above quotation strengthens the surmise that the underconfident scores in the Google Form can also be interpreted as a possible application of metacognition. Based on the claim by Callender et al. (2016), and Anet's observation that own understanding does not guarantee confidence to teach a concept, it is implied that some students possibly employed metacognitive skills when they judged their own knowledge and ability to explain the work to others as low. Measuring metacognition was not the aim of this study, and Schunk (2008) warns that accurate measuring of metacognition, which is closely related to self-directed and SRL, can only be attained through in-depth investigations of learner behaviour and benchmarking learner actions with learning outcomes. People are often unrealistic in their self-assessments of their metacognitive behaviour (Schunk, 2008), and therefore students were not asked to evaluate their metacognitive competence. Where data were analysed using a metacognitive lens, it became apparent that, although the FCA holds potential to foster metacognition (Van Vliet et al., 2015), a lack of SDL, SRL and metacognition can also hamper

the way the FCA fosters metacognitive gains. In the next section, both lecturer and student knowledge, skills, and beliefs that impacted the FCA implementation with the aim to foster metacognition are reported.

- **Knowledge, skills, and beliefs**

Teaching and learning in the 21st century demand that different learning expectations call for different instructional approaches (Care et al., 2018), and core beliefs of traditional teaching and learning of mathematics are being confronted (Ellis & Berry, 2005). Lecturers and students often find making these required paradigm shifts regarding the knowledge, skills, and beliefs of traditional teaching and learning of mathematics challenging.

Lecturer knowledge, skills, and beliefs

It is generally agreed that the lecturer's subject knowledge and skills play a determining role in successful teaching and learning. Beliefs in meaningful learning and pedagogical knowledge are equally important (§2.2.2). As reported in §4.4.3.1 (*flipped classroom in-class activities)*, the basic level of the module is supported by the following quotation by Vera:

"And I think she should put different levels of questions on the worksheet… and then maybe do more difficult sums as well as easy sums. That we can practice in the same way. She's just giving easy stuff right now. It's boring. Giving challenging sums, but also then saying: let's mark it, and let's do it together." Vera, FG3

This quotation implies a possible lack of lecturer knowledge about the ZPD of the student population. Thoughtful planning to accommodate different levels of learner competence (differentiation) should inform student activities. Problems that do not challenge student thinking (§2.3.4) may lead to low student motivation to be actively involved in their learning (Efklides, 2011), and this has implications for the development of metacognitive skills.

After the class that I observed, I made an entry in my journal referring to the problem-solving question posed to students (Figure 4.3):

"No instruction of when and/or if that question must be finished was provided by the lecturer. While working on the sum, one girl asked if there will be a question like that in the test. When the lecturer said no, she immediately lost interest in the sum." RJ (13 September)

Petra seemed oblivious of the impact her answer to this student's question may have had on the students' motivation to solve the problem. It was clear that Petra overestimated the students' self-directedness to persevere irrespective of extrinsic rewards such as marks. Students seemed driven by marks, and that appeared to be their incentive to learn. Successful FCA tasks will depend on the lecturer's knowledge of the students' ZPD, the type of tasks that will engage the student, and how to enhance student engagement in learning tasks. Students are more motivated to get involved in interesting, functional, and relevant classroom tasks (Sullivan, 2011).

Student knowledge, skills, and beliefs

In meso-cycle 1 (§4.4.2.2 *student knowledge, skills, and beliefs*), it was speculated that students were focused on marks and not the process of learning. This trend also emerged in meso-cycle 2. During meso-cycle 2, Petra suspected that students were very focused on what will typically be in their tests and exams and that they just wanted to pass the module:

"They are set to know typical exam questions. In the end, they just want to pass that's what, it's exactly that. It does not feel to me that they feel 'we should understand this stuff really well." Petra, MC5

Serving as evidence for Petra's speculation, when students were asked if they thought the FCA would work for their learners one day, participants said that for the FCA to work, they would have to make their future learners write a test in class the next day to make sure that they prepared and that it had to count for marks, as shown in the quotation below by Jade:

" … that's what I wanted to say… you're going to have to threaten them with: it counts for marks." Jade, FG4

Students clearly did not yet make the necessary paradigm shift to a more learner-centred constructivist approach to mathematics education. A belief that the lecturer is the sole source of knowledge and that learning mathematics' main objective is to pass the module or subject will impact knowledge and skills development. The need for extrinsic motivation for learning, as displayed by the students, also has implications for implementing an FCA for metacognitive gains and motivating students to regulate their learning with deep learning and understanding as the main aim is challenging. Abeysekera and Dawson (2015) confirm that, in an FCA, for the approaches to work, the acceptance that grades for attendance and requiring proof of completing out-of-class learning must be observed.

After considering the FCA and its potential to foster metacognition within student-teachers, the next section reports on the findings from the last semi-structured interview with Petra. The purpose of this interview was to reflect upon and consider possible further improvements to the implementation of the FCA for metacognitive gains.

4.5 Reflection interview

At the end of the data collection phase (§3.5.1), this interview took place to obtain post-FCA implementation reflections from Petra. She was asked general questions about her experience of the FCA to support metacognition and how she thinks the design can be improved. Petra indicated that she would again implement the FCA for the Mathematics module the following year. She was asked which aspects of the FCA she would keep the same and which aspects she would change to improve the FCA design. The first thing she mentioned was that she would implement strategies to better prepare the students for the FCA. Since this module is part of the second-semester programme, she plans to ask the lecturer who teaches these students during the first semester if she could use the last 10 minutes of their final session of the first semester to explain the FCA to students, the same as she did the year of data collection. In agreement with the literature (FLN, 2014; Fredriksen, 2020; Lo et al., 2017; Steen-Utheim & Foldnes, 2018), the change in both student and lecturer roles in a flipped-classroom implementation proved to be crucial. Explaining the FCA and expectations to students is important, but they need to be guided to make the transition (Lo et al., 2017).

Moreover, Rotellar and Cain (2016) claim that the paradigm shift in an FCA might be more challenging for educators than for students. The authors say that if an educator believes that being a good teacher is an innate ability, educators find it even more challenging to let go of their role as the deliverer of content. The following quotation by Petra explains that she too might have had difficulty with the required changed role of the flipped classroom as described:

"*They said yes, they pertinently told me every time; they think I should put up videos of the classes that I would then have explained in class because remember, I do not actually explain in class unless they ask me. Ask me about what they've watched. And then, the typical teacher that I am, then I say: okay, let me give you a lesson on this. Then I might expand a little more than they might have even asked, and that's why I thought I actually, because I know now what I really want to teach them in the videos, that the links and everything is actually a bonus and extra, but I teach them a basic lesson on what I feel they need for that lesson."*

Petra speaks about "the typical teacher that I am" and implied that her instinct in class is to teach content and that she fell into the trap of reteaching content that students were to prepare

during the out-of-class learning. Reteaching will demotivate students to take responsibility for their own learning during out-of-class activities. Reteaching could possibly have been avoided if she made her own videos with the benefit of tailormade presentations for the specific target student population and first-hand knowledge of its content. The lecturer will know precisely what content students were exposed to through viewing the videos. Self-produced videos also provide the opportunity to ensure a good match between the content of the videos and the course curriculum.

When prompted to reflect on how she would change the FCA design, she mentioned three things that she would do differently to improve on the current FCA implementation. Firstly, she would provide students with more challenging questions for in-class sessions. Secondly, she would incorporate even more real-life type questions. Thirdly, she was planning on making the video lectures herself.

Petra celebrated the fact that towards the end of the semester, she improved in using the LMS. At the beginning of the course, announcements to students did not post correctly. She was under the impression that students got the notification and necessary information, but they did not. Her posting of student announcements was more effective after she became aware of this error. This is a possible explanation to the question posed (§4.4.2.1) as to the confusion of why students did not know about the video content that they were supposed to use to prepare for class. Petra is keen to improve her skills using the LMS and to exploit more of the available features that she has heard about but has not tried out yet (Appendix F, reflection interview, lines 121-135).

Petra was again asked if she would consider asking students in future to submit the diagnostic test electronically before class. The quotation below was her response:

"Yes. I think that is absolutely the answer, but then you will implement something else to get them to attend class. But anyway, if you get them to buy in, they should actually attend class."

Petra seemed hesitant because she anticipated an extrinsic motivation to motivate students to attend classes since the class assignment contributed towards their marks. She acknowledged that if students understood the FCA's value, they should come to class without an incentive (Appendix F, reflection interview, lines 277-279). Again, this concern highlights the importance of a paradigm shift and acceptance of the changed role of the students in an FCA. Petra acknowledged that there is a lot of pressure in academia and on students; marks are often the motivation rather than deep, sustainable learning (Care et al., 2018), as is also evident throughout this investigation's findings.

The reason why some students performed average in a relatively easy module raised questions. On the one hand, it could be a lack of metacognitive skills (they cannot regulate their learning and are not able to figure out what they do not yet know), while on the other it could be a lack of motivation as a result of the content not being within their ZPD. When this question was posed to Petra, she made valuable comments that need to be considered in future improved models of the FCA for metacognitive gains. She indicated that implementing the FCA with a more challenging module would be preferable (Appendix F, reflection interview, 270-270). The course content's role in student motivation has been referred to often in both meso-cycles. Role players in the programme design should note this determining factor if an FCA is to be implemented for the teaching and learning of any course.

Compared to a more traditional classroom, Petra believes that the FCA supports students in becoming better users of the internet (Appendix F, reflection interview, lines 202-203). Students are more exposed to the possibilities of the internet in their learning. Petra also found that, since students had ample time during class to ask questions, she dealt with fewer student enquiries during office hours. Through this experience, she furthermore learned to prepare students for the FCA by thoroughly explaining to them the principles and benefits of the FCA and metacognition and its value for better student experiences (Appendix F, reflection interview, lines 290-294). This view is echoed by Cunningham et al. (2018), who provide tools that a lecturer can use to involve students in developing their metacognition.

4.6 Conclusion

This chapter reported the analysis and the findings after raw data were scrutinised and coded holistically to find concurring themes relating to the research question and sub-questions. Analysing the data through inductive and deductive coding and by organising the codes into meaningful themes enabled me to communicate the findings. Code networks reflect all themes and codes and provide a visual presentation on how they fit into emerging themes. Quotations from participants and excerpts from the lecturer’s journal and my journal, together with a continuous grounding in the literature, served to motivate and argue the findings. Various data sources provided different vantage points on how the flipped classroom design holds potential to foster metacognitive gains and illuminate how the design should be adapted to improve support for metacognitive gains.

Although certain gaps in the study, as reported in Chapter 5, were identified, it provided all role players a valuable opportunity to gain insight and knowledge of important principles of an FCA that should be considered in the designing and implementing such a student-centred teaching and learning approach. Where metacognition is viewed as a crucial skill for

successful learning in the 21st century (§2.4), and since the findings from both the literature and the empirical study confirm the value of the FCA to support metacognition, designers of an FCA for the teaching of mathematics should take note of lessons learned through this study, if students are to optimally benefit from this approach, with specific emphasis on metacognition.

Both benefits and challenges concerning the implementation of the FCA to foster metacognition became apparent through data analysis. A principal finding that emerged from this study is that, for successful FCA design for metacognitive gains, both the lecturer and the students need to make the crucial paradigm shift towards a more learner-centred approach to teaching and learning. Furthermore, both the lecturer and the students should have a clear understanding of the aim of the FCA design features as well as their roles in each part, namely the out-of-class activities, the in-class activities, and the use of technology such as the LMS to ensure that students as well as the lecturer benefit optimally from the value of the FCA, especially concerning student metacognitive gains.

Findings regarding determinants that hamper or support metacognitive gains include the knowledge, skills, and beliefs of both the lecturer and the students. Although the student plays a prominent role in this student-centred approach, the literature and the findings confirm the lecturer's important role in preparing the students for the FCA design principles and their role in an FCA and to set clear and transparent learning goals. Apart from sound subject knowledge, the lecturer should have a good understanding of the students' cognitive levels concerning mathematics to plan and implement flipped-classroom activities within these students' ZPD. Student preparedness for the FCA will influence their attitude towards the FCA and motivate their active participation in the learning process.

Grounded in the findings from the literature and the DBR, Chapter 5 concludes by arguing the way the data answers the research questions and the sub-questions. Findings of the investigation and the body of scholarship are considered regarding emerging design features of an FCA that can foster metacognitive gains. Finally, guidelines are suggested to implement an FCA for metacognitive gains to prepare mathematics teachers for the 21st century, as informed by the findings.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The demands and fast pace of the 21st century have created new challenges and problems in daily life. Gravemeijer et al. (2017, p. 106) note that “our world is changing rapidly under the influence of informatization, automatization, digitalization, and globalization”. Therefore, as Gravemeijer et al. (2017) note, change is required in both mathematics pedagogy and content, and that 21st century skills must become the goal of mathematics education. Curwen et al. (2010) advocate that student-teachers must become reflective and collaborative teachers equipped with metacognitive skills. These 21st century skills correspond with the characteristics proposed by Demirkasimoglu (2010), which include progressiveness and the ability to collaborate with colleagues. For higher education institutions to train progressive student-teachers by equipping them with the necessary metacognitive skills, not only to improve their teaching but also to model and teach it back to their students, exploring strategies that can foster metacognition within student-teachers is required.

Suggested guidelines for an FCA design, with a specific focus on metacognitive gains as the outcome, as disclosed in this chapter, was informed by the body of scholarship and the empirical findings of the investigation. As suggested by Amiel and Reeves (2008), for others to determine if guidelines can be applied to their setting, derived guidelines are described in detail.

A DBR is open and begins with the basic assumption that existing practices can be improved (Herrington et al., 2007). Therefore, this design provided the opportunity to investigate the following research question:

> *How should a flipped-classroom approach be implemented for metacognitive gains to prepare mathematics student-teachers for the 21st century?*

In Chapter 1, I provided an orientation to the main aspects of the study, focusing on the problem that led to the investigation, the research questions, aims and objectives that directed the investigation as well as the research design. The research objectives were attained by finding answers to the secondary-research questions. the. The reviewed literature reported in Chapter 2 focused on mathematics teacher preparation for the 21st century and includes constructivism, metacognition, and the foundational principles of the FCA, and was directed at answering sub-research question 1:

1. What does the body of scholarship indicate with respect to design features of a flipped-classroom approach aiming to foster metacognition as a 21st century skill in student-teachers in their learning of mathematics?

Chapter 3 consisted of an in-depth explanation of the research design and methods. The DBR was clarified and motivated, data collection and analysis methods explained, and trustworthiness and ethical considerations were discussed. The investigation set out to improve upon the FCA's initial design by understanding 'how it works' as the suggested aim of DBR (Plomp, 2013). Also, findings concur with Gravemeijer and Van Eerde (2009) that a DBR holds the potential to encourage collaboration amongst educators to share knowledge and critically reflect on practice for improving the teaching and learning of mathematics education.

In Chapter 4, the findings of the data analysis were reported and were directed at answering sub-research questions 2 and 3:

2. How do student-teachers and the lecturer experience the implementation of the flipped-classroom approach that aim to foster metacognition?

3. How can the flipped-classroom design be revised to improve support for metacognition?

This chapter conveys how the findings of the investigation reported in §5.2, and as illustrated in figure 5.1, met the primary and secondary aims of the study as set in Chapter 1 (§1.6). The way the primary aim was met is reported through an integrated summary of the findings of sub-research questions 2 and 3 (§5.2.1). To address the secondary aim, conclusions of the literature review, together with the findings from the empirical investigation, informed the answer to the sub-research question 4:

4. To what extent do findings from the literature and the empirical study explicate critical elements that are required to be accommodated in a flipped-classroom approach to foster mathematics student-teachers' metacognition as preparation for teaching in the 21st century?

Critical reflection on all findings informed suggested guidelines for an FCA design, with a specific focus on features to foster metacognitive skills within mathematics student-teachers enrolled at the higher educational institute (§5.2.2). The desired research aims were directed by the sub-research questions to ultimately answer the main research question.

Figure 5.1 illustrates how answers to the sub-research questions generated answers to the main research question of the investigation:

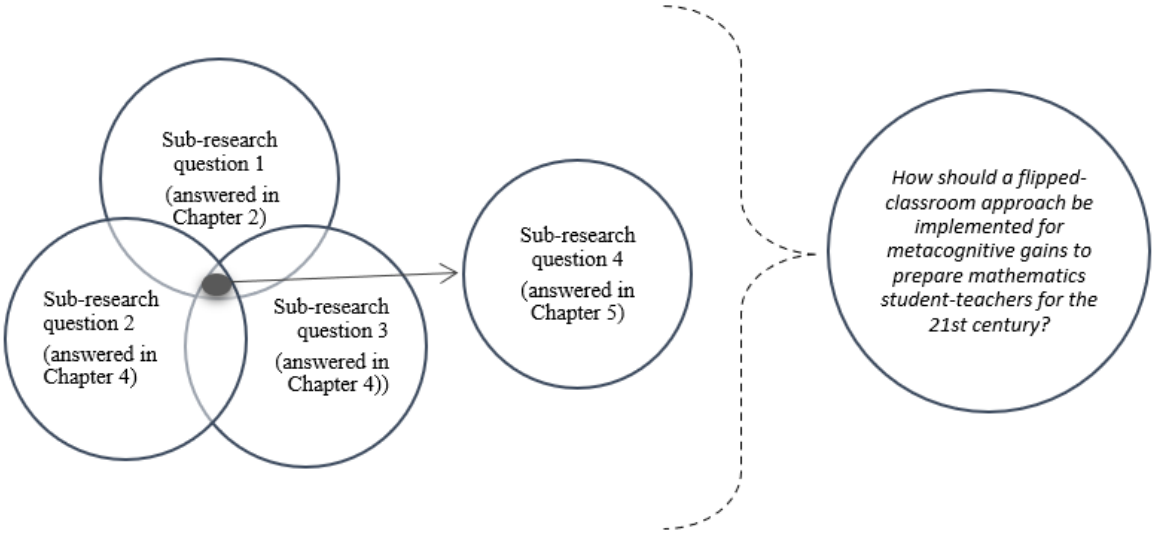


Figure 5.1 How the sub-research questions answered the main research question to reach the investigation's desired aims

The rest of Chapter 5 explains the contribution of the study to the field of mathematics teacher education and research in the field of the FCA for metacognitive gains. Limitations on the investigation are explicated, further research recommendations are suggested, and my self-reflection as researcher is shared. The chapter ends with some concluding remarks.

5.2 Meeting the aims of the research

Both the primary and secondary research aims were met by achieving the research objectives (Chapter 1, §1.6). In this section, I firstly reflect on the way the primary aim of the study was reached. Secondly, to achieve the study's secondary aim, I suggest guidelines for an FCA for metacognitive gains, as informed by the investigation.

5.2.1 Reaching the primary aim of the research

For this investigation, the primary aim was to determine how an FCA should be designed to foster metacognition in mathematics student-teachers as a 21st century skill. Data collected from participants based on their experiences regarding an FCA implementation's design features were analysed (Chapter 4) by using a metacognitive lens to reach this primary aim. Firstly, all participants' experiences concerning the FCA design with the aim to foster metacognition are summarised to draw conclusions and emphasise key findings (§5.2.1.1).

Secondly, findings of how the FCA design should be revised to improve support for metacognitive gains are reported (§5.2.1.2). Finally, suggested guidelines for the flipped classroom design to foster metacognitive gains as a secondary aim are reported (§5.2.2). Metacognition was motivated as crucial 21st century skill in §2.5 and mention made in this section to the way this skill is supported by the FCA, therefore also involves the role of metacognition in preparing student-teachers for teaching in the 21st century.

5.2.1.1 Lecturer and student experiences of the FCA design with the aim to foster metacognition

Core findings based on data collected from the participants on their experiences of the FCA design, as analysed through a metacognitive lens, indicate prerequisites for effective FCA design to support metacognitive gains. Findings include acknowledgment of the changed roles of students and lecturers in an FCA, efficient integration of technology for meaningful teaching and learning, the need for more scaffolding and feedback, the relevancy of the level of mathematics content for an FCA as well as lecturer and student motivation. The vital role of student motivation in learning (Bolhuis, 2003) (§2.4) impacted all other components of the flipped-classroom implementation and the opportunity for metacognitive gains through the FCA.

It is hypothesised that an appropriate level of challenge (§2.3.4) and efficient integration of technology (§2.4.1) will lead to increased motivation.

From the investigation, it became clear that various features of the FCA have the potential to foster metacognition, as suggested by Van Vliet et al. (2015), considering that it is well-executed since it is not the FCA itself that has the potential to foster metacognition but how it is implemented (§2.6.3). Also, the challenges concerning the implementation of an FCA for metacognitive gains became apparent.

A crucial finding from the investigation is the importance of understanding the changing roles in an FCA of both the lecturer and the students. Even though the FCA was explained to students before the course, students often did not grasp their role and/or the lecturer's role. Thus, defining the FCA to students requires a change of strategy, considered in the next section (§5.2.1.2). The findings indicated that students found that the FCA mainly entails self-study and unguided completion of tasks (§4.4.2.1). Students voiced their need for support in the form of scaffolding for out-of-class learning to make objectives clear. The finding agrees with Zack et al. (2015), who investigated a flipped classroom of an undergraduate mathematics course where students felt like they had to teach themselves. De Corte (2004)

emphasised that an active view of learning requires scaffolding and does not suggest the absence of student guidance in their knowledge construction.

During the investigation, the critical role of the lecturer's knowledge and understanding of their role for a successful implementation of an FCA became apparent and is also highlighted in previous studies (FLN, 2014; Fredriksen, 2020; Lo et al., 2017; Steen-Utheim & Foldnes, 2018). I agree with Fredriksen (2020), who also advocates for more research on the lecturer role in an FCA, since it will impact the design's potential for metacognitive gains. Lecturer knowledge and skills of the student ZPD and provision of differentiated levels of questions during in-class learning influenced student motivation and possibly hindered the development of metacognition (§2.2.2). Based on the findings, making the paradigm shift to a more student-centred approach by both the lecturer and the students are crucial since the change in roles might challenge their beliefs about mathematics teaching and learning. The lecturer tends to cling to her role as the content knowledge provider and found it challenging to adapt to her new role (§4.4.2.2; §4.5). Still, she acknowledged the need for a mind shift to ensure the FCA supports SDL and metacognitive gains. As teacher educators, Nogueiras and Iborra (2017) highlight the importance of challenging your own beliefs while trying to challenge the students' beliefs. During the data analysis it became apparent that prior subjection to the traditional transmissive and content-based approach to education may have hampered students and the lecturer in making the necessary paradigm shift (§4.4.2.2; §4.4.3.2). Such a traditional view of education might have hindered metacognitive gains that are crucial for education in an environment that entails new demands from students and educators (Darling-Hammond et al. 2020; Candy, 1991).

The importance of the efficient integration of technology as part of the FCA was highlighted during the study. In concurrence with Kaur (2016) and Schrader (2015), who claim that technology is regarded as the new mediator of learning that enhances learning and teaching methods, it was evident that integrating technology in an FCA needs to be meticulously planned. Skills of navigating online learning systems are critical as the primary source of communication for out-of-class learning. Out-of-class learning is again crucial for the success of the in-class learning activities (Kaur, 2016). Since the LMS is the main source of communication with students concerning out-of-class sessions, lecturer expertise in this area play a role in the success or failure of the FCA. The investigation did not specifically set out to collect evidence of out-of-class activities, but through experiences shared by the participants, it became apparent that deficiencies in the use of the LMS may have jeopardised the value of the out-of-class component of the FCA and therefore also the value of this approach in supporting the development of metacognitive skills (§4.4.3.1).

Furthermore, informed by the findings, I concur with Lo et al. (2017), who recommend that the LMS be utilised to monitor students and how they learn in an FCA to understand student out-of-class learning behaviour better. The literature confirms the role of the LMS as scaffolding for SDL (§2.4.2), implying that the lecturer has the necessary skills and knowledge to organise and manage the LMS to contribute towards this aim. Inefficient use of the LMS can demotivate student participation in the out-of-class activities and hamper the opportunity for metacognitive gains.

The relevance of learning content for a successful FCA strongly emerged from the data analysis. The familiar content, the difficulty level of the content, and the overlapping of content with another module played a big part in investigating the FCA for the mathematics module (§4.4.2.2). Data collected from both the lecturers involved in the study and the student participants indicated that students fail to see the module's value. The students reportedly were not motivated to prepare for in-class learning because they were not challenged by the mathematics problems solving tasks and could complete in-class learning activities without preparing for class. Calder and Campbell (2016); Kunnathodi and Sarabi (2017) also highlight the role of challenging content in successful learning. Therefore, the level of problems posed for out-of-class activities required an adaption in the design, especially since Bolhuis (2003) claims that students will not be motivated if learning needs are not met. Rajaram (2019) recognises that lecturers unfamiliar with the FCA may experience challenges in providing meaningful activities, as was found in this study (§4.4.3.2).

Kim et al. (2014) confirmed that the students' changing roles in an FCA result in a need for more structured guidance by the lecturer to ensure a positive learning experience. Students lost motivation when they struggled to figure out what is expected of them in the out-of-class activities. Another aspect that influenced student motivation was a lack of feedback (§4.4.3.1). Therefore, two essential factors that possibly hindered student motivation and metacognition were insufficient scaffolding and feedback. Irrespective of sound pedagogical content knowledge, the lecturer’s applied competence in using the LMS to provide continuous support and feedback played a central role in student motivation and the successful implementation of the FCA for metacognitive gains.

Students had a positive experience regarding the active in-class learning opportunity, as one of the FCA's main benefits (De Boer & Winnips, 2015; Heinerichs et al., 2016), and indicated that they learned from their peers by comparing strategies (§4.4.1.2). The lecturer also noted that active in-class learning provided her access to student thinking as they collaborated with peers, which allowed her to access student thinking (§4.4.3.2). The in-class component thus offered the opportunity to support metacognition. However, the data analysis also exposed

that some students lack the necessary SDL and metacognitive skills needed for successful out-of-class activities (§4.4.1.2). This finding implies that, for an FCA to foster metacognition, explicitly teaching for metacognitive gains is essential, as found by Ku and Ho (2010) and Cunningham et al. (2018). Teaching metacognitive skills as preparation for the FCA in support of metacognitive gains did not fall within this study's scope but should be explored through further empirical studies.

5.2.1.2 Revising the design of the FCA to improve support for metacognition

Informed by findings in the literature and findings on the first meso-cycle, the FCA was revised to improve the design with the anticipation that these changes would also improve support for metacognitive gains. In this section, the required adaptations to the design, based on the findings, are highlighted.

Adapting to the change in roles in an FCA

Both students and the lecturer experienced challenges regarding their changed roles in the FCA as a student-centred approach in both the meso-cycles (§2.6.2 & §4.4.1.2 *knowledge, skills, and beliefs*). Apart from students and the lecturer having a clear understanding of their roles, the need for a paradigm shift to take on their changed responsibilities in the student-centred approach was apparent. Before this paradigm shift can be effected, both the lecturer and the student need to appreciate the FCA's value for meaningful teaching and learning. As manager of the teaching and learning situation, the lecturer agreed that she needs to provide an explicit explanation to students of their roles and ensure students understand the value of the FCA before implementation.

Providing scaffolding and feedback to students in support of learning and metacognition while acknowledging their ZPD also forms part of the lecturer's changed role and was identified as an area that required more attention.

A well-set-up online environment

Although attempts were made to improve learning management through the LMS, students still experienced support for learning through this technological resource as insufficient (§4.4.3.1). The need for changes regarding the following became clear:

Scaffolding

Setting clear objectives and providing scaffolding for learning as essential strategies in an FCA that aims to develop metacognition emerged from the findings. Providing a worksheet as part

of out-of-class learning formed part of the design change implemented during the study. The students had a positive experience regarding the revised strategy (§4.4.3.1 *worksheet as out-of-class activity*). As discussed in Chapter 4, Angela found that the worksheet served as guidance as to what she is expected to know and further highlighted the need for scaffolding as part of the out-of-class learning. Furthermore, students suggested they should be notified when new content is loaded on the LMS as part of further scaffolding.

Moreover, it was found that giving students the responsibility to find their own open-access video material may not be conducive for meaningful learning. Still, specific videos allocated, either self-made or sourced online, provide an opportunity to link out-of-class activities to in-class learning and improve metacognitive gains. On the contrary, as Sarah, the previous lecturer, suggested, when students are explicitly assigned the task to find relevant open access video material to share with the group, and when this is combined with collaborative critical reflection on these videos' strengths and weaknesses, it could serve as an opportunity to foster metacognition. Hence, vital reflection to foster metacognition by listening to others' thoughts can support student-teachers in their preparation as teachers.

Content level

For the successful implementation of an FCA to foster metacognition, course content must challenge student thinking to motivate student participation as preparation for in-class-activities and to experience the module as valuable (Calder & Campbell, 2016; Kunnathodi & Sarabi, 2017). The following activities to ensure the FCA matches the students' ZPD emerged from the data:

- *Checking for student preparation*. Out-of-class activities have a direct impact on in-class activities. Therefore, checking for student preparation through out-of-class activities will enable the lecturer to plan for in-class learning based on what students already know and do not know (§4.4.3.1 *Flipped-classroom strategies*). This agrees with Strycker's (2017) research, reporting that, when students ask questions after watching videos, it enables the educator to identify possible trends in questions. The lecturer can then provide more material if required, based on student questions. Informed by this literature finding (Strycker, 2017), a diagnostic test was implemented to check student class preparation. Students can be asked to respond to reflective prompts before the in-class session. These prompts can serve the purpose of a diagnostic tool to determine if the content matches student ZPD, to identify gaps in student knowledge, check for student preparation, and activate their metacognitive thinking by reflecting upon their learning process. This strategy of checking for class

preparation will also save time during in-class sessions to be spent on problem solving in a group.

- *Providing well-designed differentiated instruction and challenging content.* Although findings on data collected during meso-cycle 1 showed evidence of the lack of challenge posed to students by the module content, this deficiency was still evident in meso-cycle 2, indicating that the lecturer may either not have sound knowledge of the students' ZPD or that the lecturer was not able to raise the bar since the module aim and purpose are pitched on a lower cognitive level. Apart from the need for critical reflection on the module content, aims, and outcomes by the programme designers, lecturers may need guidance on posing problems within the students' ZPD. A measure of familiarity with content is important in a constructivist approach to education but scaffolding learning and including appropriate level of challenge is crucial for learning leading to metacognitive gains.

Findings from the literature (§2.6.3), as well as findings based on lecturer and student experiences of the FCA design to foster metacognition (§5.2.1.1) and aspects regarding the design of the FCA that needed to be revised to improve support for metacognition (§5.2.1.2), together informed the suggested guidelines for a meaningful FCA aiming to foster metacognitive gains as the secondary aim of the research.

5.2.2 Reaching the secondary aim of the research

The secondary research aim was to suggest guidelines for a meaningful FCA implementation to foster metacognition in mathematics teaching and learning at the higher education institution (§1.6). Underlying principles support the guidelines. Provided for each suggested principle is a summary of the empirical findings that support the suggested principle, a justification from the literature, and how the proposed principle contributes to fostering metacognition. These principles are influenced by the suggested principles set out by Lo et al. (2017) (§2.6.2) that were adapted, based on the empirical findings and relevant literature considering metacognitive gains.

Principle 1: Explain the FCA to students, focussing on both student and lecturer roles.

Empirical evidence: Students understanding their new role is crucial (§4.4.1.2 and §4.5). Some students saw it as self-study and felt unguided (§4.4.2.1 *flipped classroom out-of-class activities*).

Justification from the literature: Students need to understand their role in an FCA to take on an active role, take responsibility for their learning (§2.6.3), and participate in group work (§2.6.2). An active view of learning does not suggest that students are not guided in their knowledge construction but that they are supported through appropriate scaffolding and interventions by educators or peers (De Corte, 2004).

Implications for metacognition: An active role in learning activates metacognition in which learners take responsibility for their learning, set learning goals, monitor progress, and create strategies to reach set learning goals. Collaboration during group work activates metacognition (§2.5.1; §2.6.3).

Principle 2: Explain metacognition to students, including the potential and the aim of an FCA to support these skills.

Empirical evidence: None of the students have heard of the term “metacognition” prior to the study (§4.2.2). Students struggled to reflect on their learning and/or their thought process.

Justification from the literature: Manasia and Pârvan (2014) advocate for explicit metacognitive training in teacher training (§2.5.3).

Implications for metacognition: Apaydin and Hossary (2017) opine that explicitly teaching metacognition should be a forerunner to any university module to enhance student learning.

Principle 3: Ensure effective integration of technology by providing a well set-up online environment with video content, scaffolding, and feedback.

Empirical evidence: Students were not sure what was expected to be completed for out-of-class learning. They knew what (topic) to prepare but were unsure how to prepare, and students had difficulty navigating the LMS (§4.4.2.1). The need for well thought through scaffolding of the online environment emerged from the data (§4.4.3.1).

Justification from the literature: Krouss and Lesseig (2020) claim that designing an FCA involves much more than providing online video lectures, and Bray and Tangney (2017) state that the FCA has the potential to employ technology in such a way that it essentially promotes active learning (§2.4.1). Also, Schrader (2015) claims that technological software can provide meaningful scaffolding, collaborate with peers, provide helpful feedback, and make abstract

mathematical concepts more concrete. The need for revised strategies regarding scaffolding and feedback emerged from the data findings, and according to Schrader (2015), a well set-up online environment can achieve meaningful scaffolding and feedback.

***Implications for metacognition*:** Kirsh (2005) advocated for a well set-up online environment for metacognitive gains, based on the fact that students should be aware of the knowledge expectation as a significant requisite for metacognition: realising what you need to know (§1.7.2). Instructional videos help students regulate their learning (Lape & Levy, 2014) (§2.4.3). Scaffolding (Belland, 2017; Kim & Lim, 2019) and clear learning objectives (Boysen, 2016) support metacognition and effective use of the LMS can provide in both these learning needs.

Principle 4: Provide a worksheet/quiz with feedback as part of the out-of-class learning for students to use as preparation and self-assessment, as well as for the lecturer to monitor student preparation for in-class learning (marks incentive depends on lecturer goals/views).

Empirical evidence: Students requested and had a positive experience concerning the online worksheet as part of the online learning component (§4.4.3.1). A mark incentive encouraged students to attend class (§4.4.2.2) and served as extrinsic motivation. However, intrinsic motivation is more in line with meaningful SDL (Knowles, 1975) and metacognitive goals (Care et al., 2018; Lucariello et al., 2016).

Justification from the literature: A significant challenge of the out-of-class learning of an FCA is the self-directed completion of work by the students (§2.6.4). Although SDL and metacognition as 21st century learning skills are expected to be motivated by intrinsic motivation (Zimmerman & Kitsantas, 2005), Abeysekera and Dawson (2015) claim that for an FCA to work, it may require extrinsic motivation such as assigning grades for attending class and completing out-of-class learning. More research on possible solutions for this paradox is suggested below (§5.5). Lo et al. (2017) recommend providing online exercises with computerised feedback for practice and self-assessment. Online activities support students in knowing if they have reached learning objectives (Lucariello et al., 2016).

Implications for metacognition: Self-assessment encourages metacognitive skills development (Siegesmund, 2017), while feedback is important to foster metacognition by correcting misconceptions and organising new knowledge (Apaydin & Hossary, 2017). This strategy provides students with the opportunity to check for understanding and reflect on their

strategy when preparing for class and to determine if it needs revision, thus employing metacognitive regulation (§1.7.2).

Principle 5: Modify in-class learning based on students' out-of-class learning.

Empirical evidence: The investigation provided little evidence of student participation in out-of-class activities to make informed decisions on the learning needs that might exist, strengthening the need for implementation of **principle 4**. Although the worksheets were implemented in meso-cycle 2, the lecturer could not yet derive information through this strategy on the way students prepare for in-class learning by the time the study was completed. Consequently, the lecturer could not plan according to the students' prior knowledge and understanding, and planning and implementing in-class activities within the students' ZPD (§2.3.4) did not materialise (§4.4.2.1; §4.4.3.2). The quiz at the onset of in-class learning does not enable the lecturer to know student needs as they walk into classroom.

Justification from the literature: Knowing what to plan for class can be enhanced if the lecturer understands learning needs before the in-class session (§2.6.2). Therefore, as Shen and Liu (2011) suggested, a lecturer should gain access to students' knowledge and use it as the basis for new material and hence provide content within their ZPD (§2.3.4; §2.6.2).

Implications for metacognition: In-class content that is too basic leads to students losing interest and motivation, while content and problems experienced as too difficult might result in students giving up (Artzt et al., 2008). Therefore, activities must be sufficiently challenging for meaningful learning. Active learning where content allows students to operate within the ZPD, and where the lecturer and peers provide scaffolding, supports metacognition (§2.6.3 and §2.3.4).

Principle 6: Provide ample time, feedback, and support for in-class problem-solving

Empirical evidence: Not knowing student out-of-class learning behaviour created a challenge in knowing on which level to pitch in-class sessions and problem-solving activities. When content was not challenging enough, students did not need a lot of time to complete the work (§4.4.3.1). On the other hand, when students were provided with a more challenging problem, they lacked the skill and perseverance to complete the problem-solving question (Figure 4.4). Apart from the important role of the lecturer's knowledge of the students' ZPD, the findings indicated their need for feedback and its absence could have influenced student's motivation

to either participate in out-of-class activities as preparation for in-class activities or to complete in-class activities (§4.4.3.1).

Justification from the literature: Using class time effectively by collaborating and reaching higher levels of thinking is one of the FCA's main benefits (§2.6.4). Arends et al. (2017) indicated a connection between spending more time on problem-solving and mathematics achievement, especially where the lecturer and the students collaborate in these activities. Such learning activities provide an opportunity for continuous educator observation and feedback and consequently remediation with the potential to lead to further student achievement (§2.2.2).

Implications for metacognition: Problem-solving instruction, and metacognition strategies specifically, are achievable as well as effective under the guidance of the educator (Schoenfeld, 2016). Also, metacognitive regulation is essential in mathematical problem-solving and can also be used to foster and assess metacognition (Jacobse & Harskamp, 2012), while feedback is vital for metacognitive gains (§2.5.3; §2.5.4.). Feedback enables students to plan, monitor and evaluate their learning (Apaydin & Hossary, 2017).

Principle 7: Facilitate peer-assisted learning

Empirical evidence: Students had a good experience working in groups and learning from one another and the strategies that others apply (§4.4.2.1). The lecturer found that group work provided access to student thinking (§4.4.2.1). However, putting a measure in place to monitor how and if students prepare (**principle 4**) is important so that students do not merely rely on their peers during in-class activities and refrain from preparing by participation in the out-of-class learning activities.

Justification from the literature: Peer support in the form of comparing strategies and reasoning fosters higher-order thinking (Pintrich, 2002) (§2.4.3) while collaboration is a 21st century skill (§2.4). A study by Smith and Mancy (2018, p. 29) proved a “relationship between metacognitive talk and group interactions”.

Implications for metacognition: Metacognitive thinking develops when peers model it to each other, compare their thoughts with the thoughts of others, and decide what to do with these thoughts (§2.5.3 and §2.3.2). Meaningful collaborative learning supports metacognitive gains (§2.6.3).

Since learning needs are different and because of the FCA's flexible nature, a large variety of activities can be used for both in-class and out-of-class learning. Based on their findings of the review of FCA studies, Akçayır and Akçayır (2018) surmised that using appropriate activities for meaningful learning is essential. Requisites of a successful FCA, such as flexibility, student-centred learning activities, and specific course requirements, might discourage some lecturers from implementing the FCA and, more so, explicitly aiming to use the FCA for metacognitive gains. As suggested by Zepeda et al. (2019), educators possibly need support concerning different kinds of instructional activities intending to foster metacognition. Based on the principles mentioned above, various metacognitive activities for an FCA are summarised in Table 5.1. The table contains the suggested principles described above, a practical strategy to achieve each principle, and a strategy for explicit fostering metacognitive gains.

Table 5.1 Suggestions for explicitly teaching for metacognitive gains in an FCA design

	Principle	**Strategy for meaningful application of the FCA for metacognitive gains**	**Metacognitive strategy**
1	Explain the FCA to students, focussing on both student and lecturer roles	Spend time providing a thorough in-class explanation as well as an online video explanation providing for absent students; emphasise the importance of out-of-class learning (Ray & Powell, 2014) and the benefits of in-class learning (§2.6.4). Provide particular support for students to adapt to the new approach (Dhawan, 2020).	Provide in-class reflection time on their roles in the FCA to promote student understanding. Sharing their understanding of their roles provides the opportunity for the lecturer to clarify any uncertainty/unclarities.
2	Explain metacognition to students, including the value and the aim of an FCA to support these skills	Metacognitive skills are important to be successful in an FCA. Therefore, students need to be supported in diagnosing their metacognitive needs to further develop metacognition. It is encouraged by Manasia and Pârvan (2014) to explain the importance of	Create awareness of their thinking by engaging students in their metacognitive development (Cunningham et al., 2018) and equip them to

		metacognitive skills as well as metacognitive teaching strategies to students.	model metacognition to their learners one day.
3	Provide a well-designed online environment online that includes quality and relevant video content, and that provides efficient scaffolding for and feedback on learning tasks.	The online learning environment aims to support SDL and metacognitive gains. Therefore, for each out-of-class learning session: • State clear learning objectives (what must be completed) • Allocate specific videos that all students must watch and provide additional sources based on experience and/or diagnosed student needs. • Allocate worksheets/quizzes (principle 4) and provide a memo Knowledge and skills concerning the online platform used are crucial. Consider an online forum for questions that can be answered by the lecturer, peers, or in-class. Preferably use software that integrates all elements required for teaching and learning rather than stand-alone software (Denton et al., 2008).	Guide students by providing scaffolding for learning (Rajaram, 2019) (Kim & Lim, 2019) Scaffolding can include time frames and reminders to draw students' attention (Dhawan, 2020) Consider checkboxes that students can check as they complete tasks (Kirsh, 2005). Include self-assessment as part of the out-of-class activity (Siegesmund, 2017). Create tailormade videos and consider using software to build in specific prompts during the video and a mechanism to monitor who views the videos. Encourage students to pause and rewind videos for clarity.
4	Provide a worksheet/quiz with feedback as part of the out-of-class learning for	For example, a quiz on Google Forms scaffolds SDL and generates data to provide the lecturer with instant	Reflective prompts (§2.5.3) To rather say: the quiz is to reinforce what you have learned, rather than "to check for preparation". And

	students to use as preparation and for the lecturer to monitor student preparation for in-class learning (marks incentive depends on lecturer goals/views)	feedback regarding student answers to prompts and questions. Provide detailed memos on the LMS to allow students to check for understanding.	encourage intrinsic motivation (Lucariello et al., 2016). Encourage students to share their strategies of how they answered the question. Encourage students to diagnose their learning and adapt their strategy for out-of-class learning if they struggle with out-of-class quizzes/worksheets.
5	Modify in-class learning based on students' out-of-class learning	Motivate students by highlighting the benefits of preparing for the in-class activities as part of the FCA and actively engaging during sessions (**principle 1**). Use quiz data/reflective prompts to identify trends in student misunderstanding or questions to modify in-class sessions. Address identified issues in-class before group activities are introduced. Provide differentiated questions based on out-of-class data.	Accommodate the students' ZPD (Shen & Liu, 2011) Provide clear instruction (Boysen, 2016) Provide space on the online platform where students can publish their work to compare methods and strategies.
6	Provide ample time, feedback, and support for in-class problem-solving	Encourage active learning during in-class problem-solving. For an FCA to foster metacognition, "student-teachers must get the opportunity to assess the task at hand, to evaluate their strengths and weaknesses, to plan their approach, to try and judge various strategies, and to reflect how far every approach and technique they purposefully experiment is working"	Think-aloud protocol (Jacobse & Harskamp, 2012) (§2.5.4) Assessing understanding requires not merely to consider answers but also thinking and reasoning. Concept mapping (§2.5.3)

		(Kunnathodi & Sarabi, 2017, p. 27). Such a classroom environment takes time, and some students work faster than others. Accommodate all students' needs by providing differentiated questions.	Explain think-aloud protocol to students and while assessing, consider thinking and reasoning and not only the answer/solution Assist students with problem-solving by questioning them and encourage students to use words and drawings (Su et al., 2016).
7	Facilitate peer-assisted learning	Facilitating group activities in which students are guided to exchange ideas, strategies, and discuss arguments (§2.6.2).	Implement group work for in-class activities, give specific guidelines for groups, explicitly teach how to support each other. Provide reflective prompts to guide group work (§2.5.3) Explain the think-aloud protocol to be followed (§2.5.4) Lecturers should model metacognition

Considering these guidelines, which are based on empirical findings and relevant literature, in the next section, the contribution made by this investigation in implementing an FCA for metacognitive gains in mathematics teacher preparation is motivated.

5.3 Contributions of the study

The study adds to the growing literature on the flipped classroom and will contribute to the importance of metacognition in mathematics teacher education. Also, in a fast-developing milieu where time and economic constraints hamper access to full-time studies, education will increasingly have to rely on blended-learning approaches such as the FCA. Therefore, the

study contributed in suggesting guidelines for an FCA design to accommodate and foster metacognition and can serve as valuable data for instructional design in higher education institutions to improve the collaborative design of programmes, grounded in scientific research. The guidelines could help overcome the challenge named by Adler and Sfard (2017) of turning research findings, that can impact mathematics teaching and learning, into practice. Elliott (2015) explained that case studies could be generalised across cases if the cases share relevant features.

Although implementing a DBR posed some challenges to me as an inexperienced researcher, honest reporting of lessons learned (§5.6) provides future researchers insight into the value and possible pitfalls when using this design to improve programme design. To improve mathematics education teaching and learning practice, the study indicates that DBR provides the opportunity for educators to collaborate by sharing experiences and knowledge through reflection.

5.4 Limitations of the investigation

During the investigation, the following limitations became apparent:

- **Time constraint**

I found it challenging to be the researcher, fulfilling my role in the DBR and responding to contingency. This is possibly a limitation to the study as the lecturer and I did not have sufficient periodic meetings, both due to time constraints and the relationship dynamic of the researcher (student) and lecturer where I did not want to overstep professional boundaries. As recognised by Herrington et al. (2007), sometimes close collaboration is not achievable.

- **Research design**

I regret not recording the informal meetings with the lecturer that was not part of the DBR since that could have provided further insight into the study's findings. A third meso-cycle could have provided further insight into participants' experience of the FCA design after more design adaptations had taken place and could have provided me with the opportunity to ask follow-up questions regarding challenges experienced during meso-cycle 2. Therefore, more time/cycles should be allocated for a follow-up study. Lastly, incorporating more class observations into the research design could have strengthened some data analysis by allowing me to make stronger connections between focus-group interview discussions and first-hand data of in-class learning sessions.

- **Data collection**

Due to time constraints and pressure, the lecturer was not part of focus-group interviews. As suggested by Zappe and Litzinger (2017), her presence could have provided some different findings on how to improve the strategies and the design of the FCA and would have provided the lecturer with first-hand information of the student-participants' experiences of the design features of the FCA with the potential to support metacognition. A planned open-ended questionnaire concerning how the FCA fostered student-teachers' metacognitive skills was scheduled for the last lesson of the Mathematics module but could not be implemented due to a change in the roster.

- **Reflection on the choice of course content for the FCA**

The fact that the Mathematics module content was familiar, and content overlapped with another module, caused frustration for students and could have influenced students' ability to reflect on their learning. Hence, response bias might have occurred due to frustration with the module content.

- **Assumptions by the researcher**

I should have explained the concepts of metacognition and FCA more thoroughly to participants rather than assuming their level of understanding. A more in-depth understanding of the concepts might have led to different responses to some of the interview questions. Also, I made assumptions about shared goals with the lecturer regarding the FCA implementation, which led to a lack of clear communication on my part.

5.5 Further research recommendations and future studies

Listed here are research suggestions evolving from the findings of the investigation:

- A mixed-method design where a quantitative pre-test post-test component measures if an FCA that incorporates the guidelines suggested by this study indeed supports student metacognition.
- Investigating strategies to support intrinsic student motivation in an FCA.
- Investigating ways to assess student metacognitive gains through the FCA.
- Research on assessment tools and strategies that can be used for feedback in a mathematics education FCA.

5.6 Lessons learned and self-reflection

My interest and investment in the study gave me new insight into mathematics teachers' training and the much-discussed reform required in teacher preparation in the 21st century. It became apparent that training teachers in becoming reflective practitioners is crucial but not an easy task. However, the research process and the knowledge I acquired through reading and the empirical investigation convinced me that it is possible to do so. What further became apparent to me is that we need mathematics teachers to be agents of change in our schools and that the change needs to start there.

My experience of being exposed to academia and the higher educational institution provided me with further insight into the pressures involved in teaching and learning at this level and the challenges that lecturers face. My first-hand experience of the challenges of research making its way into the classrooms and the pressures of the school environment, and the challenge of introducing change made me realise the need for collaboration by all stakeholders to change South African education. More collaboration between researchers and classroom practitioners is important to close the gap between research and practice and bring about change in education. There are various reasons why change is so difficult to bring about, including the lack of teacher voices on educational issues. The challenge regarding the change that stood out for me most was becoming more aware of deep-rooted beliefs about teaching and learning, specifically mathematics teaching and learning. We need to challenge our own belief systems to bring about change.

Through the research process, I became aware of the potential of DBR and critical reflection and its value for educators on all levels of education. However, an essential determinant of the DBR is that of a shared vision. From my personal experience, I have found that bringing about change is not a shared priority of all teachers, and not all educators share the same perception of what needs to be changed. Through the research, I also came to appreciate the value of qualitative research by hearing people's voices involved in the phenomenon under study.

I further learned that thinking about one’s thinking and reflecting on those thoughts does not come naturally and needs to be taught and learned. My interest in the FCA and its potential to train mathematics teachers to become more effective practitioners grew. Consideration as to exactly how much planning goes into an FCA cannot be overlooked. Planning for out-of-class and in-class learning while accommodating the student's cognitive level, implementing and checking for student preparation, motivating students, providing feedback, facilitating understanding, being flexible, and making necessary changes based on critical reflection on

teaching and learning outcomes are all time-consuming lecturer responsibilities. However, I also became aware that the most time-consuming aspect of preparing for the FCA is creating video content and integrating technology efficiently. A further valuable lesson has been the many possible determinants involved that need to be considered and addressed to implement a successful FCA. In my experience, the FCA holds value and potential to bridge research and practice because of the active learning and student-centred nature, considering it is well implemented and the design revised based on continuous reflection on student learning needs.

Concerning the research process, I learned that all research aspects are time-consuming and need to be well thought through and planned. As a researcher, you need to be prepared to deal with challenges that arise and clear communication with everyone involved is crucial. Practical research-related skills that I have learned have been valuable, such as the importance of ethical and trustworthy research, using software such as ATLAS.ti™ 8.0, important interview skills such as keeping the discussion open-ended but to the point, and suggestions such as using pseudonyms in interviews instead of introducing them during transcribing. I learned about my expectations and the assumptions that I brought to the research process – beliefs such as shared goals and vision, that led to a lack of clear communication on my part. For example, it caused me to make further assumptions about the lecturer and student's readiness to work with the LMS and the participants' knowledge and understanding of the FCA. I furthermore learned that research does not have to be a lonely experience and that there is value in talking to experts and individuals who have been through similar experiences of working and doing research simultaneously. What I found very challenging was the amount of reading, making sense of the literature, staying focused on relevant sources, and synthesising sources. A valuable lesson that I will apply more often in my personal and professional life is to be aware of my own biases, investigate where it possibly originated, and why I hold the belief that surfaces.

5.7 Conclusion

This chapter aimed to summarise the research conducted by restating the problem experienced that led to the investigation, as well as the data findings to answer the research question as directed by the research aims. For the investigation, an FCA was implemented, and the literature and participants' experiences of design features that can foster metacognition were studied. As the research process progressed, the importance of motivation, the appropriate level of challenge, and the lecturer's critical role in an FCA became apparent. A lot of FCA research focusses on the out-of-class learning components. Still, I agree with Bishop and Verleger (2013), who state that the FCA's in-class experience possibly

leads to the success or failure of the FCA implementation. This study found that the importance of well-planned in-class sessions needs to be given equal consideration. Furthermore, even though some of the design features could not be thoroughly investigated as planned due to the familiar content that led to some students not engaging as part of the out-of-class learning as hoped, I am of the opinion that the FCA can be designed in such a way that both the lecturer and the students can benefit through its potential to foster metacognition in student-teachers.

It is acknowledged that the reported time-consuming nature might deter some lecturers from an FCA implementation. Trying to make up for lost time and background knowledge before formal testing often does not allow the teacher or lecturer the luxury of student-centred approaches and time-consuming activities such as active learner participation in collaborative problem-solving activities. However, once planned, with the design regularly revised, preferably in collaboration with colleagues, the FCA can add value to teacher education programmes and prepare teachers for the 21st century by equipping them with metacognitive skills. The value of DBR should not be overlooked, and lecturers are encouraged to engage in DBR and revise the design of a meaningful FCA with the potential to foster metacognition. Since no FCA is identical, lecturers should be motivated to adapt and design their FCA to meet their students' needs, as confirmed by Hao (2016). For meaningful mathematics learning, the FCA needs to be critically reflected upon regularly. As reported in the literature, the most time-consuming aspect of the FCA implementation is often making the videos. From insight gained through the investigation, I would recommend considering using open educational resources if possible, considering quality, and spending time mastering the online tools employed for the FCA implementation and optimally utilising tools and software for meaningful learning and preparing differentiated instruction for in-class learning.

Mathematics teacher education needs to create a culture of teacher reflectivity and challenging of own beliefs. If the FCA for metacognitive gains is implemented well, it can create the opportunity to provide such an environment where students reflect upon their thinking and learning and their beliefs about mathematics teaching and learning based on their academic experience. If our future teachers are not challenged to be progressive, the much-needed reform in mathematics teaching and learning will be postponed further. This should not be the responsibility of an individual lecturer. The pressures added by academic institutions might add to the challenge of implementing differentiated approaches, even though it is encouraged by the higher educational institution (§1.3). From the investigation and my own teaching experience, the expectation and responsibility of teaching and learning are critically important and requires the attention of not only the education sector. I echo the

sentiment of Reddy et al. (2017) that improvement in our education system does not rest on the shoulders of classroom teachers and institutions only but must become a national narrative.

REFERENCES

Aabla, B. (2017). A Review on 21st Century Learning Models. *International Interdisciplinary Journal of Education, 6*(1), 254-263.

Aaronsohn, E. (2003). *The exceptional teacher: Transforming traditional teaching through thoughtful practice* (1st ed.) Jossey-Bass.

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. *Higher Education Research & Development, 34*(1), 1-14. doi:10.1080/07294360.2014.934336

Adams, N. E. (2015). Bloom's taxonomy of cognitive learning objectives. *Journal of the Medical Library Association, 103*(3), 152-153. doi:10.3163/1536-5050.103.3.010

Adler, J., & Sfard, A. (2017). *Research for educational change: transforming researchers' insights into improvement in mathematics teaching and learning.* Routledge.

Ahmed, H. (2016). Flipped learning as a new educational paradigm: An analytical critical study. *European Scientific Journal, 12*(10), 417–444.

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education, 126*, 334-345.

Akyüz, H. I., Samsa Yetik, S., & Keser, H. (2015). Effects of metacognitive guidance on critical thinking disposition. *Pegem Journal of Education and Instruction, 5*(2), 133-148.

Al-Samarraie, H., Shamsuddin, A., & Alzahrani, A. (2019). A flipped classroom model in higher education: A review of the evidence across disciplines. *Educational Technology Research Development, 68*(3), 1-35. doi:10.1007/s11423-019-09718-8

Alaszewski, A. (2006). *Using diaries for social research*. Sage.

Alex, J. K. (2019). The preparation of secondary school mathematics teachers in South Africa: Prospective teachers' student level disciplinary content knowledge. *EURASIA Journal of Mathematics, Science Technology Education, 15*(12). doi:org/10.29333/ejmste/105782

Alias, M., & Sulaiman, N. L. (2017). Development of metacognition in higher education: Concepts and strategies. In *Metacognition and successful learning strategies in higher education* (pp. 22-42). IGI Global.

Allen, B. A., & Armour-Thomas, E. (1993). Construct validation of metacognition. *The Journal of Psychology: Interdisciplinary and Applied, 127*(2), 203-211. doi:10.1080/00223980.1993.9915555

Altindağ, M., & Senemoglu, N. (2013). Metacognitive skills scale. *Hacettepe University Journal of Education, 28*, 15-26.

Amankwaa, L. (2016). Creating protocols for trustworthiness in qualitative research. *Journal of Cultural Diversity, 23*(3), 121-127.

Amiel, T. C., & Reeves, T. (2008). Design-based research and educational technology: Rethinking technology and the research agenda. *Educational Technology & Society, 11*(4), 29-40.

Ananiadou, K., & Claro, M. (2009). *21st Century skills and competences for new millennium learners in OECD Countries. OECD Education Working Papers*. Retrieved from org/10.1787/218525261154

Anderson, J. R., Reder, L. M., & Simon, H. A. (1996). Situated learning and education. *Educational Researcher, 25*(4), 5-11.

Anney, V. N. (2014). Ensuring the quality of the findings of qualitative research: Looking at trustworthiness criteria. *Journal of Emerging Trends in Educational Research and Policy Studies, 5*(2), 272-281.

Apaydin, M., & Hossary, M. (2017). Achieving metacognition through cognitive strategy instruction. *International Journal of Educational Management, 31*(6), 696-717.

Arends, F., Winnaar, L., & Mosimege, M. (2017). Teacher classroom practices and Mathematics performance in South African schools: A reflection on TIMSS 2011. *South African Journal of Education, 37*(3), 1-11. doi:10.15700/saje.v37n3a1362

Artzt, A. F., Armour-Thomas, E., & Curcio, F. R. (2008). *Becoming a reflective mathematics teacher: A guide for observations and self-assessment* (2nd ed.). Lawrence Erlbaum

Ashwin, P., Boud, D., Coate, K., Hallett, F., Keane, E., Krause, K., & Tooher, M. (2015). *Reflective teaching in higher education.* Bloomsbury

Auerbach, A. J., & Andrews, T. (2018). Pedagogical knowledge for active-learning instruction in large undergraduate biology courses: A large-scale qualitative investigation of instructor thinking. *International Journal of STEM Education, 5*(1), 19. doi:10.1186/s40594-018-0112-9

Azevedo, R. (2009). Theoretical, conceptual, methodological, and instructional issues in research on metacognition and self-regulated learning: A discussion. *Metacognition and learning, 4*(1), 87-95. doi:10.1007/s11409-009-9035-7

Azevedo, R., Feyzi Behnagh, R., Duffy, M., Harley, J., & Trevors, G. (2013). Metacognition and self-regulated learning in student-centered leaning environments. *Theoretical Foundations of Student-Centered Learning Environments, 22*, 171-192.

Bakar, M., & Ismail, N. (2019). Metacognitive learning strategies in mathematics classroom intervention: a review of implementation and operational design aspect. *International Electronic Journal of Mathematics Education, 15*(1), em0555. doi:org/10.29333/iejme/5937

Bakker, A., & Van Eerde, D. (2015). An introduction to design-based research with an example from statistics education. In Bikner-Ahsbahs A., Knipping C., & Presmeg N. (Eds.), *Approaches to qualitative research in mathematics education.* (pp. 429-466). Springer.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special. *Journal of Teacher Education, 59*(5), 389-407.

Bansilal, S., Webb, L., & James, A. (2015). Teacher training for mathematical literacy: A case study taking the past into the future. *South African Journal of Education, 35*(1).

Baten, E., Praet, M., & Desoete, A. (2017). The relevance and efficacy of metacognition for instructional design in the domain of mathematics. *ZDM*(4), 613. doi:10.1007/s11858-017-0851-y

Baytiyeh, H. (2017). The flipped classroom model: When technology enhances professional skills. *International Journal of Information and Learning Technology, 34*(1), 51-62.

Bellanca, J. A., & Boss, S. (2015). *Deeper learning: Beyond 21st century skills.* Solution Tree Press.

Belland, B. R. (2017). *Instructional scaffolding in STEM education: Strategies and efficacy evidence.* Springer International Publishing.

Berg, B. L. (2004). *Qualitative research methods for the social sciences* (5th ed.). Pearson.

Bergmann, J., & Sams, A. (2012). *Flip your Classroom: Reach every student in every class every day.* ISTE.

Bergmann, J., & Sams, A. (2014). *Flipped learning, gateway to student engagement.* ISTE.

Biggs, J. (1988). The role of metacognition in enhancing learning. *Australian Journal of Education, 32*(2), 127-138. doi:10.1177/000494418803200201

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education, 32*(3), 347-364.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defining twenty-first century skills. In B. G. McGraw, P & Care, E. (Eds.), *Assessment and teaching of 21st century skills* (pp. 17-66). Springer.

Bishop, J. L., & Verleger, M. A. (2013). *The flipped classroom: A survey of the research.* Paper presented at the ASEE National Conference Proceedings, Atlanta, Georgia.

Black, P., & Wiliam, D. (2005). *Inside the black box: Raising standards through classroom assessment*. Granada Learning.

Bless, C., Higson-Smith, C., & Sithole, S. L. (2013). *Fundamentals of social research methods: An African perspective.* Juta and Company Ltd.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives, Handbook I: The cognitive domain* (Vol. 19). Longmans.

Boaler, J. (2013). Ability and mathematics: The mindset revolution that is reshaping education. *FORUM, 55*(1), 143-152.

Boaler, J. (2016). How students Should be Taught mathematics: Reflections from research and practice. Retrieved from https://www.youcubed.org/how-math-should-be-taught/

Boeije, H. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality and Quantity: International Journal of Methodology, 36*(4), 391-409. doi:10.1023/a:1020909529486

Boitshwarelo, B., Reedy, A. K., & Billany, T. (2017). Envisioning the use of online tests in assessing twenty-first century learning: a literature review. *Research Practice in Technology Enhanced Learning, 12*(1), 1-16. doi:10.1186/s41039-017-0055-7

Bolhuis, S. (2003). Towards process-oriented teaching for self-directed lifelong learning: A multidimensional perspective. *Learning and Instruction, 13*, 327-347. doi:10.1016/S0959-4752(02)00008-7

Botha-Ravyse, C., & Reitsma, G. (2015). Multi-media for flipped classrooms: engaged nutrition learning in a multi-media enhanced flipped classroom. *Progressio, 37*(1), 19-32.

Bound, M. (2012). Ethical considerations with gatekeepers. Doctoral dissertation, (Unpublished doctoral dissertation), Nova South Eastern University.

Bowie, L., Venkat, H., & Askew, M. (2019). Pre-service primary teachers' mathematical content knowledge: An exploratory study. *African Journal of Research in Mathematics, Science and Technology Education, 23*(3), 286-297. doi:10.1080/18117295.2019.1682777

Boysen, G. (2016). Hitting the Metacognitive Targets with Learning Objectives. Retrieved from https://www.improvewithmetacognition.com/hitting-metacognitive-target-learning-objectives/

Bray, A., & Tangney, B. (2017). Technology usage in mathematics education research – A systematic review of recent trends. *Computers & Education, 114*, 255-273. doi:10.1016/j.compedu.2017.07.004

Brewer, R., & Movahedazarhouligh, S. (2018). Successful stories and conflicts: A literature review on the effectiveness of flipped learning in higher education. *Journal of Computer Assisted Learning, 34*(4), 409-416.

Brookfield, S. (2017). *Becoming a critically reflective teacher* (2nd ed.). Jossey-Bass.

Brooks, J. G. (1999). *In search of understanding: The case for constructivist classrooms.* AscD.

Brown, A. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. In F. E. Weinert & R. H. Kluwe (Eds.), *Metacognition, motivation, and understanding.* (pp. 65-116). Lawrence Erlbaum Associates.

Brown, A., & DeLoache, J. (1978). Skills, plans, and self-regulation. In R. S. Siegler (Ed.), *Children's thinking: What develops.* (pp. 3-35). Lawrence Erlbaum Associates.

Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, *31,* 21–32

Buhagiar, M. A., & Murphy, R. (2008). Teachers' assessments of students' learning of mathematics. *Assessment in Education: Principles, 15*(2), 169-182. doi:10.1080/09695940802164192

Calder, N., & Campbell, A. (2016). Using mathematical apps with reluctant learners. *Digital Experiences in Mathematics Education, 2*(1), 50-69.

Callender, A. A., Franco-Watkins, A. M., & Roberts, A. S. (2016). Improving metacognition in the classroom through instruction, training, and feedback. *Metacognition and Learning, 11*(2), 215-235. doi:10.1007/s11409-015-9142-6

Campione, J. (1987). Metacognitive components of instructional research with problem learners. In F. E. Weinert & R. H. Kluwe (Eds.), *Metacognition, motivation, and understanding* (pp. 117-140). Lawrence Erlbaum associates.

Candy, P. C. (1989). Alternative paradigms in educational research. *The Australian Educational Researcher, 16*(3), 1-11. doi:10.1007/BF03219446

Candy, P. C. (1991). *Self-direction for lifelong learning. A comprehensive guide to theory and practice.* Jossey-Bass.

Carcione, A. (2017). Development of a self-report measure of metacognition: The metacognition self-assessment scale (MSAS). Instrument description and factor structure. *Clinical Neuropsychiatry, 14*, 185-194.

Care, E., Kim, H., Vista, A., & Anderson, K. (2018). Education system alignment for 21st Century skills: Focus on assessment. Center for Universal Education at The Brookings Institution.

Çelik, H. C., & Özdemir, F. (2020). Mathematical thinking as a predictor of critical thinking dispositions of pre-service mathematics teachers. *International Journal of Progressive Education, 16*(4), 81-98. doi:10.29329/ijpe.2020.268.6

Çevikbas, M., & Argün, Z. (2017). An innovative learning model in digital age: Flipped classroom. *Journal of Education and Training Studies, 5*(11), 189-200. doi:org/10.11114 /jets.v5i11 .2322.

Cevikbas, M., & Kaiser, G. (2020). Flipped classroom as a reform-oriented approach to teaching mathematics. *ZDM, 52*(7), 1291-1305. doi:org/10.1007/s11858-020-01191-5

Chalkiadaki, A. (2018). A systematic literature review of 21st century skills and competencies in primary education. *International Journal of Instruction, 11*(3), 1-16. doi:10.12973/iji.2018.1131a

Chinn, C., & Sandoval, W. (2018). Epistemic cognition and epistemic development. In *International handbook of the learning sciences* (pp. 24-33). Routledge.

Chinnappan, M. (2008). Productive pedagogies and deep mathematical learning in a globalised world. In P. Kell, W. Vialle, D. Konza, & G. Vogl (Eds.), *Learning and the learner: Exploring learning for new times* (pp. 181-193). University of Wollongong.

Chu, S., Reynolds, R., Tavares, N., Notari, M., & Lee, C. (2017). Teachers' professional development. In *21st Century skills development through inquiry-based learning* (pp. 109-129): Springer.

Chytrý, V., Říčan, J., Eisenmann, P., & Medová, J. (2020). Metacognitive knowledge and mathematical intelligence - Two significant factors influencing school performance. *Mathematics Education Research Journal, 8*(6), 969. doi:10.3390/math8060969

Cishe, E. N. (2017). Teachers' perspectives on transforming teacher education curriculum for relevance to basic education for sustainable development. *Perspectives in Education, 35*(2), 73-84.

Clements, D. H., & Battista, M. T. (1990). Research into practice: Constructivist learning and teaching. *The Arithmetic Teacher, 38*(1), 34-35. doi:10.5951/AT.38.1.0034

Cobb, P. (1994). Where Is the Mind? Constructivist and sociocultural perspectives on mathematical development. *Educational Researcher, 23*(7), 13-20.

Cobb, P., Confrey, J., diSessa, A., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. *Educational Researcher, 32*(1), 9-13.

Cobb, P., Jackson, K., & Dunlap, C. (2016). Design research: An analysis and critique. *Handbook of international research in mathematics education, 3*, 481-503.

Cobb, P., Yackel, E., & Wood, T. (1992). A constructivist alternative to the representational view of mind in mathematics education. *Journal for Research in Mathematics Education, 23*(1), 2-33.

Coghlan, D., & Brydon-Miller, M. (2014). *The SAGE encyclopedia of action research.* Sage.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). Routledge.

Collins, R. (2014). Skills for the 21st Century: teaching higher-order thinking. *Curriculum Leadership Journal, 12*(14).

Confrey, J., & Kazak, S. (2006). A thirty-year reflection on constructivism in mathematics education in PME. In *Handbook of research on the psychology of mathematics education* (pp. 305-345). Brill Sense.

Conrady, K. (2015). Modeling metacognition: Making thinking visible in a content course for teachers. *REDIMAT - Journal of Research in Mathematics Education, 4*(2), 132-160.

Craig, K., Hale, D., Grainger, C., & Stewart, M. E. (2020). Evaluating metacognitive self-reports: systematic reviews of the value of self-report in metacognitive research. *Metacognition and Learning, 15*(2), 155-213. doi:10.1007/s11409-020-09222-y

Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five approaches* (2nd ed.). Sage.

Creswell, J. W. (2012). *Educational research: planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Pearson.

Cunningham, P., Matusovich, H., & Blackowski, S. (2018). *Teaching metacognition: Helping students own and improve their learning.* Paper presented at the Workshop presented at the American Society for Engineering Education Annual Conference and Exposition.

Curwen, M. S., Miller, R. G., White-Smith, K. A., & Calfee, R. C. (2010). Increasing teachers' metacognition develops students' higher learning during content area literacy instruction: Findings from the Read-Write Cycle Project. *Issues in Teacher Education, 19*(2), 127-151.

Daniels, K. (2013). Professional Development. In *Flipping 2.0 practical strategies for flipping your classroom* (pp. 291-311). Bretzmann Group.

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science, 24*(2), 97-140. doi:10.1080/10888691.2018.1537791

Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research and Development, 61*(4), 563-580.

De Backer, L. (2015). *Fostering university students' individual and socially shared metacognitive regulation through reciprocal same-age peer tutoring: A study into the impact and interaction processes.* Ghent University

De Backer, L., Van Keer, H., & Valcke, M. (2012). Exploring the potential impact of reciprocal peer tutoring on higher education students' metacognitive knowledge and regulation. *Instructional Science, 40*(3), 559-588.

De Boer, V., & Winnips, K. (2015). *Flipped classroom at the University of Groningen*. Retrieved from http://www.rug.nl/e-learning/documenten/flippedclass-report-nl.pdf

De Corte, E. (2004). Mainstreams and perspectives in research on learning (Mathematics) from instruction. *Applied Psychology: An International Review, 53*(2), 279-310. doi:10.1111/j.1464-0597.2004.00172.x

De Corte, E. (2012). Constructive, self-regulated, situated, and collaborative learning: An approach for the acquisition of adaptive competence. *Journal of Education, 192*(2/3), 33-47.

De Vos, A. S. (2011). *Research at grass roots: For the social sciences and human services professions* (4th ed.). Van Schaik.

Demirkasimoglu, N. (2010). Defining "Teacher Professionalism" from different perspectives. *Procedia Social and Behavioral Sciences, 9*, 2047–2051.

Demirkasımoğlu, N. (2010). Defining "Teacher Professionalism" from different perspectives. *Procedia Social and Behavioral Sciences, 9*, 2047-2051.

Denton, P., Madden, J., Roberts, M., & Rowe, P. (2008). Students' response to traditional and computer-assisted formative feedback: A comparative case study. *39*(3), 486-500. doi:10.1111/j.1467-8535.2007.00745.x

Denzin, N. K. (1970). Strategies of multiple triangulation. In *The research act in sociology: A theoretical introduction to sociology methods* (pp. 297-313). Aldine.

Denzin, N. K. (1994). The art and politics of interpretation. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research.* (pp. 500-515). Sage Publications, Inc.

Department of Basic Education. (2011). *Curriculum and assessment policy statement (CAPS): Grades 4-6 Mathematics*. South Africa. Retrieved from http://www.education.gov.za

Department of Basic Education. (2018). *Teacher development and curriculum management (TDCM) Lekgotla: Repositioning the curriculum for 21st Century education and skills development*. South Africa Retrieved from https://www.education.gov.za/TDCMLekgotla2018.aspx

Department of Education. (2000). *Norms and standards for educators, National education policy act (20844/1996)*. South African Retrieved from http://www.info.gov.

Department of Higher Education and Training of South Africa. (2015, 19 Feb). Revised policy on the minimum requirements for teacher education qualifications. (Vol 596). *Government Gazette, 38487,* pp. 1-69.

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *49*(1), 5-22. doi:10.1177/0047239520934018

Dossey, J. A. (1992). The nature of mathematics: Its role and its influence. In D. Grouws (Ed.), *Handbook of research on mathematics teaching learning* (pp. 39-48). MacMillan.

Downing, K. (2010). Problem-based learning and metacognition. *Asian Journal on Education and Learning, 1*(2), 75-96.

Dunlosky, J., & Rawson, K. A. (2012). Overconfidence produces underachievement: Inaccurate self- evaluations undermine students' learning and retention. *Learning and Instruction, 22*(4), 271-280.

Dweck, C. S. (2008). *Mindset: The new psychology of success.* Ballantine Books.

Efklides, A. (2008). Metacognition: Defining its facets and levels of functioning in relation to self-regulation and co-regulation. *European Psychologist, 13*(4), 277-287. doi:10.1027/1016-9040.13.4.277

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model. *Educational Psychologist, 46*(1), 6-25.

Elazab, S., & Alazab, M. (2015). The effectiveness of the flipped classroom in higher education. Presented at the Fifth International Conference on e-Learning (econf), 207-211.doi:10.1109/ECONF.2015.34.

Ellies, A., & Denton, D. (2010). *Teaching, learning, and assessment together*: *Reflective Assessments for Middle and High School Mathematics and Science* (1st ed). Routledge.

Elliot, E. S., & Dweck, C. S. (1998). Goals: An approach to motivation and achievement. *Journal of Personality Social Psychology, 54*(1), 5-12. doi:org/10.1037/0022-3514.54.1.5

Elliott, J. (2015). Educational action research as the quest for virtue in teaching. *Educational Action Research, 23*(1), 4-21.

Ellis, M. W., & Berry, R. (2005). The paradigm shift in mathematics education: Explanations and implications of reforming conceptions of teaching and learning. *Journal of Higher Education Outreach and Engagement, 15*(1), 7-17.

Ernest, P. (1992). The nature of mathematics: Towards a social constructivist account. *Science & Education, 1*(1), 89-100. doi:10.1007/BF00430212

Ernest, P. (1998). *Social constructivism as a philosophy of mathematics*. New York Press.

Ernest, P., Skovsmose, O., Paul van Bendegem, J., Bicudo, M., Miarka, R., Kvasz, L., & Moeller, R. (2016). *The philosophy of mathematics education*. Springer.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *5*(1), 1-4. doi:10.11648/j.ajtas.20160501.11

Fadel, C., Bialik, M., & Trilling, B. (2015). *Four-dimensional education*: The competencies learners need to succeed. Createspace publishing.

Fahnoe, C., & Mishra, P. (2013). *Do 21st century learning environments support self-directed learning? Middle school students' response to an intentionally designed learning environment.* Paper presented at the Society for Information Technology & Teacher Education International Conference, Michigan State University.

Feng, W., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research & Development, 53*(4), 5-23.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*(1), 80-92.

Flavell, J. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), *The nature of intelligence.* Lawrence Erlbaum Associates

Flavell, J. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. *American Psychologist, 34*(10), 906-911. doi:10.1037/0003-066X.34.10.906

Flavell, J. (1987). Speculations about the nature and development of metacognition. In F. E. Weinert & R. H. Kluwe (Eds.), *Metacognition, motivation, and understanding* (pp. 21-29). London. Lawrence Erlbaum Associates.

Flipped Learning Network (FLN). (2014, March 12). The four pillars of FLIP™. https://flippedlearning.org/definition-of-flipped-learning/

Fook, C. Y., Dalim, S. F., Narasuman, S., Sidhu, G. K., Fong, L. L., & Keang, K. M. (2015). Relationship between active learning and self-efficacy among students in higher education. *International Academic Research Journal of Social Science*, *1*(2), 139-149.

Fredriksen, H. (2020). Exploring realistic mathematics education in a flipped classroom context at the tertiary level. *International Journal of Science and Mathematics Education*. *19*(2), 377-396. doi:10.1007/s10763-020-10053-1

Freire, P. (2000). *Pedagogy of the oppressed*: The Continuum International Publishing Group. https://www.academia.edu/37919934/Pedagogy_of_the_oppressed_by_Paulo_Freire?auto=download

Friese, S. (2019). *Qualitative data analysis with ATLAS.ti* (3rd ed.). Sage publications.

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology, 13*(1), 117. doi:10.1186/1471-2288-13-117

Gama, C.A. (2004). *Integrating metacognition instruction in interactive learning environments.* (D.Litt.thesis), University of Sussex, UK.

Gardner, H. (1993). *Multiple intelligences: The theory in practice.* Basic Books.

Geisinger, K. F. (2016). 21st century skills: What are they and how do we assess them? *Applied Measurement in Education, 29*(4), 245-249. doi:10.1080/08957347.2016.1209207

Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: Interviews and focus groups. *British Dental Journal, 204*(6), 291-295.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 597-606.

Gravemeijer, K., Stephan, M., Julie, C., Lin, F., & Ohtani, M. (2017). What mathematics education may prepare students for the society of the future? *International Journal of Science and Mathematics Education, 15*(1), 105-123. doi:10.1007/s10763-017-9814-6

Gravemeijer, K., & Van Eerde, D. (2009). Design research as a means for building a knowledge base for teachers and teaching in mathematics education. *The Elementary School Journal, 109*(5), 510-524.

Gravett, S. (2005). *Adult learning: Designing and implementing learning events: A dialogic approach* (2nd ed.). Van Schaik.

Griffin, T. D., Wiley, J., & Salas, C. R. (2013). Supporting effective self-regulated learning. The critical role of monitoring. In R. A. Azevedo, V. (Ed.), *International handbook of metacognition and learning technologies* (pp. 19-34). Springer.

Guba, E. G. (1990). *The alternative paradigm dialog*. Sponsored by Phi Delta Kappa International and The School of Education, Indiana University. Sage

Guba, E. G., & Lincoln, Y. (1994). Competing paradigms in qualitative research. *Handbook of qualitative research, 2*(163-194), 105.

Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation.* Sage.

Guglielmino, L. M. (2013). The case for promoting self-directed learning in formal educational institutions. *SA-eDUC, 10*(2).

Gullen, K., & Zimmerman, H. (2013). Saving time with technology. *Educational Leadership, 70*(6), 63-66.

Gurat, M. G., & Medula, C. (2016). Metacognitive strategy knowledge use through mathematical problem solving amongst pre-service teachers. *American Journal of Educational Research, 4*(2), 170-189.

Guri-Rosenblit, S., & Gros, B. (2011). E-learning: Confusing terminology, research gaps and inherent challenges. *International Journal of E-Learning Distance Education, 25*(1).

Halili, S. H., Razak, R.A & Zainuddin, Z. (2014). Enhancing collaborative learning in flipped classroom. *Australian Journal of Basic and Applied Sciences, 9*(7), 147-149.

Halili, S. H., Sulaiman, S., Sulaiman, H., & Razak, R. (2019). Exploring students' learning styles in using mobile flipped classroom. *International Multidisciplinary Journal of Social Sciences, 8*(2), 105-125.

Halili, S. H., & Zainuddin, Z. (2015). Flipping the classroom: What we know and what we don't. *The Online Journal of Distance Education and e-earning, 3*(1), 28-35.

Hall, A. A., & DuFrene, D. D. (2016). Best practices for launching a flipped classroom. *Business & Professional Communication Quarterly, 79*(2), 234-242. doi:10.1177/2329490615606733

Han, J., & Yin, H. (2016). Teacher motivation: Definition, research development and implications for teachers. *Cogent Education, 3*(1), 1217819.

Händel, M., Artelt, C., & Weinert, S. (2013). Assessing metacognitive knowledge: Development and evaluation of a test instrument. *Journal for Educational Research Online, 5*(2), 162.

Hao, Y. (2014). *Students' attitude towards a flipped classroom and its relationship with motivation orientations in an undergraduate course*. Paper presented at the 2014 Society for information technology & teacher education international conference. https://www.learntechlib.org/p/131225

Hao, Y. (2016). Exploring undergraduates' perspectives and flipped learning readiness in their flipped classrooms. *Computers in Human Behavior, 59*, 82-92. doi:10.1016/j.chb.2016.01.032

Hardman, J. (2019). Towards a pedagogical model of teaching with ICTs for mathematics attainment in primary school: A review of studies 2008–2018. *Heliyon, 5*(5), e01726. doi:10.1016/j.heliyon.2019.e01726

Haynie, J. M., Shepherd, D. A., & Patzelt, H. (2012). Cognitive adaptability and an entrepreneurial task: The role of metacognitive ability and feedback. *36*(2), 237-265. doi:10.1111/j.1540-6520.2010.00410.x

Heinerichs, S., Pazzaglia, G., & Gilboy, M. B. (2016). Using flipped classroom components in blended courses to maximize student learning. *Athletic Training Education Journal, 11*(1), 54-57.

Herrington, J., McKenney, S., Reeves, T. C., & Oliver, R. (2007). *Design-based research and doctoral students: Guidelines for preparing a dissertation proposal.* In C. Montgomerie & J. Seale (Eds.), Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2007 (pp. 4089-4097). AACE. https://ro.ecu.edu.au/ecuworks/1612

Herrington, J., & Parker, J. (2013). Emerging technologies as cognitive tools for authentic learning. *British Journal of Educational Technology, 44*(4), 607-615.

Higgins, K., Huscroft-D'Angelo, J., & Crawford, L. (2019). Effects of technology in mathematics on achievement, motivation and attitude: A meta-analysis. *Journal of Educational Computing Research, 57*(2), 283-319. doi:10.1177/0735633117748416

Hill, H. C., & Chin, M. (2018). Connections between teachers' knowledge of students, instruction, and achievement outcomes. *American Educational Research Journal, 55*(5), 1076-1112. doi:10.3102/0002831218769614

Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S. I., & Reiss, K. M. (2020). The potential of digital tools to enhance mathematics and science learning in secondary schools: A context-specific meta-analysis. *Computers & Education, 153*, 103897. doi:10.1016/j.compedu.2020.103897

Hrastinski, S. (2019). What do we mean by blended learning? *TechTrends, 63*(5), 564-569.

Ibrahim, M., & Watts, A. (2016). *Assessing preservice teachers' metacognitive skills in a flipped classroom environment*. Paper presented at the EdMedia: World Conference on Educational Media and Technology 2016, Vancouver. https://www.learntechlib.org/p/173098

Jacobse, A. E., & Harskamp, E. G. (2012). Towards efficient measurement of metacognition in mathematical problem solving. *Metacognition and Learning, 7*(2), 133-149.

Jaleel, S. (2017). A study on the relationship between self-directed learning and achievement in information technology of students at secondary level. *Universal Journal of Educational Research, 5*(10), 1849-1852. doi:10.13189/ujer.2017.051024

Jarvis, W., Halvorson, W., Sadeque, S., & Johnston, S. (2014). A large class engagement (LCE) model based on service-dominant logic (SDL) and flipped classrooms. *Education Research Perspectives, 41*(1), 1-24.

Jiang, Y., Ma, L., & Gao, L. (2016). Assessing teachers' metacognition in teaching: The teacher metacognition inventory. *Teaching and Teacher Education, 59*, 403-413.

Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly, 24*(4), 602-611. doi:10.2307/2392366

Johnson, R. B. (1997). Examining the validity structure of qualitative research. *Education, 118*(2), 282-292.

Jojo, Z. (2019). Mathematics education system in South Africa. In G. Porto (Ed.), *Education systems around the world* (pp. 129-140). InTechOpen.

Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B. B. (1995). Constructivism and computer-mediated communication in distance education. *American Journal of Distance Education, 9*(2), 7-26.

Joseph, N. L. (2003). Metacognition in the classroom: Examining theory and practice. *Pedagogy, 3*(1), 109-113. doi:10.1215/15314200-3-1-109

Joutsenlahti, J., & Kulju, P. (2017). Multimodal languaging as a pedagogical model—A case study of the concept of division in school mathematics. *Education Sciences, 7*(1), 1-9. doi:10.3390/educsci7010009

Kameda, Q. (2017). A case study on effective approaches for implementing constructivist teaching strategies into a mathematics classroom. *International Journal of Education Learning and Development, 5*(11), 23-33.

Kaur, H. (2016). Technology transforming mathematics education. *International Journal of Advanced Research in Computer Science, 7*(6), 246-249.

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education, 29*, 76-85. doi:10.1016/j.tate.2012.08.005

Kim, J., & Lim, K. (2019). Promoting learning in online, ill-structured problem solving: The effects of scaffolding type and metacognition level. *Computers & Education, 138*, 116-129. doi:10.1016/j.compedu.2019.05.001

Kim, M., Kim, S., Khera, O., & Getman, J. (2014). The experience of three flipped classrooms in an urban university: An exploration of design principles. *The Internet and Higher Education, 22*, 37-50. doi:10.1016/j.iheduc.2014.04.003

King, A. (1991). Improving lecture comprehension: Effects of a metacognitive strategy. *Applied Cognitive Psychology, 5*(4), 331-346.

King, A. (1993). From sage on the stage to guide on the side. *College Teaching, 41*(1), 30-35. doi:10.1080/87567555.1993.9926781

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75-86.

Kirsh, D. (2005). Metacognition, distributed cognition and visual design. *Cognition, Education and Communication Technology*, 147-180.

Kivunja, C., & Kuyini, A. B. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education*, *6*(5), 26-41.

Kjellgren, K. I., Hendry, G., Hultberg, J., Plos, K., Rydmark, M., Tobin, G., & Säljä, R. (2008). Learning to learn and learning to teach - Introduction to studies in higher education. *Medical Teacher, 30*(8), 239-245. doi:10.1080/01421590802258896

Kloosterman, P., & Stage, F. K. (1992). Measuring beliefs about mathematical problem solving. *92*(3), 109-115.

Kluwe, R. H. (1987). Executive decisions and regulation of problem solving behaviour. In F. E. Weinert & R. H. Kluwe (Eds.), *Metacognition, motivation, and understanding* (pp. 31-64). Lawrence Erlbaum Associates.

Knowles, M. S. (1975). *Self-directed learning: A guide for learners and teachers.* Association Press.

Kögce, D. (2017). A study of pre-service classroom teachers' beliefs about teachers' and students' roles. *International Journal of Mathematical Education in Science and Technology, 48*(6), 830-848.

Kramarski, B., & Kohen, Z. (2016). Promoting preservice teachers' dual self-regulation roles as learners and as teachers: effects of generic vs. specific prompts. *Metacognition and Learning*, 1-35. doi:10.1007/s11409-016-9164-8

Kramarski, B., Mevarech, Z. R., & Arami, M. (2002). The effects of metacognitive instruction on solving mathematical authentic tasks. *Educational Studies in Mathematics, 49*(2), 225-250. doi:10.1023/a:1016282811724

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory Into Practice, 41*(4), 212-264.

Krouss, P., & Lesseig, K. (2020). Effects of a flipped classroom model in an introductory college mathematics course. *PRIMUS: Problems, resources, and issues in mathematics undergraduate studies, 30*(5), 617-635. doi:10.1080/10511970.2019.1625471

Kruger, N., & Adams, H. (Eds.). (1998). *Psychology for teaching and learning.* Heinemann

Ku, K., & Ho, I. (2010). Metacognitive strategies that enhance critical thinking. *Metacognition and Learning, 5*(3), 251-267.

Kunnathodi, A. G., & Sarabi, M. K. (2017). *Environmental essentials of signature pedagogy of constructivist teacher education – An analogy*. Online Submission. Paper presented at the National seminar on mapping new terrain of environmental psychology in 21st century teacher education (Kozhikode, Kerala, Mar 1-2, 2017)

Kurt, G. (2017). Implementing the flipped classroom in teacher education: Evidence from Turkey. *Journal of Educational Technology & Society, 20*(1), 211-221.

Lage, M., Platt, GJ and Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 31*(1), 30-43.

Lai, C., & Hwang, G. (2016). A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. *Computers & Education, 100*, 126-140. doi:10.1016/j.compedu.2016.05.006

Lai, E. R. (2011). Metacognition: A literature review. *Always Learning. Pearson Research Report, 24*, 1-40.

Lape, N. K., & Levy, R. (2014). *Probing the inverted classroom: A controlled study of teaching and learning outcomes in undergraduate engineering and mathematics*. Paper presented at the 360 degrees of Engineering Education, Indianapolis. https://www-scopus-com.nwulib.nwu.ac.za/record/display.uri?eid=2-s2.0-84905192244&origin=inward&txGid=7ee6ec2ae8be88380cae2d8f13403f9f

Le Roux, A. (2016). Exploring a partially flipped ecology classroom on a rural campus in South Africa. *Journal for New Generation Sciences, 14*(1), 51-62.

Lee, J., & Choi, H. (2017). What affects learner's higher-order thinking in technology-enhanced learning environments? The effects of learner factors. *Computers & Education, 115*, 143-152. doi:10.1016/j.compedu.2017.06.015

Lee, Y., & Kim, K. (2018). Enhancement of student perceptions of learner-centeredness and community of inquiry in flipped classrooms. *BMC medical education, 18*(242), 1-6. doi:org/10.1186/s12909-018-1347-3

Leong, Y. H., & Chick, H. L. (2011). Time pressure and instructional choices when teaching mathematics. *Mathematics Education Research Journal, 23*(3), 347. doi:10.1007/s13394-011-0019-y.

Lester, F. K. (2007). *Second handbook of research on mathematics teaching and learning: A project of the National Council of Teachers of Mathematics.* Information Age.

Lester, F. K. (2013). Thoughts about research on mathematical problem-solving instruction. *The Mathematics Enthusiast, 10*(1), 245-278.

Ley, T., Kump, B., & Gerdenitsch, C. (2010). *Scaffolding self-directed learning with personalized learning goal recommendations.* Paper presented at the International conference on user modeling, adaptation, and personalization.

Li, Q., Lemieux, C., Vandermeiden, E., & Nathoo, S. (2013). Are you ready to teach secondary mathematics in the 21st century? A study of preservice teachers' digital game design experience. *Journal of Research on Technology in Education, 45*(4), 309-337.

Li, Y., & Schoenfeld, A. H. (2019). Problematizing teaching and learning mathematics as "given" in STEM education. *International Journal of STEM Education, 6*(1), 44. doi:10.1186/s40594-019-0197-9

Lichtman, M. (2013). *Qualitative research in education: A user's guide* (3rd ed.). Sage.

Limueco, J. M., & Prudente, M. S. (2019). *Flipped classroom enhances student's metacognitive awareness.* IC4E '19 Proceedings of the 10th International conference on e-education, e-business, e-management and e-learning, https://doi.org/10.1145/3306500.3306507

Lincoln, Y., & Guba, E. (1985). *Naturalistic Inquiry.* Sage.

Liu, C. H., & Matthews, R. (2005). Vygotsky's philosophy: Constructivism and its criticisms examined. *International Education Journal, 6*(3), 386-399.

Liu, Y., Li, Y., Lei, M., Liu, P., Theobald, J., Meng, L., Jin, C. (2018). Effectiveness of the flipped classroom on the development of self-directed learning in nursing education: A meta-analysis. *Frontiers of Nursing, 5*(4), 317-329.

Lo, C. K., Hew, K. F., & Chen, G. (2017). Toward a set of design principles for mathematics flipped classrooms: A synthesis of research in mathematics education. *Education Research Review, 22*, 50-73.

Longworth, N. (2003). *Lifelong learning in action: Transforming Education in the 21st century.* Routledge.

Loyens, S., Magda, J., & Rikers, R. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review, 20*(4), 411-427. doi:10.1007/s10648-008-9082-7

Lubbe, E. (2016). Innovative teaching in accounting subjects: Analysis of the flipped classroom. *International Journal of Social Sciences and Humanity Studies, 8*(2), 63-74.

Lucangeli, D., Cornoldi, C., & Tellarini, M. (1998). Metacognition and learning disabilities in mathematics. In T. E. Scruggs, M. A. Mastropieri, T. E. Scruggs, & M. A. Mastropieri (Eds.), *Advances in learning and behavioral disabilities, Vol. 12.* (pp. 219-244). Elsevier Science.

Lucariello, J. M., Nastasi, B. K., Anderman, E. M., Dwyer, C., Ormiston, H., Skiba, R. J. M., Brain & Education. (2016). Science supports education: The behavioral research base for psychology's top 20 principles for enhancing teaching and learning. *Mind, Brain, and Education, 10*(1), 55-67.

Luneta, K. (2016). Mathematical cognition: Understanding how children acquire mathematical knowledge and skills. *Wulfenia, 23*(4), 291-296.

Mack, L. (2010). The philosophical underpinnings of educational research. *Polyglossia, 19*, 5-11.

Magno, C. (2010). The role of metacognitive skills in developing critical thinking. *Metacognition and Learning, 5*(2), 137-156.

Manasia, L., & Pârvan, A. (2014). Challenging adult learning and work experience through metacognitive reflection. A case study approach. *Procedia - Social and Behavioral Sciences, 142*, 447-453. doi:10.1016/j.sbspro.2014.07.694

Mariano, G. J., Figliano, F. J., & Dozier, A. (2017). Using metacognitive strategies in the STEM field. In *Metacognition and successful learning strategies in higher education* (pp. 216-230). IGI Global.

Mayer, R. E. (2002). Rote versus meaningful learning. *Theory into Practice, 41*(4), 226-232.

McKenney, S., Nieveen, N., & Van den Akker, J. (2006). Design research from a curriculum perspective. In J. Van den Akker, K. Gravemeijer, S. McKenney, & N. Nieveen (Eds.), *Educational design research* (pp. 62-90). Routledge.

McKenney, S. E., & Reeves, T. C. (2012). *Conducting educational design research.* Routledge.

McKernan, J. (1996). *Curriculum action research: A handbook of methods and resources for the reflective practitioner* (2nd ed.). Kogan Page.

McLaren, A. (2013). Math. In J. Bretzmann (Ed.), *Flipping 2.0 practical strategies for flipping your classroom* (pp. 99-122). Bretzmann Group.

McLean, S., Attardi, S. M., Faden,L. & Goldszmidt, M. (2016). Flipped classrooms and student learning: Not just surface gains. *How we teach: Generalizable Education Research, 40*(1), 47-55.

McMillan, J., & Schumacher, S. (2014). *Research in education* (7th ed.). Pearson

Menz, P., & Xin, C. (2016). Making students' metacognitive knowledge visible through reflective writing in a mathematics-for-teachers course. *Collected Essays on Learning and Teaching, 9*, 155-166.

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). John Wiley & Sons.

Mevarech, Z. R., & Kramarski, B. (2003). The effects of metacognitive training versus worked-out examples on students' mathematical reasoning. *British Journal of Educational Psychology, 73*(4), 449-471. doi:10.1348/000709903322591181

Mezirow, J. (2003). Transformative learning as discourse. *Journal of transformative education, 1*(1), 58-63. doi:10.1177/1541344603252172

Montalvo, F. T., & Torres, M. C. G. (2004). Self-regulated learning: Current and future directions. *Electronic Journal of Research in Educational Psychology, 2*(1), 1-34.

Moonsamy, S. (2014). Thinking classrooms: How to recognise a thinking classroom. In L. Green (Ed.), *Schools as thinking communities* (1st ed., pp. 290). Van Schaik.

Muis, K. R. (2007). The role of epistemic beliefs in self-regulated learning. *Educational Psychologist, 42*(3), 173-190. doi:10.1080/00461520701416306

Muis, K. R., Psaradellis, C., Chevrier, M., Di Leo, I., & Lajoie, S. P. (2016). Learning by preparing to teach: Fostering self-regulatory processes and achievement during complex mathematics problem solving. *Journal of Educational Psychology, 108*(4), 474-492. doi:10.1037/edu0000071

Naccarato, E., & Karakok, G. (2015). Expectations and implementations of the flipped classroom model in undergraduate mathematics courses. *International Journal of Mathematical Education in Science and Technology, 46*(7), 968-978.

NCTM. (2015). Strategic use of technology in teaching and learning mathematics: A position of the National Council of Teachers of Mathematics. https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/Strategic%20Use%20of%20Technology%20July%202015.pdf

Nederveld, A., & Berge, Z. L. (2015). Flipped learning in the workplace. *Journal of Workplace Learning, 27*(2), 162-172.

Nenniger, P. (1999). On the role of motivation in self-directed learning: The “two-shells-model of motivated self-directed learning” as a structural explanatory concept. *European Journal of Psychology of Education, 14*(1), 71-86. doi:10.1007/BF03173112

Newbury, D. (2001). Diaries and fieldnotes in the research process. *Research Issues in Art, Design and Media, 1*(1), 1-17.

Nieuwenhuis, J. (2007). Qualitative research designs and data gathering techniques. In K. Maree (Ed.), *First steps in research.* Van Schaik.

Nilson, L. B. (2013). *Creating self-regulated learners: Strategies to strengthen students' self-awareness and learning skills* (1st ed.). Sterling.

Ning, H., & Downing, K. (2010). The reciprocal relationship between motivation and self-regulation: A longitudinal study on academic performance. *Learning Individual Differences, 20*(6), 682-686.

Nogueiras, G., & Iborra, A. (2017). Understanding and promoting self-direction in freshman and master's students: A qualitative approach. *Behavioral Development Bulletin, 22*(2), 394-404. doi:10.1037/bdb0000024

North-West University. (2017). Faculty of Educational Sciences. Retrieved 10 May 2017 http://www.nwu.ac.za/faculty-education-sciences

North-West University Faculty of Educational Sciences. (2017). Vision and Mission. Retrieved from http://www.nwu.ac.za/content/faculty-education-sciences-dean-visione

Nortvedt, G. A., & Buchholtz, N. (2018). Assessment in mathematics education: Responding to issues regarding methodology, policy, and equity. *ZDM, 50*(4), 555-570. doi:10.1007/s11858-018-0963-z

Nowell, L., Norris, J., White, D., & Moules, N. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods 16*. doi:10.1177/1609406917733847

Olive, J., Makar, K., Hoyos, V., Kor, L., Kosheleva, O., & Sträßer, R. (2009). Mathematical knowledge and practices resulting from access to digital technologies. In L. J. Hoyles C. (Ed.), *Mathematics Education and Technology - Rethinking the Terrain* (Vol. 13). Springer.

Ortlipp, M. (2008). Keeping and using reflective journals in the qualitative research process. *Qualitative Report, 13*(4), 695-705.

Oxford Advanced Learners' Dictionary. (n.d). Transaction. Retrieved October 11, 2020 https://www.oxfordlearnersdictionaries.com/definition/english/transaction?q=transaction

Özcan, Z. Ç. (2016). The relationship between mathematical problem-solving skills and self-regulated learning through homework behaviours, motivation, and metacognition. *International Journal of Mathematical Education in Science and Technology, 47*(3), 408-420.

Ozturk, N. (2017). Assessing metacognition: Theory and practices. *International Journal of Assessment Tools in Education, 4*(2), 134-148. doi:10.21449/ijate.298299

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology, 8*, 422. doi:10.3389/fpsyg.2017.00422

Papaleontiou-Louca, E. (2008). *Metacognition and theory of mind.* Cambridge Scholars Publishing.

Paris, S. G., & Byrnes, J. P. (1989). The constructivist approach to self-regulation and learning in the classroom. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement* (pp. 169-200). Springer.

Patton, M. (2002). *Qualitative Research & Evaluation Methods* (3rd ed.). Sage.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Sage Publications.

Peppler, C. (2013). Technology for Teachers. In *Flipping 2.0 practical strategies for flipping your classroom* (pp. 313-319). Bretzmann Group.

Pintrich, P. R. (2002). The role of metacognitive knowledge in learning, teaching, and assessing. *Theory into practice*, 41(4), 219-225. https://doi.org/10.1207/s15430421tip4104_3

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research, 31*(6), 459-470.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451-502).

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications.* Prentice Hall.

Plomp, T. (2013). Educational design research: An introduction. In T. Plomp & N. Nieeven (Eds.), *Educational design research Part A: An introduction* (pp. 10-51). SLO.

Polman, J., Hornstra, L., & Volman, M. (2020). The meaning of meaningful learning in mathematics in upper-primary education. *Learning Environments Research*, 1-18. doi:10.1007/s10984-020-09337-8

Ponterotto, J. G. (2005). Qualitative research in counseling psychology: A primer on research paradigms and philosophy of science. *Journal of Counseling Psychology, 52*(2), 126-136.

Pool, J., & Laubscher, D. (2016). Design-based research: Is this a suitable methodology for short-term projects? *Educational Media International, 53*(1), 42-52. doi:10.1080/09523987.2016.1189246

Portilho, E., & Medina, G. (2016). Metacognition as methodology for continuing education of teachers. *Creative Education, 7*(1), 1.

Pournara, C., Hodgen, J., Adler, J., & Pillay, V. (2015). Can improving teachers' knowledge of mathematics lead to gains in learners' attainment in Mathematics? *South African Journal of Education, 35*(3), 1-10.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223-231.

Pritchard, A. (2009). *Ways of learning: Learning theories and learning styles in the classroom* (2nd ed.). Routledge.

Punch, K. (2014). *Introduction to social research: Quantitative and qualitative approaches* (3rd ed.). Sage.

Rajaram, K. (2019). Flipped classrooms: Providing a scaffolding support system with real-time learning interventions. *Interventions, 9*(1), 30-58.

Ramocki, S. P. (2007). Metacognition and transfer: Keys to improving marketing education. *Journal of Marketing Education, 29*(1), 18-24.

Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. *Computers Education, 144*, 103701. doi:org/10.1016/j.compedu.2019.103701

Ray, B. B., & Powell, A. (2014). Preparing to teach with flipped classroom in teacher preparation programs. In Keengwe, J., Onchwari, G., & Oigara, J. N. (Eds.), *Promoting Active Learning through the Flipped Classroom Model* (pp. 1-22). IGI Global. doi:10.4018/978-1-4666-4987-3.ch001

Reddy, V., Visser, M., Winnaar, L., Arends, F., Juan, A.L., Prinsloo, C. & Isdale, K. (2016) TIMSS 2015: *Highlights of mathematics and science achievement of grade 9 South*

African learners. (Commissioned by the Department of Basic Education, December). http://hdl.handle.net/20.500.11910/10673

Richardson, V. (1997). Constructivist teaching and teacher education: Theory and practice. In V. Richardson (Ed.), *Constructivist teacher education: Building a world of new understandings* (pp. 3-14). The Falmer Press.

Robinson, J. D., & Persky, A. M. (2020). Developing self-directed learners. *American Journal of Pharmaceutical Education, 84*(3). doi:10.5688/ajpe847512

Rotellar, C., & Cain, J. (2016). Research, perspectives, and recommendations on implementing the flipped classroom. *American Journal of Pharmaceutical Education, 80*(2), 1-9. doi:10.5688/ajpe80234

Ruey, S. (2010). A case study of constructivist instructional strategies for adult online learning. *British Journal of Educational Technology, 41*(5), 706-720.

Rutkowski, J., & Moscinska, K. (2013). *Self-directed learning and flip teaching*. Paper presented at the 41st SEFI Conference, Leuven, Belgium.

Saavedra, A., & Opfer, D. (2012). Learning 21st-century skills requires 21st-century teaching. *The Phi Delta Kappan, 94*(2), 8-13.

Safari, Y., & Meskini, H. (2016). The effect of metacognitive instruction on problem solving skills in Iranian students of health sciences. *Global Journal of Health Science, 8*(1), 150-156.

Sandoval, W. A., Greene, J. A., & Bråten, I. (2016). Understanding and promoting thinking about knowledge: Origins, issues, and future directions of research on epistemic cognition. *Review of Research in Education, 40*(1), 457-496.

Sarma, S. K. (2015). Qualitative research: Examining the misconceptions. *South Asian Journal of Management, 22*(3), 176-191.

Sawyer, A. G. (2017). Factors influencing elementary mathematics teachers' beliefs in reform-based teaching. *The Mathematics Educator, 26*(2), 26-53.

Schabort, C. J., & Reitsma, G. M. (2016). Is it worthwhile to flip? Reflecting on flipped teaching in chemical engineering. *Journal for New Generation Sciences, 14*(3), 111-125.

Schoen, R., & LaVenia, M. (2019). Teacher beliefs about mathematics teaching and learning: Identifying and clarifying three constructs. *Cogent Education, 6*(1). doi:10.1080/2331186X.2019.1599488

Schoenfeld, A. H. (1988). When good teaching leads to bad results: The disasters of 'well-taught' mathematics courses. *Educational Psychologist, 23*(2), 145-166.

Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition and sense making in mathematics (Reprint). *Journal of Education, 196*(2), 1-38.

Schoenfeld, A. H. (2007). What is mathematical proficiency and how can it be assessed? *Assessing Mathematical Proficiency, 53*, 59.

Schoenfeld, A. H. (2019). Reframing teacher knowledge: A research and development agenda. *ZDM, 52*(2), 1-18. doi:10.1007/s11858-019-01057-5

Schrader, D. E. (2015). Constructivism and learning in the age of social media: Changing minds and learning communities. *New Directions for Teaching & Learning, 2015*(144), 23-35.

Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science, 26*(1-2), 113-125. doi:10.1023/A:1003044231033

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education, 36*(1-2), 111-139.

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology, 19*(4), 460-475. doi:10.1006/ceps.1994.1033

Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review, 7*(4), 351-371.

Schunk, D. H. (1996). *Learning theories: An educational perspective* (2nd ed.). Prentice Hall.

Schunk, D. H. (2008). Metacognition, self-regulation, and self-regulated learning: Research recommendations. *Educational Psychology Review, 20*(4), 463-467.

Seto, C. (2016). Teaching in the 21st century mathematics classroom: Metacognitive questioning. In *Developing 21st century competencies in the mathematics classroom: Yearbook 2016, Association of Mathematics Educators* (pp. 95-107). World Scientific.

Setyaningrum, W., & Mahmudi, A. (2018). Pedagogical content knowledge of mathematics pre-service teachers: Do they know their students? *Journal of Physics: Conference Series, 1097*(1), 012098. doi:10.1088/1742-6596/1097/1/012098

Shahnaz, S., & Hussain, R. (2016). Designing instruction for active and reflective learners in the flipped classroom. *Malaysian Journal of Learning and Instruction, 13*(2), 147-173.

Shen, C., & Liu, H. (2011). Metacognitive skills development: A web-based approach in higher education. *Turkish Online Journal of Educational Technology, 10*(2), 140-150.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*(2), 63-75.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-23.

Shulman, L. S., & Shulman, J. H. (2004). How and what teachers learn: A shifting perspective. *Journal of Curriculum Studies, 36*(2), 257-271. doi:10.1080/0022027032000148298

Siegesmund, A. (2017). Using self-assessment to develop metacognition and self-regulated learners. *FEMS Microbiology Letters, 364*(11). doi:10.1093/femsle/fnx096

Sleegers, P., Elshout, M., Daalen-Kapteijns, V., Meeus, W., & Tempelaar, D. (2013). The development of a questionnaire on metacognition for students in higher education. *Educational Research, 55*, 31-52. doi:10.1080/00131881.2013.767024

Smith, J. M., & Mancy, R. (2018). Exploring the relationship between metacognitive and collaborative talk during group mathematical problem-solving – what do we mean by collaborative metacognition? *Research in Mathematics Education, 20*(1), 14-36. doi:10.1080/14794802.2017.1410215

Sommer, M., & Ritzhaupt, A. (2018). Impact of the flipped classroom on learner achievement and satisfaction in an undergraduate technology literacy course. *Journal of Information Technology Education, 17*.

Sparks, S. (2017). Open educational resources (OER's). Retrieved from https://www.edweek.org/ew/issues/open-educational-resources-oer/index.html

Staker, H., & Horn, M. B. (2012). *Classifying K-12 blended learning.* Innosight Institute.

Stanciu, M. (2016). The international experiences related to the modernization of the academic didactic approach by means of the flipped classroom. *Agronomy Series of Scientific Research, 59*(2), 353-358.

Steen-Utheim, A. T., & Foldnes, N. (2018). A qualitative investigation of student engagement in a flipped classroom. *Teaching in Higher Education, 23*(3), 307-324. doi:10.1080/13562517.2017.1379481

Steffe, L. P., Nesher, P., Cobb, P., Sriraman, B., & Greer, B. (2013). *Theories of mathematical learning.* Lawrence Erlbaum.

Stehle, S. M., & Peters-Burton, E. (2019). Developing student 21st century skills in selected exemplary inclusive STEM high schools. *International Journal of STEM Education, 6*(1), 1-15. doi:10.1186/s40594-019-0192-1

Stiggins, R. (2002). Assessment crisis: The absence of assessment for learning. *Phi Delta Kappan, 83*(10), 758-765.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom.* Free Press.

Stott, A. E. (2018). Are instructivist pedagogies more appropriate for learning the sciences in South African low-quintile schools than western literature suggests? *Journal of Education* (71), 39-57. doi:10.17159/2520-9868/i71a03

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments Research, 15*(2), 171-193.

Strycker, J. (2017). Flipping education: A case study on integration. In L. S. Green, J. Banas, R. Perkins (Eds.), *The flipped college classroom: Conceptualized and re-conceptualized* (pp. 119-123). Springer.

Su, H., Ricci, F., & Mnatsakanian, M. (2016). Mathematical teaching strategies: Pathways to critical thinking and metacognition. *International Journal of Research in Education and Science, 2*(1), 190-200.

Su, Y., Feng, L., Yang, C., & Chen, T. (2012). How teachers support university students' lifelong learning development for sustainable futures: The student's perspective. *Futures, 44*, 158-165. doi:10.1016/j.futures.2011.09.008

Sullivan, P. (2011). Teaching mathematics: Using research-informed strategies. ACER Press

Suter, W. N. (2012). Qualitative data, analysis, and design. In W. N. Suter (Ed.), *Introduction to educational research: A critical thinking approach* (2nd ed., pp. 342-386). Sage.

Tall, D. (2013). *How humans learn to think mathematically: Exploring the three worlds of mathematics.* Cambridge University Press.

Tan, C., Chua, C. S., & Goh, O. (2015). Rethinking the framework for 21st-century education: Toward a communitarian conception. *The Educational Forum, 79*(3), 307-320. doi:10.1080/00131725.2015.1037511

Tang, C., & Chaw, L. (2016). Digital literacy: A prerequisite for effective learning in a blended learning environment? *Electronic Journal of E-learning, 14*(1), 54-65.

Tanner, M., & Scott, E. (2015). A flipped classroom approach to system analysis, design and implementation teaching . *Journal of Information Technology Education* (14), 219-241.

Tarrant, P., & Holt, D. (2016). *Metacognition in the primary classroom: A practical guide to helping children understand how they learn best.* Routledge.

Taylor, N. (2008). *What's wrong with South African Schools?* Paper presented at the What's Working in School Development, JET Education Services https://www.jet.org.za/resources/Taylor%20Whats%20wrong%20with%20SA%20schools%20JET%20Schools%20Conf%20final.pdf/view

Tekkol, İ. A., & Demirel, M. (2018). An investigation of self-directed learning skills of undergraduate students. *Front Psychol, 9*(2324). doi:10.3389/fpsyg.2018.02324

Thai, N., De Wever, B., & Valcke, M. (2017). The impact of a flipped classroom design on learning performance in higher education: Looking for the best "blend" of lectures and guiding questions with feedback. *Computers & Education, 107*, 113-126. doi:10.1016/j.compedu.2017.01.003

The Centre for Developmental Enterprise. (2014). What does research tell us about teachers, teaching and learner performance in Mathematics? Retrieved October 2014, from The Centre for Developmental Enterprise http://www.cde.org.za/what-does-research-tell-us-about-teachers-teaching-and-learner-performance-in-mathematics/

The Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher, 32*(1), 5-8.

Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 127-146). MacMillan.

Thompson, D. (2016). Marks should not be the focus of assessment – but how can change be achieved? *Journal of Learning Analytics, 3*(2), 193-212.

Thorpe, K. (2004). Reflective learning journals: From concept to practice. *Reflective Practice, 5*(3), 327-343. doi:10.1080/1462394042000270655

Tiahrt, T., & Porter, J. C. (2016). What do I do with this flipping classroom: Ideas for effectively using class time in a flipped course. *Business Education Innovation Journal, 8*(2), 85-91.

Tseng, S. S., Yang, S. H., & Yeh, H. C. (2016). *A review of design-based research.* Paper presented at the IEEE 16th International Conference on Advanced Learning Technologies.

Tucker, C. (2012). *Blended learning in grades 4-12.* Corwin.

Tzohar-Rozen, M., & Kramarski, B. (2014). Metacognition, motivation, and emotions: Contribution of self-regulated learning to solving mathematical problems. *Global Education Review, 1*(4), 76-95.

Van Alten, D., Phielix, C., Janssen, J., & Kester, L. (2019). Effects of flipping the classroom on learning outcomes and satisfaction: A meta-analysis. *Educational Research Review, 28*, 100281. doi:10.1016/j.edurev.2019.05.003

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2010). *Elementary and middle school mathematics: Teaching developmentally* (7th ed.). Allyn & Bacon.

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2013). *Elementary and middle school Mathematics* (8th ed.). Pearson.

Van der Stel, M., & Veenman, M. (2010). Development of metacognitive skillfulness: A longitudinal study. *Learning and Individual Differences, 20*(3), 220-224. doi:10.1016/j.lindif.2009.11.005

Van Vliet, E. A., Winnips, J. C., & Brouwer, N. (2015). Flipped-class pedagogy enhances student metacognition and collaborative-learning strategies in higher education but

effect does not persist. *CBE Life Sciences Education*, *14*(3), ar26. doi:10.1187/cbe.14-09-0141

Van Wyk, M. M. (2018). Economics student teachers' views on the usefulness of a flipped classroom pedagogical approach for an open distance eLearning environment. *The International Journal of Information Learning Technology, 35*(4), 255-265. doi:10.1108/IJILT-07-2017-0068

Veenman, M., Van Hout-Wolters, B., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning, 1*(1), 3-14.

Vijaya Kumari, S. N. (2014). Constructivist approach to teacher education: An integrative model for reflective teaching. *Journal on Educational Psychology, 7*(4), 31-40.

Vintere, A. (2018). A constructivist approach to the teaching of mathematics to boost competences needed for sustainable development. *Rural Sustainability Research, 39*(334), 1-7. doi:org/10.2478/plua-2018-0001

Virtanen, P., Niemi, H. M., & Nevgi, A. (2017). Active learning and self-regulation enhance student teachers' professional competences. *Australian Journal of Teacher Education, 42*(12), 1-19. doi:10.14221/ajte.2017v42n12.1

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Harvard University Press.

Wagner, T. (2010). *The global achievement gap: Why even our best schools don't teach the new survival skills our children need-and what we can do about it.* Basic Books.

Wang, M., Haertel, G. D., & Walberg, H. J. (1990). What influences learning? A content analysis of review literature. *Journal of Educational Research, 84*, 30-43.

White, B. Y., & Frederiksen, J. R. (1998). Inquiry, modeling, and metacognition: Making science accessible to all students. *Cognition and Instruction, 16*(1), 3-114.

Willis, L. (2017). Implications for pedagogy: Flipping the classroom to engage pre-service teachers. In *The flipped classroom: Practice and practices in higher education* (pp. 273-287). Springer.

Willoughby, S. (2000). *Learning mathematics for a new century*: National Council of Teachers of Mathematics.

Wilson, N. S., & Bai, H. (2010). The relationships and impact of teachers' metacognitive knowledge and pedagogical understandings of metacognition. *Metacognition and Learning, 5*(3), 269-288. doi:10.1007/s11409-010-9062-4

Winne, P. H. (1995). Inherent details in self-regulated learning. *Educational Psychologist, 30*(4), 173-187. doi:10.1207/s15326985ep3004_2

Winne, P. H. (1996). A metacognitive view of individual differences in self-regulated learning. *Learning and Individual Differences, 8*(4), 327-353. doi:10.1016/S1041-6080(96)90022-9

Wladis, C., Offenholley, K., Lee, J., Dawes, D., & Licwinko, S. (2017). *A review of research on teacher beliefs and practices*. Paper presented at the Tenth Congress of the European Society for Research in Mathematics Education (CERME 10), Dublin, Ireland.

Wolfram, C. (2010). Teaching kids real with computers. Retrieved 6 June 2018, from TedTalks https://www.youtube.com/watch?v=60OVlfAUPJg

Wood, T., Cobb, P., & Yackel, E. (1991). Change in teaching mathematics: A case study. *American Educational Research Journal, 28*(3), 587-616. doi:10.3102/00028312028003587

Woolfolk, A. (2014). *Educational Psychology* (12th ed.). Pearson Education Limited.

Yimer, A., & Ellerton, N. (2010). A five-phase model for mathematical problem solving: Identifying synergies in pre-service-teachers' metacognitive and cognitive actions. *ZDM, 42*(2), 245-261.

Yin, R. K. (2014). *Case Study Research: Design and Methods.* Sage.

Zack, L., Fuselier, J., Graham-Squire, A., Lamb, R., & O'Hara, K. J. P. (2015). Flipping freshman mathematics. *PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies, 25*(9-10), 803-813.

Zainuddin, Z., & Halili, S. (2016). Flipped classroom research and trends from different fields of study. *International Review of Research in Open and Distributed Learning, 17*(3).

Zainuddin, Z., & Perera, C. J. (2018). Supporting students' self-directed learning in the flipped classroom through the LMS TES BlendSpace. *On the Horizon, 26*(4), 281-290. doi:org/10.1108/OTH-04-2017-0016

Zappe, S. E., & Litzinger, T. A. (2017). Considerations when evaluating the classroom flip instructional technique. In L. S. Green, J. Banas, R. Perkins (Eds.), *The flipped college classroom: Conceptualized and re-conceptualized* (pp. 51-62). Springer.

Zepeda, C. D., Hlutkowsky, C. O., Partika, A. C., & Nokes-Malach, T. J. (2019). Identifying teachers' supports of metacognition through classroom talk and its relation to growth in conceptual learning. *Journal of Educational Psychology, 111*(3), 522-541. doi:10.1037/edu0000300

Ziegler G.M., Loos A. (2017) "What is Mathematics?" and why we should ask, where one should experience and learn that, and how to teach it. In Kaiser G. (Eds) Proceedings of the 13th International Congress on Mathematical Education. ICME-13 Monographs. Springer, Cham. https://doi.org/10.1007/978-3-319-62597-3_5

Zimmerman, B. J. (1989). Models of self-regulated learning and academic achievement. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement* (pp. 1-25). Springer.

Zimmerman, B. J. (1995). Self-regulation involves more than metacognition: A social cognitive perspective. *Educational Psychologist, 30*(4), 217-221.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & Z. Moshe (Eds.), *Handbook of self-regulation* (pp. 13-39). Elsevier.

Zimmerman, B. J., & Kitsantas, A. (2005). *The hidden dimension of personal competence: Self-regulated learning and practice.* Guilford Press.

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23*(4), 614-628.

Zimmerman, B. J., & Moylan, A. R. (2009). Self-regulation: Where metacognition and motivation intersect. In D. J. Hacker, J. Dunlosky, & A. Graesser, C (Eds.), *Handbook of metacognition in education* (pp. 299-318). Routledge.

APPENDIX A

Codebook

Theme	Categories		Codes	
FCA design for metacognitive gains	FCA design	All FCA principles as defined in chapter 1 and/or implemented during this study.	#design change	The lecturer implemented the FCA for the first time in 2017. This code was linked to quotations reflecting the lecturer's planning for the revised FC model to be implemented in 2018 (the same year as data collection), based on experience gained during 2017.
			#design same	This code was linked to strategies experienced as successful and that the lecturer wanted to use again for the 2018 (2nd) implementation.
			FC design change	FCA principles that changed during this study.
			FC design same	FCA principles that stayed the same during this study.
	FCA knowledge	Knowledge and understanding about the design principles of the FCA.	FC lecturer knowledge	Lecturer knowledge and understanding of the FCA and its components.
			FC student knowledge	Student knowledge and understanding of the FCA and its components.

	FCA in-class	Quotations referring to actions/experiences related to the in-class learning	FC lecturer role	The role of the lecturer in an FCA.
			FC student role	The role of the student-participant in an FCA.
	FCA out-of-class	Quotations referring to actions/experiences related to the out-of-class learning	FC student role	The role of the student-participant in an FCA.
			FC lecturer role	The role of the lecturer in an FCA.
	FCA strategies	All strategies (defined in chapter 1) that enables implementing a successful FCA.	Feedback	Feedback provided to the students by the lecturer.
			MC teaching	Explicit teaching of metacognitive strategies.
			Objectives	"Objectives are specific enough to be measured and shared as the expectation for learning during one class period or even one activity."(Boysen, 2012).
			Scaffolding	Reference to scaffolding of learning or the lack/need thereof. Wood et al. (1976, p. 90) define scaffolding as a process "that enables a child or novice to solve a task or achieve a goal that would be beyond his unassisted efforts."

			Active learning	Student active and engaged in the learning process, facilitated through collaboration (Prince, 2004).
			MC assessing	Ways of assessing MC. Access to student thinking is required. (Discussions, demonstration of solutions to problems, Group-work, think-out-loud, etc.
	FCA benefits	Benefits of the flipped-classroom design principles that has the potential to foster metacognition.	FC benefits	Benefits of the flipped-classroom design principles that has the potential to foster metacognition.
	FCA challenges	Any element in the flipped-classroom design that hinders metacognitive gains.	FC challenges	Any element in the flipped-classroom design that hinders metacognitive gains.
	Technology	Quotations related to technology.	LMS	The influence/effect of the learning management system.
FCA determinants that hinder or support	Mathematics content	The role of the course content concerning the FCA.	ZPD	Zone of proximal development. Evidence that student tasks fall within students; ZPD (or not) (challenging but achievable with some support).
			Cognitive levels	Any mention of higher order thinking or the lack thereof.
			Constructivism	Use of constructivism principles or the opportunity where it could have potentially been implemented.

			Student profile	Information about the target student population typically enrolled for the course. (This does not just refer to the sample).
	Knowledge, skills and beliefs	Lecturer knowledge, skills and beliefs of metacognition, FC, content, pedagogy, technology etc.	Lecturer skills	Lecturer skills about metacognition, content, pedagogy, technology, the student etc.
			Lecturer knowledge	Lecturer knowledge about metacognition, content, pedagogy, technology, the student etc.
			Lecturer beliefs	Lecturer beliefs about metacognition, content, pedagogy, technology, the student etc.
		Student knowledge, skills and beliefs of metacognition, FCA, content, pedagogy, technology etc	Student skills	Student skills about metacognition, content, pedagogy, technology, the student etc.
			Student knowledge	Student knowledge about metacognition, content, pedagogy, technology, the student etc.
			Student beliefs	Student beliefs about metacognition, content, pedagogy, technology, the student etc.
	Motivation	Motivation regarding teaching and learning	Lecturer motivation	Quotations related to the role of lecturer motivation regarding the FCA, the student etc (general).

			Student motivation	Quotations related to the role of student motivation regarding the FCA etc (general).
	SDL	Reference to aspects related to SDL (Fostering SDL by lecturer; student-teachers employing SDL or the lack thereof).	Group work	Quotations related to group work.
	Metacognition	Refers to quotations related to student-teachers' metacognitive knowledge unless stated otherwise.	MC knowledge	Refers to what a person knows about knowledge (Schraw & Moshman, 1995, p. 352).
			MCK conditional	As defined in Chapter 1.
			MCK declarative	As defined in Chapter 1.
			MCK procedural	As defined in Chapter 1.
		Refers to quotations related to student-teachers' metacognitive regulation unless stated otherwise.	MC regulation	Regulation component refers to the regulation and control of MC knowledge, emphasising the role of metacognition in the self-regulation of own learning (Papaleontiou-Louca, 2008, p. 3).

			MCR evaluating	As defined in Chapter 1.
			MCR monitoring	As defined in Chapter 1.
			MCR planning	As defined in Chapter 1.

APPENDIX B

Date and time of data collection

MC 1	Previous Lecturer interview	24 April 2018	08:30
MC 2	Current lecturer interview 1	26 April 2018	14:00
MC 3	Focus-group interview 1	5 September 2018	16:15
	Focus-group interview 2	6 September 2018	16:15
MC 5	Current lecturer interview 2	10 September 2018	14:30
MC 6	Focus-group interview 3	17 October 2018	16:15
	Focus-group interview 4	18 October 2018	16:15
	Current lecturer interview 3	6 November 2018	14:30

APPENDIX C

Permission letter: North-West University's Research Data Gatekeeping Committee



Private Bag X6001, Potchefstroom
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Dr C Kruger
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ETHICS NUMBER:

NWU-00630-17A2

Prof MM Verhoef
Institutional Registrar
North-West University
Private Bag X1290
Potchefstroom

Date: 26 April 2018

Dear Prof Verhoef

APPLICATION FOR PERMISSION TO CONDUCT RESEARCH:

Implementing a flipped-classroom approach for metacognitive gains to prepare mathematics student-teachers for the 21st century

I intend to conduct research for a master's degree (MEd) at the Faculty of Education Sciences at the North-West University (NWU).

The aim of the study is to explore design features to foster metacognition of student-teachers in a flipped-classroom approach to teaching mathematics at this higher education institution. It is anticipated that research findings will provide guidelines for the meaningful implementation of the flipped-classroom approach with specific focus on the way the flipped classroom approach can be implemented for the teaching and learning of a mathematics module to support the development of student-teachers' metacognitive skills.

I hereby apply for permission to conduct this research with BEd (Further Education and Training Phase) full-time students enrolled for the MATV121 module at the NWU Potchefstroom campus. This study has been approved by the Ethics committee of the Faculty of Education Sciences of the North-West University and will be conducted according to the ethical guidelines of this committee. Permission was also asked from the Department of Basic Education as well as the school principal.

For this study, data will be collected by means of a maximum of three focus group interviews with the same group of students as well as an open-ended questionnaire for members of the group enrolled for MATV121 (approximately 70 students,) who have granted informed consent.

As the researcher, I commit myself to the professional code of ethics for researchers, which among others include the following:

- The research findings will be made available to the North-West University upon completion of the study.
- Participation in the study is voluntary;
- Participants will be provided with all the information about the intended study
- Confidentiality and protection of identity and
- All requirements in terms of the Protection of Personal Information Act, 2013 and relevant university policies will be adhered to.

If any additional information about the research is required, you are welcome to enquire and I will gladly provide you with the requested information.

PROJECT SUPERVISOR: Dr C Kruger
CO-SUPERVISOR: Prof JAK Olivier
CONTACT NUMBER: 018 299 2159
E-mail: corne.kruger@nwu.ac.za
MEMBER OF PROJECT TEAM MEd-Student: Miss C Lotz
CONTACT NUMBER: 084 880 0133
E-mail:

FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE: Ms Erna Greyling,
CONTACT NUMBER. (018) 299 4656
E-mail: Erna.Greyling@nwu.ac.za,

Yours sincerely

Celizma Lotz
MEd student (North-West University, Potchefstroom campus)
Student number: 29741343

---------- ----------

Signature: **Ms C Lotz** Date

(MEd candidate)

---------- ----------

Signature: **DR C Kruger** Date

(Supervisor)

---------- ----------

Signature: **PROF J Olivier** Date

(Co-supervisor)

---------- ----------

Signature: **PROF M Verhoef** Date

Permission letters: Faculty of Education's Executive Dean



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ETHICS NUMBER:

NWU-00630-17A2

Date: 26 April 2018

Dr Neal Peterson
Director: School for Mathematics, Science and Technology Education
North-West University
Private Bag X6001
Potchefstroom

Dear Dr Peterson

APPLICATION FOR PERMISSION TO CONDUCT RESEARCH:

Implementing a flipped-classroom approach for metacognitive gains to prepare mathematics student-teachers for the 21st century

I intend to conduct research for a master's degree (MEd) at the Faculty of Education Sciences at the North-West University (NWU).

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ethical guidelines of this committee. Permission was also asked from the Department of Basic Education as well as the school principal.

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- Participation in the study is voluntary.
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- Confidentiality and protection of identity and
- All requirements in terms of the Protection of Personal Information Act, 2013 and relevant university policies will be adhered to.

If any additional information about the research is required, you are welcome to enquire and I will gladly provide you with the requested information.

PROJECT SUPERVISOR: Dr C Kruger
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FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE: Ms Erna Greyling,

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Yours sincerely

Celizma Lotz

MEd student (North-West University, Potchefstroom campus)

Student number: 29741343

---------- ----------

Signature: C Lotz Date

(MEd candidate)

---------- ----------

Signature: **DR C Kruger** Date

(Supervisor)

---------- ----------

Signature: **PROF J Olivier** Date

(Co-supervisor)

---------- ----------

Signature: **DR N Peterson** Date

APPENDIX D

Consent forms: lecturer-participants



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Date: 27 March 2018

Potchefstroom Campus

North-West University

Recruitment letter: Lecturer-participants

To:

I hereby wish to request your consideration to participate in a research study as well as allowing the research project to include the students that will register for module XXX (Mathematics for senior phase, Geometry), in the second semester, for which you are currently responsible. Before you give consent, please acquaint yourself with the information below.

The details of the research are as follows:

TITLE OF THE RESEARCH PROJECT:

Implementing a flipped-classroom approach for metacognitive gains to prepare mathematics student-teachers for the 21st century

PROJECT SUPERVISOR: Dr CG Kruger
CO-SUPERVISOR: Prof JAK Olivier
ADDRESS: Building B11, Office G44; Potchefstroom Campus; North-West University
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MEMBER OF PROJECT TEAM – MEd-Student: Ms C Lotz
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FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE MEMBER: Ms Erna Greyling
CONTACT NUMBER: 018 299 4656
E-mail: erna.Greyling@nwu.ac.za

The research has been approved by the Research committee as well as the Ethics committee of the Faculty of Education of the NWU and will be conducted according to the ethical guidelines of this committee.

What is this research about?

The primary aim of this research is to explore design features to foster metacognition within student-teachers in a flipped-classroom approach to teaching mathematics at a higher education institution. The secondary aim of the study is to suggest guidelines that foster the metacognition within student-teachers through the meaningful implementation of the flipped-classroom approach for the teaching and learning of mathematics at this higher education institution.

Participants

Participants will include you as the lecturer of XXX, the lecturer previously responsible for this module as well as the students who are registered for the module.

What is expected of the students as participants?

- The whole group of students will be asked to voluntarily complete an open-ended questionnaire at the end of the semester;
- A maximum of eight students who volunteer will participate in a maximum of 3 focus groups, to share their experiences of the flipped-classroom approach for learning of mathematics.

What is expected of you as the lecturer of Module XXX?

Should you agree to participate it will be expected of you to:

- Collaborate with the researcher before and after lectures on design principles to be incorporated into the teaching and learning of the specific module content
- Participate in a maximum of three focus group interviews
- Share your lived experiences of the flipped classroom approach with the researcher during two individual interview, before and after the semester respectively.
- Keep a journal of your lived experiences of the flipped classroom approach for the teaching and learning of XXX during the semester.

Risks involved for participants

No risk.

Confidentiality and protection of identity

No student or lecturer names will be used for reporting of the findings but rather codes.

Dissemination of findings

Students will be invited to a presentation where findings will be shared. Reporting of findings in the form of publications such as articles or book chapters will also be done anonymously.

If you have any further questions or enquiries regarding this research, please contact the researchers for more information.

DECLARATION BY LECTURER:

I, ……; the lecturer of XXX**, agree to participate in the research with title:**

Implementing a flipped-classroom approach for metacognitive gains to prepare mathematics student-teachers for the 21st century

I declare that:

- I have read this information and consent form.
- I have had a chance to ask questions to the researcher and all my questions have been adequately answered.
- I agree to participate in this research project.
- I hereby provide written consent that Dr Dorothy Laubscher may address the students registered for XXX after the first lecture in order to present the aim of the research and to recruit students to participate in the research.

I, the researcher, agree that:

- No interference will be made on class time.
- Students will have the option to leave if they do not wish to attend the information session.

Signed at (place)_____on (date) _____/_____/20____

_____ _____

Signature of Lecturer **Signature of student**
Miss C Lotz

Consent forms: student-participants



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Informed consent to participate in research: Focus-group interviews

A flipped-classroom approach will be used for the teaching and learning of module XXX. You are invited to participate in this research study to explore design features to support metacognition of student-teachers in a flipped-classroom approach to teaching mathematics at a higher education institution. The study is being conducted by Celizma Lotz (MEd student) from the Faculty of Education Sciences at the North-West University (Potchefstroom campus). The results from this study will be included in an MEd dissertation accessible to the public. You were asked to participate in this study since the study investigates mathematics education in a higher education institution. This MEd study falls under the Research Focus Area Self-Directed Learning (SDL) and is also part of the multimodal multiliteracies in support of SDL project.

Being part of this study will entail that you (the participant) are involved in maximum three focus-group interviews. Discussions will not be more than 45 minutes. The study will not expose participants to any risks and will not influence academic marks in any way. Although students will not receive any compensation for participation, there will be the benefit in the form of working as a community of students who can contribute to improve the BEd programme. Your experience through the flipped-classroom approach will allow the lecturer to address concerns and problems to improve support to students.

The focus-group interviews will be audio-recorded for accuracy. No one but the researcher and the supervisors of the study will have access to the recordings. Data will be dealt with confidentially and reported anonymously. Being part of this study is voluntarily and you have the right to withdraw from the study during any stage of the study with no penalty. The results will be used for the purpose of the study and be made available to you on request.

Any questions with regard to the research can be answered by Dr Corné.Kruger (supervisor of the study) at corne.kruger@nwu.ac.za, Prof Jako Olivier (co-supervisor) at jako.olivier@nwu.ac.za or Ms Celizma Lotz (MEd student and researcher) at celizma@gmail.com.

If you are willing to participate, please complete and sign the following form.

Informed consent from the participant

By signing below, I …….…….. agree to take part in a research study entitled:

Implementing a flipped-classroom approach for metacognitive gains to prepare mathematics student-teachers for the 21st century

I declare that:

- I have read this information and consent form and understand what is expected of me in the research.
- I have had a chance to ask questions to the researcher and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.

- I may be asked to leave the research process before it has finished, if the researcher feels it is in my best interests, or if I do not follow the research procedures, as agreed to.

Signed at (place)_____on (date) _____/_____/2018

_____ _____

Signature of participant Signature of witness

APPENDIX E

Previous lecturer semi-structured interview questions

Micro-cycle 1 (analysis and exploration)

Semi-structured interview questions:

1. How has this module been taught up to now?
2. What type of activities did students complete in class?
3. What type of activities did students complete for homework?
4. Did students come to class prepared? Motivate.
5. What were the challenges with regard to meaningful learning?
6. What would be your recommendations to improve teaching and learning in this module?
7. What are your views regarding possible changes to support the metacognitive skills of students through this module?

Current lecturer semi-structured interview questions

Micro-cycle 2 (evaluation and reflection)

Semi-structured interview questions:

1. How, do you think, students benefitted from the flipped-classroom approach thus far?
2. What are your concerns with the flipped classroom?
3. How can these concerns be addressed?
4. How did you experience the implementation of the flipped classroom thus far?
5. Explain your role in the flipped classroom.
6. How has lesson planning changed for you?
7. How do you know when your students have learned what you wanted them to learn?
8. Tell me about the activities that students do in class.
9. How, in your opinion, do the students experience the flipped classroom?
10. Do you notice students demonstrating metacognitive skills? Explain.
11. Do you find that this approach allows more opportunity for the lecturer to access student thinking? If yes, how?
12. If any, what were notable non-verbal behaviours?
13. Do students demonstrate self-regulation? Please give examples.
14. How do the students accept the shift in their role as self-regulated learners?

Focus-group interview questions

Micro-cycle 3 (evaluation and reflection)

Questions for discussion:

1. What is this mathematics module about? (content)
2. Tell me about your feelings towards mathematics.
3. What does ‘flipped classroom’ mean to you?
4. How do you view metacognition?
5. How well did you understand video material? Accessible? Do you control the video’s (pause, rewind)?
6. Do you find that you work more at home than you used to? Please explain.
7. What is your role in the flipped classroom?
8. Is there anything that inhibits you from learning well in this module?
9. How can you change that?
10. Explain your thought process during face-to-face sessions.
11. Explain your thought process to me during homework session.

Focus-group interview questions

Micro-cycle 6 (evaluation and reflection)

Questions for discussion:

1. Considering the previous discussion, what is the reason that you still prepare for class?
2. How and when do you go about preparing for class?
3. When do you access the LMS for sources in order to prepare?
4. How has the class changes over the course of the semester?
5. Where you able to find and use video content on the LMS?
6. Do you have any suggestions relating to the LMS?
7. Did you watch the videos in the email I sent you?
8. Do you find that you have a better idea of the flipped classroom at this stage?
9. How did you find the test that you wrote this week?
10. Explain your thought process during face-to-face sessions.
11. How do you view your role as well as the lecturer role in the flipped classroom?

Lecturer journal reflective prompts

My expectations for the flipped classroom this semester:

Weekly Journal Prompts

1. During today's face to face session my students engaged in the following ways:
2. The following student actions/comments/behaviour made me excited about the flipped classroom:
3. The following student actions/comments/behaviour may be an indication that I may need to change some of my flipped classroom strategies:
4. The following student comments/behaviour during face-to-face session reflected students' attitude (positive/negative) towards video's viewed in their own time:
5. The following comments of students maybe evidence that the students find the video's helpful:
6. The following student actions/comments/behaviour maybe evidence that the flipped classroom strategies support self-directed learning/metacognition:
7. The following aspect of eFundi (LMS) supports/hampers effective flipped classroom/metacognition/self-directed learning:

General remarks:

APPENDIX F

Micro-cycle 1

Sarah – previous lecturer interview

Interviewer 1: Okay hier gaan hy. Okay, Dr dankie dat Dr ons help. Ek wil net gou vinnig eers begin net so vinnig saamvat oor die studie se fokus. So, wat ons wil doen is om tradisionele meer tradisionele klaskamer te vat flipped classroom approach principles in te bring en om dan weer te … implimenteer en dan te probeer vasstel deur middel van fokusgroepe hoe ons dit kan aanpas so dat dit die metakognisie van leerders bevorder en dan gaan ons dan kyk en analisseer en weer oor inplementeer en veranderinge maak en dan weer kyk help dit vir kognisie, help dit nie vir kognisie, watter dele van flipped classroom bevorder wel kognisie wat dan nou nie en dan aan die einde hopelik beginsels, design principels voor te stel en te sê in ons konteks in hierdie vak is dit dalk ‘n goeie manier om hierdie flipped classroom te implimenteer Sal Dr asseblief net vir my meer vertel van hierdie module en wat die inhoud was.

Sarah: Goed. Die module het gegaan oor meetkunde maar ook baie basiese vlak wil amper sê inleidend nou maar. Dit het gegaan oor vorm en ruimte en meting se eienskappe byvoorbeeld van 4 hoeke, veelhoeke, driehoeke het ons na gekyk ... maar ook om die dinge toe te pas in lewenswerklike konteks. Veral toe ons gekom het by die oppervakte en volume van figure en liggame het ons dit toe maar op ‘n baie meer werklike konteks van toepassing gemaak dat dit sin maak in die studente se leef wêreld. Die aanvanklike studente vir wie dit die doel was nie hoëvlak studente nie, dit was ‘n module wat vir alle onderwys studente geskryf is so ons het gevoel dat hulle in die eerste plek hulle self kan help as onderwysers en dit moet ook hulle algemene kennis uitbrei want iewerste in hulle lewe gaan hulle hierdie goeters gebruik, want hoeveel verf het ek nodig om daai muur te verf, wat is die volume van my swembad by die huis en die suur inhoud kan reg ingooi en so meer so hulle basiese begrippe in terme van meetkunde. Ook interessant, ons het gehoop hulle kan gaan voortbou op hulle Wiskundige agtergrond in hulle skool die wat geletterdheid gehad het op skool, maar ons het tot ons verbasing agter gekom daar is nie veel om op te bou nie hulle het maar baie gesukkel.

Interviewer 1: Dokter ek wonder nou, is dit nog steeds ‘n module wat vir alle onderwys studente is?

Sarah: Nee, die leerprogram is toe ingeskryf as ‘n hulpmodule vir die noem dit nou maar die X onderwysers, daai baan, daar was bietjie los biljette in die nuwe program en toe het hulle gesê ons moet op eerstejaarsvlak die behoefte om vir outjies dan hierdie vak aan te bied meerendeels soos ek sê dit is hoofsaaklik vir die senior studente in die groep. Maar die vak staan bekend as ‘n Y module waar student wat Fisiese Wetenskap het, sal dit van 8 tot 9 dit aan te bied maar Wiskunde is Wiskunde, daar is nie so iets as aparte Graad 10, 11en 12 loop teenoor die wetenskappe in Graad 8 en 9 nie, maar omdat daar nou die ekwivalent moes wees vir die Wiskunde het ons gesê kom ons voer die moduletjie in as ‘n berig wel dit is nie ‘

n berig nie dit is bloot net ‘n addisonele module kom ons noem dit nou maar ‘n intree vlak module om hulle vir die volgende meetkunde modules eintlik maar ook voor te berei.

Interviewer 1: Ja, ons is glad nie didatiek dit I net suiwer…

Sarah: Ja, dit is omdat dit net ‘n 8 krediet module is dus so klein min data daar nie nog maar in plesiet is daar maar nog die manier hoe mens klas gee die tipe van aktiwiteit wat hulle in die klas doen behoort vir hulle dalk idees te gee van wat hulle in die klas situasie kan doen.

Interviewer 1: So dokter het nou genoem wat hulle in die klas gedoen het. Ek wil sommer dan op daai noot hoor hoe was hierdie module aangebied, wat was die benadering?

Sarah: In 2011 het ek begin om met Prof H se hulp, hy het hierdie groot groep projek onderrig geloop of geloods in verskeie modules en toe het ek nogal die gaping gesien en het geding dit is die ideale module om dit daar te doen toe het ons DVDs op daai stadium opgeneem en ek het basies die inhoud van die bepaalde leer gedeeltetjies so sê nou maar dit was oppervlakke maar dan sou ek verduidelik het goed wat is oppervalkte en hoe bereken ons die oppervlakte van …wat ook al die geval is dan was die idee studente het aanvanklik die DVD gekry en hulle moes dit gebruik om voor te berei vir die klas en dan het hulle in die klas ingekom en ‘n kort onderrig toetsie geskryf so hulle moes eintlik die kennis gedeeltetjie voorberei aan die hand van hulle leesbundels en DVD’s dan het ons in die klas ‘n kort samevatting gegee oor wat hulle nou eintlik voorberei het. Ek het nie weer die werk herhaal nie, want die veronderstelling was dat dit reeds gedoen is en dan het ons oorgegaan en hulle het dan ‘n bietjie van ‘n toepassing gedoen. Dit wat hulle moes voorberei meer op ‘n kognitiewe vlak, maar dan was ek en 2 assistente wat baie keer honneurs studente was, in die klas teenwoordig. Ons het hulle gehelp en hulle het twee-twee gewerk aan die groep opdraggie. Ons het hulle gehelp, hulle het mekaar gehelp so ek wil sê dit was ‘n aktiewe leer gedeelte waar hulle nou self kon kennis maak met hoe hulle moes voorberei en hoe dit toegepas word. En dan het ons, as hulle klaar is, mekaar se opdraggies geassesseer aan hand van wat ek op die skerm gegooi het ek het altyd vir hulle gesê dit is tweeledig in die eerste plek moet hulle dit asseseer so hulle moet daaruit leer en ook onmiddelike terugvoer so hulle kon onmiddellik sien as hulle dit verkeerd gedoen het dit is eintlik hoe hulle dit moes gedoen het. Dit is ‘n baie groot groep daar is omtrent 180 studente in ‘n klas. Dit is twee groepe van 80 so dit is maar eintlik baie moeilik die motivering is maar laag. Ja, baie studente kom met ‘n negatiewe houding en ‘n mental blok oor die Wiskunde, dit is vir hulle sleg ek het gedink deur hulle te help en deur hulle aktief te laat deelneem aan die proses kan hulle meer gemotiveer word dan kan hulle sien dit is nie so erg nie. Dit is eintlik ‘n gemaklike atmosfeer eintlik bietjie chaoties die meeste van die tyd tot ons begin assesseer en so aan. Ja, so het

hulle maar bietjie geinvolve want op'n stadium mag ons nie meer die DVD's vir die studente gegee het nie dit, was 'n bietjie van 'n storie gewees oor botsende belange en Prof H was nie meer toegelaat om die DVD aan die studente te verkoop nie toe het ons vir hulle op 'n stadium 'n link gegee en hulle kon ook koop teen R 20 maar lyk my dit het ook probleme veroorsaak so ons het al minder daarvan gebruik

Interviewer 1: Omdat hulle dit moes koop?

Sarah: Ja, omdat hulle dit moes koop. Dit het bepaalde implikasies gehad. Baie klagtes was ook maar, omdat hulle hierdie negatiewe houding het hoekom moet hulle toets skryf voordat ek dit aan hulle verduidelik het, maar dit is tyd mors hulle moes voorberei sodat hulle die toetsie kan skryf hulle oor die algemeen het gevoel hulle moet eers verduidelik word voordat hulle kan skryf.

Interviewer 1: Dit is waaraan hulle gewoond is.

Sarah: Dit is waaraan hulle gewoond is ongelukkig daai amper sê ek die lepel voer. Ja, toe het ek in verlede jaar ook besef dat die multi keuse kaarte is ook 'n uitdaging nou moet ek op die skerm die toets hou as ek wil af beweeg na vraag 5 toe wil een opbeweeg na vraag 1, dit het vir my moeilik geraak dan moet jy die kaarte in neem om te merk of die assistente vra om dit te doen. Toe het ek so twee jaar terug besluit ek gaan maar ... toets rigting beweeg dan is daar geen papierwerk betrokke nie, maar uit die aard van die saak het dit nou meegebring dat ek op die ou end twee groepe gehad en hulle periodes het verskil party sin op 'n Maandag en die ander groep op 'n Woensdag. Ek kan kwalik vir hulle sê hulle moet die vorige week die toets klaar gedoen hê vir die Maandag want die week begin eers die Maandag hulle is nog nie gereed om die dinge te doen nie die rigting van die periodes het my genoodsaak na ons klaar die werk gedoen het nou gaan julle terug en gaan doen nou die toets. So die hele gedagte van die flip het eintlik so geinvolve omdat hulle maar 'n weerstand gehad het oor die inhoud, oor die werk en so aan, maar ek het op die ou end soos dit nou huidiglik is, hulle het klas, ons doen nog steeds die groep opdrag, ek verwag van hulle om voor te berei, maar dit is nie in alle gevalle die waarheid nie. Tien of twintig persent berei voor en hulle kom met dit wat hulle voorberei het klas toe sodat hulle die groep opdrag kan doen so dat hulle nogsteeds dieselfde patroontjie het ek help hulle en twee studente as ek die voorreg het om studente te hê, help hulle in die klas met die groepsopdrag. Na die klas het hulle 'n hele week tyd om voor te berei vir die efundi toets maar dan voel ek die werk is nou bespreek as jy in die klas was weet jy waaroor die vaslegging gaan, hulle kan mekaar nog steeds help met die toets dit is 'n timed test so 20 minute of so en hulle kan net een maal submit as hy dit nou ingegee het en hy wil sy maatjie help is hy baie welkom om sy maatjie te help as hulle op daai manier leer dan is dit

nou maar so dan leer hulle maar of hulle kan twee-twee saam by ‘n rekenaar sit maar die feit is hulle kan dit net een maal doen en die antwoorde is ook geskommel so dit is nie almal 1A wat die regte antwoord is nie. Ja, so mens probeer maar dat hulle nogsteeds, en dan nog ook bietjie ander, ek wil nie sê dit is motivering nie, dit is eintlik weet, ek het vir hulle gesê die beste ses uit die nege weke sal tel so die beste ses toetsies tel die beste ses groepsopdragte tel so as jy nie daar is nie moet my nie oorval met ‘n siekbrief of so nie.

Interviewer 1: Net om die admin bietjie makliker te maak.

Sarah: Ja. Dit is jou wegval toets so werk hard om daai minimum van ses geleenthede te benut hoe meer eintlik hoe beter maar as jy net 6 punte, is dit vir jou op eie risiko, maar ses van die nege sal byvoorbeeld tel.

Interviewer 1: Ek het nou nogal klomp vragies wat ek wil vra oor wat Dr reeds gesê het. Ek wil net eers ‘n aanmerking maak, dit is vir my hartseer om te dink ons soveel moet doen om net ons studente te motiveer dat ons amper moet teen gaan wat ons dink reg is

Sarah: Absoluut. Dit is wat ek sê, die hele gedagte vir ‘n jaar of twee het ek dit geadministreer asof dit werk of ek het geglo dit werk en ek het gesê ek sal nooit weer terug gaan na die traditionele noodwendig die lesing, dis maar nogsteeds waardevol dat hulle self doen en self besig is, want die oomblik wat hulle ‘n pen in hulle hand het besef hulle ‘ek het gedink ek weet maar ek weet nie hoe die stelling van Pythagoras nou werk nie’. Ek bedoel dan is dit goed wat ek nou sopas daar voor dalk gesê het miskien aan die hand van ‘n voorbeeld en dan weet ek daai een het op sy foon gesit daai een het dit gedoen daai een het dat gedoen. As ek daar by hulle kom dan vra hulle, hulle weet nou nie hoe nie ek het nounet daarvoor gesê maar goed kom ons kyk nou dan moet hulle nou skryf, maar ek glo nou maar rêgtig om hulle net daai brug te slaan daai negatiewe houding wat baie van hulle het, meeste van hulle het, want ja, want baie van hulle het mos nie Wiskunde as hoofvak en gaan dit nie gee nie maar net om hulle ‘n bietjie te laat glo in hulle self en ek kan hierdie doen ek is instaat om dit te doen en dan sien hulle haai jinne dit is nie so erg nie lyk my hulle is so gewoont om te glo dat hulle nie Wiskunde kan doen nie.

Interviewer 1: Dit is ‘n mindset.

Sarah: Ja, dit is absoluut ‘n mindset en die oomblik en ek moet sê ek is baie versigtig om hierdie of vir hulle direkte antwoorde te gee, ek wil nie vir hulle gee nie, maar ek sal eerder vir hulle vra verduidelik vir my wat het jy daar gedoen hoekom sê jy so weet dan kom ek agter metakognitief is dit ook hoegenaamd nie eers jy weet hulle dink glad nie metakognitief nie hulle, daai vaardighede is total onderontwikkel so hulle uh ja hulle is maar bang hulle is maar

huiwerig oor die vak, maar ek sal nie sê die persepsie het verander noodwendig na ‘n semester nie, maar ek hoop dat ek hier en daar dat ek êrens by iemand gemotiveer om ‘n bietjie anderster te dink oor die.

Interviewer 1: Nee, Dr dit is so en êrens moet iemand hulle begin voorberei vir die wêreld daar buite. Ek wonder oor hierdie studente wat Dr genoem het, die honneurs studente wat saam met Dr in die klas werk. Is hulle opgelei om ook in ‘n manier soos Dr goeie vra te kan vrae en ook te kan luister vir, is daar metakognisie teenwoordig?

Sarah: Ek dink ongelukkig is hulle nie ja, so jy sê opgelei is verseker nie noodwendig nie. Ek probeer dit vir hulle, maar sê hoor hierso moenie vir hulle direkte antwoode gee nie, vra liewer vir hulle ‘n teenvraag of ‘n vraag op ‘n vraag en van hulle doen dit op ‘n natuurlike manier baie oulik, maar ja ek wil nie hê hulle moet vir hulle net direkte antwoorde gee nie en hulle moet as die bron van die antwoord beskou word nie. Hulle moet die studente fasiliteer om te dink is die groot ding, hulle moet kan dink so hulle is nie, ek dink hulle wil vreeslik graag, omdat dat hulle aard is wil hulle verduidelik hulle wil baie die bron van kennis wees en so aan, maar ja ek dink maar ja ek maak maar staat op hulle om bietjie te help want jy weet as daar so baie studente is jy kom nie by almal in ‘n uur se tyd nie.

Interviewer 1: Natuurlik, nee mens kan nie.

Sarah: Jy kan nie almal help nie en ek wil nou nie hê dat dit nou die klagte moet wees agterna maar nee ‘ek het my hand die heeltyd ophad en niemand het by my uitgekom nie’.

Interviewer 1: Nee dit is so.

Sarah: Dit was ook al die geval gewees. Die sleg is ook dat al so interessante klagtes gekom juis omdat jy weet ek het altyd vir my kollegas gesê dit is sleg maar dit toon eintlik hulle eie onvermoë om te cope met hierdie situasie so hulle gaan soek enige verskoning. Rêrig ek bedoel soos ek het al gesien dit was vroeër ‘n aanklag gewees, ek het byvoorbeeld daar was min swart of kleurling studente in ‘n klas gewees en ek het hulle geïgnoreer en toe het hulle dit oor die rasse boog gegooi byvoorbeeld. Want dis nou ‘n gerieflike ding om te doen. Anders sal die ander sê ja, hulle het nie geweet wat om voor te berei nie en hulle sukkel met Wisknde, hulle was nog nooit goed met Wiskunde nie of hulle sal vir my sê hulle het nie Wiskunde op skool gehad nie en ek sê vir hulle hulle jok want hulle het dit tot Graad 9 gehad. Jy het dit dalk nie tot Graad 12 gehad nie, maar hierdie is nie Graad 10, 11 en 12 werk nie, dit verskriklik dis eintlik...hulle soek eintlik baie keer ek wil sê daai aangeleerde hulpeloosheid, daar is nie daai dit is my verantwoordelikheid nie dit is altyd iemand anders se skuld dat ek dit nie verstaan nie. Uh so verantwoordelikheid vir hulle eie leer

Interviewer 1: Verantwoordelikheid is om hulleself te reguleer en uhm.

Sarah: Skies ek val jou in die rede. Jy sal nogal enkele studente as ek nou byvoorbeeld sê ons doen daai dag sal ons byvorbeeld die einskappe van vierhoeke, dan sal ek enkeles sien met bronne en afgerolde bladsye wat hulle uit een of ander ding kry en hulle meen ...my word hulle het self gaan bronne soek en hulle weet okay dit is die topic wat gaan bespreek word ek het aditionele bronne nodig bo en behalwe wat ek noodwendig in my leesbundel kon kry het ek gaan soek en ek het ‘n hele leêr vol aantekening or die onderwerp dan dink ek wow kan almal nie net so wees nie. Ander sal byvoorbeeld met die hande gevou sit omtrent of so uh ja.

Interviewer 1: Dr het nou genoem van as hulle nou klagtes insit, wat hulle nou half gryp na enige iets, so hulle sukkel om spesifiek te sê waarmee hulle sukkel. ‘Ek sukkel met hierdie deel van die wiskunde spesifiek’. Wat goeie metakognitiewe vaardighede dalk aandui, dis dalk nog ‘n aanduiding?

Sarah: Ja, dis reg. Soos jy sê, byvoorbeeld hulle sal sê ‘ek weet nie wat hier aangaan nie’.

Interviewer 1: Oor die algemeen.

Sarah: Goed. Waarmee sukkel jy, sê vir my wys vir my wat het jy sover gedoen dat ons daarop kan voortbou. Hulle sukkel om te verwoord dit wat hulle nie weet nie.

Interviewer 1: Of hulle weet glad nie.

Sarah: Dis reg, hulle weet nie wat aangaan nie. Dis presies.

Interviewer 1: En uhm, dan het Dr genoem oor die voorbereiding, as ek reg is het Dr gesê dit het vir Dr gevoel dat tussen 10-20% regtig voorbereid gekom het, met ander woorde hulle het die DVD’s gekyk en die voorbereiding gedoen, dis nogal jammer.

Sarah: Dit is hartseer, want jy voel joh dis regtig nogal harde werk om daai dvd’s te maak en toe moes ek dit in Afrikaans uit die aard van die saak doen en toe het ek engels ook gedoen uhm ek bedoel ek het besef op ‘n stadium ek moet dit seker maar oordoen maar met al die verwikkeling van jy mag nie verskaf en verkoop en toe het hulle dit inelk geval dit laat staan ek uhm ja uh dit is nou nie ‘n moontlikheid die volgende moontlikheid is om nou in jou kantoor ‘n opname te maak en dit total herbedink en dan in jou kantoor te sit en ‘n bepaalde videotjie te doen en daai klein stukkie op efundi te laai of youtube of wat okal wat hulle kan gaan kyk dit is die volgende moontlikheid behoort ek nou maar volgende eintlik te doen end at die hele ding nou maar net op ‘n ander manier geïmplienteer ord.

Interviewer 1: So ek hoor dat dr sê dat hierdie module hom goed uitleen vir ‘n flipped classroom omdat dr hom al so gedeeltelik gedoen het daarmee aangaan.

Sarah: Absoluut. Ja, verseker. Ek dit die feit dat dit nie dat ek so sê dis nie dat dit nie gewerk het nie om die waarheid te sê ek het eintlik n honneurs student gehad en ek moet die goed op ‘n stadium vir jou gee sy het nogal haar uh projek haar navorsing projekkie het sy nogal gedoen op studente die eerste jaar wat dit geloop het sy uh self-gereguleerde leer en daar het nogal oulike goedjies navore gekom uh die studente was wel psitief gewees daaroor of weet baie studente was positief gewees daaaroor maar dis asof die laaste ek wil amper sê drie vier jaar ie ding bietjie vir my ‘n aftraande pad begin loop het dit wat die aanvanklike sukses wat ek gedink het daar is en dit was versekerlik daar die eerste twee drie jaar uh dis asof hulle half uh uh ja ‘n nuwe groep studente uit die aard van die saak maar dis asof dieselfde tipe van motivering nie betsaaan het by hierdie lotjie van die laaste klompie jare aswat daar by die vorige grope bestaan het nie ek sê vir jou dit voel vir my dis eintlik oulike resultate eitlik gewees.

Interviewer 1: Ek sal dit defnitief kry.

Sarah: Bloot net om te sien jy weet wat hulle daarvan te sê wat wel die waarheid is is dat die deurvloei syfer dramaties verbeter het hulle gaan uh die outjies wat geslaag het en hulle punte die gemiddelde persentasie dit het verseker baie verbeter as ek moes dink as ek moes dink aan voor ek dit byvoorbeeld 2010 2009 rond wat ons die module ook gegee het was dit regtig maar ‘n risiko module dit is maar elke liwe jaar ‘n risiko module daar is maar permanent fasilitering wees en daar is fasilitering aditioneel tot die klas maar dis regtig die punte en die deurvloei syfer uh het rergi verbeter so in daai opsig ja. Dis hoekom ek sal dit aanhou doen uh ek dink net ‘n mens moet maar elke keer opnuut herdink hoe sekere aspekte ek bedoel want wat 6 jaar terug kon werk soos met die DVD’s dar is nou ander maniere om dit te doen ek meen jy kan dit nou of efunde aai jy kan dit op ‘n yiutube laai of wat okal uh jy kan korter uh uh jy weet videotjies maak dit hoef nie ‘n halfuur te wees nie uh paar kortjies maak om aspete te verduidelik en hulle kan daarna toe terug gaan as hulle weer en weer wil kyk en baie het vir my kom sê dis vir hulle regtig waar in daai opsig want hulle kan weer en weer gaan kyk in die klas die groep gee nie altyd noodwendig om nie jy voel nie altyd so op jou nommer nie maar jy kan altyd weer terug gaan.

Interviewer 1: Dit in ‘n groot voordeel.

Sarah: Dit is regtig ‘n groot voordeel.

Interviewer 1: Nog twee goed die ander ding is bywoning hoor ek reg ek mak half die aaneming bywoning was goed omdat hulle die toeties geskryf het in die klas? En toe dr later die toetsies op efundi maak het die bywoning toe afgeneem.

Sarah: Weet jy Kyk weet jy omdat die gropeopdrag ook daar is uhm is dit darem ook ‘n mate van ‘n ek wil sê eksterne motivering.

Interviewer 1: Het julle rollcall geneem?

Sarah: Ek het nie rollcall geneem nie ek weet vir ‘n feit want ek het al ‘n hele klompie studente wat byvoorbeeld sys al alleen it en werk maar dan sien ek maar daar is twee name op haar opdrag dan het sy nou ‘n maaitjie se naam natuurlik So daar is nie as hulle nie self verantwoordelikheid neem om te besef dat ek kan dit nie doen nie my integriteit laat my nie te om dit te doen nie uhm dis vir my baie hartseer om te dink hulle beskou dit as total normal noudie dag het ek juis verby enetjie geloop wat frie name op haar papier het en toe sê ek vir haar maar wat van dai twee name? Toe sê sy vir my maar hulle het gevra hulle kan nie hier wees nie sal sy hulle name op die papier skryf. Toe sê ek maar dit is soos korrupsie julle kan nie dit doen nie ek het omtrent ontplof maar dit is hulle sien niks daarmee verkeerd nie dit is hoe dit werk en ek vermoed dit is hoe dit in ander klasse werk as jy nie daar is nie mag ek my naam opskryf so uh toe dog ek weet jy wat as dit is hoe jy redelneer ekgaan jou nie verander as jou waardestelsel anderster is uhm erenster gaan die ou himself in die voet skiet met ‘n semester toets want hulle skryf dan

Interviewer 1: of in die toekoms.

Sarah: Ja ek kan polisie speel sover as wat ek wil maar ek kan nie elke liewe een noodwendig check dit is bloot net te veel om daai orde te neem. Die ideal sou wees maar even dan kan ‘n ander outjie vir sy maaitjie nogsteeds teken maar ek weet hulle doen dit ek hoor ‘hoori teken jy vir my’ so dit is ek probeer partykeer want daar was nou een dag net so voor die vakansie was daar minder in die klas ek wil amper sê amper die helfte maar die helfte maak dit nogsteeds so 80-90 omtrent toe dig ek dalk noet ek nou tel hoeveel sit hierso en dalk moet ek kyk hoeveel groepsopdragte handig in toe dog ek ag weet jy wat ek het getel hovel is daar dis is net so ekstra slep

Interviewer 1: Ja mens het net twee hande.

Sarah: Maar uhm soos ek sê ek het geweet as ek ‘n lesing metode gaan gee is die wegbly syfer ek weet dit so dis ‘n manier om hulle daar te kry die blote feit dat hulle ‘n opdrag moet doen en uh dit motivering hulle ook dat hulle die hele ding van dit is vir punte dit gaan nie vir

my soseer oor die punte nie dit gaan oor die leerervaring saam met sy maats, praat oor die wiskunde hy is daar om te redeneer en so meer hulle sien dit nie noodwedig altyd so nie maar .

Interviewer 1: Maar dit is goed vir hulle.

Sarah: Kan die werk mee kennis maak en al die werk wat ek vir hulle gee al die vrae maar dis nou meer uitgebreide vrae is alles ou eksamen vrae so dis tipies die goed wat ek in ‘n eksamen sou vra daai hele argument van ja maar in die klas het ons maklike goed en dan kom ons in die eksamen dan is dit te moeilik dan kan ons dit nie doen nie uhm is total nie geldig nie want ek gee vir hulle uit en uit wat in die eksmane vraestelle van vorige vraestelle was sodat hulle kan sien hoe dit gevra word uhm weet hoe word ‘n vraag tipies beanwoord wat is belangrik byvoorbeeld dat jy darem jou eenhede bysit 100 kubieke cm of watokal die geval is weet klein goedjies jy weet dat hulle eerstehands die leerervaring kan meemaak en dit is nie iets wat hulle afskryf van ander mens of total net nie belangstel in nie. Soos ek sê mens probeer maar dit is uhm dis is uh soos ek sê dis ‘n middle wat ek probeer inbou het net om hulle daar te kry en te motiveer dat hulle darem in die eerste plek meer positief is oor die module maar ook dat die punt op die ou einde darem beter is as in die verlede...maar ja. Soosek sê dit bly maar ‘n moeilike ding want dit is meeste van die ouens wat negatief is oor die vak het al hierdie dink ek gaan dit anyway nooit gebruik nie want ons nou weet hulle wel gebruik.

Interviewer 1: Ek het d rook hoor sê vroeër dat uhm dis ‘n verskriklike groot groep maar wat ek hoor is dat hierdie dalk nog beter kan werk met ‘n kleiner groep.

Sarah: Ja,ja absoluut. Uhm ek dink jou kontrole is is beter jy kan meer uh oop ek wil amper sê connect in engels jammer daarvoor maar connect met die studente maar dis is dis gaan defnitief ek dink dit gaan makliker werk beter werk in ‘n kleiner groep en uhm waar jy dalk studente het wat dalk as ‘n keuse module neem. Uh dit kan dalk beter werk.

Interviewer 1: Hier is nou ‘n goeie vraag. Ek gaan dit in engels lees. What were the challenges with regard to meaningful learning met ‘n spesifieke fokus vir SRL asook MC en die uitdagings vir die dosent uitdagings vir die student asook uitdagings vir die leeromgewing soos byvoorbeeld efundi en klaskamers enigeites van die leer omgewing. So die uitdagings uh ten opsigte van betekenisville leer spesifiek SRL MC vir die dosent vir die student en da nook die leeromgewing so dis algemene uitdagings.

Sarah: Goed. Dis bietjie ‘n komplekse vraag maar goed.

Interviewer 1: Ons breek hom maar so in stukkies op.

Sarah: Okay uh miskien het ek nou al van die goed so bolangs aangeraak.

Interviewer 1: Defnitief ja.

Sarah: uhm as ek nie reg antwoord nie in terme van jou vraag antwoord ek sou sê die motivering van studente maw uh hulle sien nie noodwendig die waarde van die vak nie uh en dit beteken dan hulle nie voorberei nie soos ek nou gesê het ek veralgemeen maar daar is uh wat baie oulik voorberei uhm ja so ek dink dit gaan oor hulle oor die motivering hulle sien dalk nie die nut van die vak nie uhm ‘n ander uitdaging en dis nou maar met die elektroniese leeromgewing te doen is dat uhm dit gebeur nou maar met on tipe van internet uhm toegang of hulle toegang hulle sal ‘n toets doen byvoorbeeld en dan hulle hom nie weer submit nie en jy weet daai tipe van tegniese aspekte ek kan nou ongelukkig ek sê vir hulle, gelukking is daar nou omdat jy enige plek die efundi toets kan doen en kon doen al was jy siek daai dag uh daai is nou ‘n wegval toetsie as jy dan as die internet jou nou gevaal het ek is jammer ek het al in enkele gevalle vir hulle gesê kom nou my kantoor toe dan gee ek vir hulle ‘n harde kopie van die toets en sê kom doen hom nou maar hierso maar omdat dit so baie studente is kan jy dit amper nie met elke klagte doen nie weereens as dit ‘n kleiner groep is maar 80 en daar is 8 probleme kan jy dalk die agt problem hanteer maar jy kan nie weet as dit 20 byvoorbeeld raak. Dan begin dit net te veel raak.

Interviewer 1: Die beplanning klink swak hulle kan nie beplan nie.

Sarah: Ja dit is absoluut so hulle tydsbeplanning is ‘n baie groot faktor uh wat as jy dit los vir die aand voor die tyd en jy dit is dan ‘n issue dan gaan dit vir jou inhaal iewerster uhm ja so tydsbelaning is ‘n groot ding ek dink hule maak net nie gebruik ook van hulpbronne nie ek bedoel hulle sal in die klas byvoorbeeld sit en dan sal iemand vra maar wat is nou weer die omtrek van ‘n sirkel dan sal ek vir hulle sê weet julle wat hier is jou foon julle is so mal oor julle fone vat hom nou en google dit dan is hulle stomverslaan om te dink mens kan so iets op google kan raakloop. Nog nooit daarvan gehoor nie al uitdaging is die taal Afrikaans engels wiskunde groepe dit weet jy nou baie goed klink total iets anders in engels uhm of dit is nie eers naastenby waaraan hulle gewoont is nie dan sê ek okay ek sal vir julle ‘n wenk gee die engels is circumference maar ek wil hê jy moet hom gaan soek ek kan vir jou sê, maar ek wil hê jy moet op google gaan kyk so gaan googel dit want jy sit inelkgeval op jou foon so uh so ja ek dink hulle weet nie hoe om hulpbronne te soek nie dit is regtig ‘n problem ons dink ek is nou juis besig om ‘n phD te eksamineer maar ons dink ons kinders is geweldig tegnologies daar nê uh en hulle kan tegnologie verseker goed gebruik ek dink vir ontspaniing en vir speletjie en so aan.

Interviewer 1: Vir tyd mors.

Sarah: Maar ek dink nie hulle weet hoe om die tegnologie of dan nou soekenjins soos google uhm met uh jy wet te gebruik dat dit tot hulle voordeel strek. Hulle is rergig stomverbaas as ek vir hulle sê hoor hierso maar soek daai ding op google hulle hoef nie die hulpbronne of ander gedrukte materiaal ook altydn te hê nie as hulle dit net op google kan kry is dit maar beter so ek probeer hulle nou maar half in die klas aanmoedig om te se nou maar vat julle fone en dat julle dit self kan sien want dan gaan jy dit ook beter onthou uhm ja so die uitdaging van die studente self was nou maar die hele feit was die vorige module waaroor ek nou maar gaan praat is dat dit studente is wat nie noodwendig die vak wil hê of gaan verder gee nie uhm so jy werk met ‘n grope studente wat in daai opsig uhm alklaar met ‘n negatiewe houding uhm teenoor die vak kom uhm. Ja uhm.

Interviewer 1: Vir ‘n dosent?

Sarah: Uitdaging ja dis maar die groot klas wat ook sleg is is bloot die fisiese rankskik van banke in ‘n klas en bedoel ons leeromgewings, fisiese leeromgewings, is nie uh so engels sê condusive vir co-opperative learning noodwendig nie want dis die lesing styl banke so jy sukkel maar want as jy nou vir die outjie in die heel middle van die bank dan moet jy nou maar verby almal skuur dit vat jou nou nogal ‘n rukkie dis sulke tegniese goed wat as dit groepsbankies was of ronde tafeltjies was soos bv in die de la rey saal deesdae is dan sal jy baie makliker by die ouens uitkom dink jy gaan tyd ‘n bietjie spaar in daai opsig so on sons rangskikking van ons lesinglokale of die uitleg is ‘n beter word is regtig nie bevorderlik vir daai tipe van leer nie uhm want hulle sit nogsteeds so ja en wag en kyk en ja dan omdat dit so verskriklike groot groep is uhm weet jy weet jy kan baie mooi sien daai in die agterste ry het nie ‘n saak nie wat jy doen of sê as jy daai 10 min se vaslegging vooraf doen of so nie daai een het ‘n foon daai een sit met sy aaitjie gou en praat die dissilpine op ‘n derdejaarsvlak voel ek hulle is derderjaars die ander outjies is nou die eerstejaars met kan ‘n ou nou nie polisieman speel soos ek sê nie daai tipe van studente se eie integriteit dit is vir my nogal ‘n uitdaging soos ek gesê het waar hulle vir mekar opdragte doen en dan weet jy vir ‘n feit hierdie ou uh het dit nie maar dit gaan hom erenster maar inhaal dis nie sy eie kennis nie uh ja dar uh wat is daar nou nog wat ek kan dink aan uhm .

Interviewer 1: Ons kan positief ook kyk.

Interviewer 2: Vir jou as dosent?

Sarah: Uhm ja soos ek gesê het die groot uitdaging bly maar die klasuitleg dis nie altyd maklik om dit on te doen nie om by elke student noodwendig uit te kom nie uh men die uhm o ja ek

het dit ook net terloops geê die tolk is ook maar altyd daar want daar is ‘n baie groot deel van die klas is nou maar engels taamlik ‘n bedydende hoeveelheid dit is nou nogals amper 40% toe maar dis nie ‘n uitdaging nie maar uh dit bly maar net ‘n ou moet bedag wees daarop.

Interviewer 1: Natuurlik.

Sarah: Dis is so.

Interviewer 1: Net nog iets waaraan mens moet dink.

Sarah: Maar net nog iets waaraan jy moet dink. Dis is waar want as jy goed alles wat ek sê word darem vertaal ek is nie altyd seker noodwendig altyd reg ek aanvaar dit word reg vertaal so daar het ek ongelukkig geen insae of insette nie, maar dit is maar dit vat ‘n rukkie om uh in terme van rustigheid jy weet as die studente inkom dis vir my taamlik lawaaierig en dan moet hulle oorfone kry en dan moet hulle in die banke inskyf so daai tipe van ding maak dit maar moelik veral ook in ‘n groot opset. Uhm hulle vat bietjie lank om tot ruste te kom maar dis een van die dinge waarmee mens maar moet aanpas dis ‘n gegewe ons kan nou nie verander aan dit nie uh men natuurlik o ek het netnou genoem van fasilitering waar daar aditioneel ok nou is bo en behalwe die klas opset maat uhm daar is maar nie baie studente dis nou vir my nog ‘n teken dat hulle amper nie bewus is van dat hulle ‘n robleem het nie want die bywoninh van die fasilitering is maar verhouding gewys baie baie klein uhm ek meen daar is nie eers ‘n goeie 10-12 studente per fasilitering sessie nie as jy dink dit is nie eers 10 % van die klas wat dit bywoon nie ek weet daar is eintlik meer as 10% wat ‘n behoefte het om dit bytewoon maar weereens dit is iets wat hy of sy self besef ek het dit nodig ek moet gaan ek kan nie jy het ek sien jy sukkel jy moet dit bywoon nie hulle moet dit self besef.

Interviewer 1: En die verantwoordelikheid ook van werk om te besef hier is 180 mense om my of 179 en uh daar is een dosent en daar is 2 mense wat help, ek moet die ekstra myl stap as ek sukkel ek kan nie net gaan vinger wys en na die tyd nie ek moet ook ‘n plan maak om by my dosnet uit te kom en self bronne, maar in elk geval dis net ‘n gedagte wat mens nie kan help om te dink net soos hulle ywer om te besef ek moet hierdie goed in die hande kry, uhm nog vir die dosent ek wonder sommer en om daai DVD’s te gemaak het. Dis tog nogal ‘n groot werk, waar het dr hulle dit gedoen het julle gebruik gemaak van die online distance learning se fasiliteite?

Sarah: Nee prof Hennie het ‘n plek gehad hier in van der hoff park, ‘n kantoor opname lokaaltjie gehad het waat ons die goed opgeneem het ek weet die grondslagfase mense het dit ook nogal gedoen so ons het dit ja ek het seker so 4 dae in ‘n ry het ons dit gedoen of ek het dit nou maar gedoen. Ja so dit was maar vir my stresvol in daai oomblik want om voor ‘n kamera

te praat en jy is so bang jy maak ‘n fout want jy weet presies hoe hierde ding werk maar as jy nou voor daai kamera sit en praat dan kan jy nou sê 2 en 3 is nou 6 en dan sê sorry cut en hal daai stukkie dan nou uit so jy weet dit is ‘n uitdaging en jy weet die volgende uitdaging en ek wee tons het eitlik l op hierdie stadium alreeds gedoen gehad het om op die videotjies of die demonstrasies te vernuwe byvoorbeeld iets eenvoudig daai hele ding van die verwantskap tusen ‘n volume van ‘n cylinder en ‘n keel as jy 3 uhm keeltjies vol maak met water dan pas dit mos nou presies is die volume van die cylinder in so die verwantskap kan hulled an nou baie mooi sien is 1 tot 3 anders bly dit net iets wat hule in hulle boek leer. Maar nou kan jy nie in die klas hierdie water daar gooi en heen en weer en dis hoekom ek dink dit in ideaam om ‘n videotjie vir hulle te wys en daai tipe van demonstrasietjies wat jy ondersoekende werk gaan kan jy baie makliker op die videotjie want dan moet die studente dit vooraf sien want dan help dit nie dis daar en jy het dit wonderlik probeer verduidelik maar hulle so okay terug te kom na jou vraag toe ek weet uh die uitdaging bly vir my of die dosent om meer en meer uhm wel ek moes nou al weer hierdie videotjies heropgeneem het dalk vernuwe het en dalk uh ja korter deeltjies gedoen het om dit vir hulle beskikbaar te stel want nou op die stadium nie die geval is nie tyd is maar weer die groot faktor van ek moes dit gedoen het, maar wanneer moes ek dit gedoen het.

Interviewer 1: Hoe lank was die videotjie omtrent gewees kan dr onthou?

Sarah: Hulle was hulle het eintlik gesê dit moenie langer ‘n deeltjie moet omtrent maar 10 min maar dan het jy dalk vir ‘n leereenheid het jy dalk gesê wag ek gaan nodig hê om 3 10min videotjies te mak vir hierdie geval ek gaan dalk net twee 10min videotjies maak. So ek dink het hulle as ek reg is was die onderafdelings 10min gewees per stukkie maar partykeer is dit dan nou sê nou maar jy het dalk meer as een nodig gehad vir ‘n bepaalde onderwerp of so.

Interviewer 1: So die probleem is dan dit sou nice gewees het as hulle huleself ok so kan reguleer en hulle help scaffold en sê kyk eendag dit, kyk een dag dit want hulle het tog nie elke dag klas gehad nie maar die probleem kom dan in volgens cognitive load as hulle sê moet dit nie meer as 10min mak nie maar die aand voor die tyd wil hulle dit nou inscach maak nie saak hoe goed jou bedoelings dan nou is om dit ir hulle te scaffold en uiteentesit as hulle nie daarmee gaan saamwerk nie. So sal dr sê voel dr ‘n flipped classroom implementeringdat mens ongelooflik mooi vir hulle moet verduidelik hoe hierdie model werk wat die doel daarvan is en spesifiek vir hulle uit een te sit as jy wil suksesvol wees in hierdie model sal ek aanbeveel dat jy hom so moet aanpak en nie so nie dat hulle net ingelig is en dan wat hule dan nou daarmee doen is dan nou hulle saak.

Sarah: Ja kyk verseker hulle sal moet weet dit is wat van hulle verwag gaan word maar nogsteeds dink ek nogsteeds gaan hulle hulle eie tyd moet bestuur as jy vir hulle sê goed hierdie week gaan ons nou einskappe van driehoeke bespreek uhm dan sal hulle gaan moet beplan en sê nou maar goed hoe gaan ek my tyd hierdie week indeel om voorbereid by die klas by die lokaal uit te kom so ja hulle sal moet weet wat dit behels hulle moet weet wat dit van hulle gaan verg dit gaan van hulle meer verg as net klas toe kom en arms gevou sit maar die leer wins daaruit gaan soveel meer wees as hy klas toe kom met alreeds die voorkennis om dan sinvolle vrae te vrae want dan kan jy uhm net toepassing doen en probleemoplossing doen wat dan uiteindelik by die hoër kognitiewe vlakke uitkom want omdat ons die aan kennis tipe vra in die klas aandag gee nie dis onnodig, total onnodig.

Interviewer 1: Mens kan die klas tyd soveel meer effektief gebruik.

Sarah: Ja defnitief, maar dan moet hulle weet hulle varantwoordelikheid is om daai die basiese ek wil sê die kennis vlk en uh enkele toepasnkies in term e van voorbeelde met hulle deurgewerk en voor die tyd al want jy gan nie in die klas uh

Interviewer 1: En hulle moet dit weet, mens moet dit vir hulle sê.

Sarah: Hulle moet dit weet ja. Ja so dit moet baie mooi aan hulle gekommunikeer word so hulle gaan weet wat van hulle verwag word. Amper soos ‘n kontrak met hulle opstel goed wat is jou verwagting en wat is my verwagting van jou en jou verwagting van my maar dit is wat jy moet doen om hierdie module suksesvol te laat gebeur. Want ons het net ‘n beperke kontaktyd

Interviewer 1: Dr het aan die begin van die onderhoud gesê dat uhm hulle spoonfeed dr het toe nou daai word gebruik dr wou hom nie gebruik nie maar ons het hom gebruik uhm dat dit is wat hulle ongelukkig gewoont is hulle kom so van laerskool af kom so deur hoerskool verskeie redes waaroor ons nou nie noodwendig ingaan ni, ‘n ander dag dalk, maar uhm sal dr dalk aanbeveel omdat hierdie as ‘n eerstejaars dit vir hulle nuut is om verantwoordelikheid te vat vir jou leer om elstra hulpbronne saam te gaan kry self te gaan kry en en sal dr aanbeveel dat mens nou juis met hierdie implimentering vir hulle baie mooi scaffolding moet gee om op terug te val dalk moet jy maandag seker maak dat jy hierdie video kyk en dan gaan ek vir jou hierdie google form gee om daaroor te voltooi en dan dinsdag kan jy hierdie video..net om hulle te lei so dat hulle dalk later tweede of derde jaar dit meer vir hulle natuurlik omdat dit so nuut is vir hulle.

Sarah: Ek dink verseker jy is baie reg as hy nou rou eerstejaar is kan mens nie net sê siestog kom ek help hom maar nog nie jy kan ook nie vir hom die hele pot gee en sê nou moet jy self en jou eie leer.

Interviewer 1: Dit lyn nie so lekker op met wat navorsing sê nie nê?

Sarah: Ja, maar ek dink. Dit is belangrik wat jy sê jy moet op ‘n punt begin en en geleidelik moet hulle gespeen word

Interviewer 1: Geleidelik dan nê.

Sarah: So ek dink regtig dit is baie waar wat jy sê en baie wardevol as mens dit gaan baie beplanning van die dosent verg uh

Interviewer 1: Tyd

Sarah: dis nog ‘n stukkie uitdaging maar ek dink dit gaan later vir jou makliker word as jy aan die begin vir hulle ek wil sê op ‘n manier dit mooi modeleer of uh jy weet soos jy sê scaffold en sê uh dit is wat ek van jou verwag so geledelik sonder dat ek agterkom moet jy so bietjie terugstaan en ietsie ietsie minder maak dat hulle op die ou end self soen goed om maar uiteielik by daai week of daai dag uit te kom oet ek ‘n bepaalde aktiwiteite self doen self maar mens moet vir hulle ruglyn gee jy kan nie net verwag jy is nou op universiteit en nou moet jy ‘n self-geruguleerde leerder wees en en hulle gaan nie weet waar om te begin nie so daar moet regtig ruglyne wees. Dit is die uitdaging rerig ‘n dosent sal baie mooi moet beplan uhm ja dit gaan aanvanklik dan van jou bietjie werk verg maar ek dink dit is in belang van die student wat uhm dit is ‘n geleidelike proses dit gaan nie van self gebeur nie.

Interviewer 1: Ja. Don’t set them up for failure.

Sarah: As jy vir hulle ‘n hoop werk gee en jy sê berei voor hy gaan nie weet hoe of waar om te begin nie so dit is ‘n baie goeie uh

Interviewer 1: En as mens nie weet waar om te begin nie dan verloor jy ook motivering

Sarah: Verloor jy ook motivering want jy weet ook nie hoe nie, maar as dit in kleiner bite size chucks vir jou gegee word kan jy dalk sê ek het dit bemeester goed ek weet nou as ek dit het kan ek dit doen uh

Interviewer 1: En wat hulle metakognisie dan sal bevorder, sal dit nie?

Sarah: Want nou moet ek teruggaan want ek moet reflekteer kan ek dink doen ek kan al hierdie doen so ek kan aangaan nee ek sukkel hiermee so ek moet iets doen om hierdie konsep nog te verstaan watkan ek doen om hierdie nog te verstaan so ek moet beheer neem en sê ja ek is okay met a b c maar ek het nog nie vir d onder die knie nie. Laat want dan hulle moet want almal gaan verskil so ek bedoel uh wat een ou mee sukkel gaan ‘n ander ou nie mee sukkel nie maar hulle moet self hulle leer behoefte kan identifiseer en sê ek verstaan die nog nie so lekker nie so wat kan ek doen is dar dalk ‘n videotjie wat ek kan gaan kyk aditionele skakeltjie of iets anders op google wat jy vir hulle kan inbou of hoe ook al.

Interviewer 1: As hulle daai kan regkry aan die einde van ‘n module dan sal dit absoluut fantasties wees. Uh. Dr Roux my wekker het nou afgegaan dat 45 min verby is.

Sarah: Sjoe so vinnig

Interviewer 1: is dr gemaklik daarmee dat ons nog een vraag saam en dat Interviewer 2 ook net toelaat as sy dalk laaste paar aanmerking wil maak en vrae vrae en so is dit reg?

Sarah: 100% doodreg

Interviewer 1: Net nog verder ons gaan eintlik net aanlas waar ons nou aangegaan het so uh what are your views dr roux regaring possible strategies and approaches to support the development of metacognitive skills in hierdie module ook dalk so saam met die flipped classroom wat julle begin doen het. Moet ek hom weer lees?

Sarah: Ja, sê gou weer.

Interviewer 1: What are your views and recommendations regarding possible changes, strategies and approaches to support the development of metacognitive skills.

Sarah: Ek dink wat jy nou eintlik reeds in die vorige vragie gesê het dat mens baie mooi sal moet beplan uh rondom hulle leer progressie dit wat ek van jou verwag uh want hulle gaan soos ons gesê het nie alles vanself weet hoe om te doen nie uhm so ‘n mens moet nogsteeds ek dink nogsteeds dit eskaleer eintlik in terme van dit wat jy vir hulle gee uh wel ek sê eskaleer maar jy moet eintlik al hoe minder doen jy sal baie mooi fyn moet beplan aanvanklik rondom die strategie wat hulle moet implimenteer uh en pertinent dalk vragies vra refleksie vragies inbou en sê goed ek is seker nou van hierdie of ek sukkel nog met daai aspek wat gaan ek doen om myself hiermee te help uhm goed gaan ek die dosent raadpleeg gaan ek ‘n maat in die klas raadpleeg gaan ek ‘n aditionele bron raadpleeg wat het ek gedoen om hierdie probleem dan nou te oorkom ek dink ons moet leidinde vragies inwerk.

Interviewer 1: Waar dink dr moet mens dit inwerk? In die klas of in die video?

Sarah: Ek dink mens moet dit amper op efundi in die egids op ‘n manier uh..

Interviewer 1: Nadat hulle die video gekyk het dalk?

Sarah: Nadat hulle die video gekyk het dalk ja.

Interviewer 1: Ook in die videos dalk?

Sarah: Ja miskien na of jy wee tamper it moet iets van homself wees of hy moet amper ek wil sê dit as deel van sy portefuelje vir jouk an wel sê ja of hy ‘n portefuelje ooit doen maar op ‘n manier vir jou sê uh dit amper formeel aanvanklik deel wees van sy self assessering want daarna dink ek gaan dit automatie gebeur jy weet as hy dit vir die eerste paar leereenhede gedoen het uh eksplisiet gesê het ek sukkel hiermee ek is reg daarmee dit het jy weet watter hulpbronne kan ek gebruik en so meer en dat hy dit later automaties gaan doen.

Interviewer 1: Dit is die idee.

Sarah: Dit is die idee dat dit amper deel van sy modering gaan word omdat hy aanvankilk gedwing was om dit te doen maar dan later hoef hy homself nie eers meer attent daarop te maak nie hy gaan dit vanself doen.

Interviewer 1: Dis wat mens wil hê. Jy wil dit by hulle tuisbring dat dit soos ‘n tweede natuur raak.

Sarah: Dis reg ja.

Interviewer 1: Dit sal fantasties wees.

Sarah: Ja,ja.

Interviewer 1: Dalk verdure voorstelle om hulle kognisie te monitor, om dalk ‘n kyk as ons bietjie wil boekhou of is dit besig om te verbeter of nie. Het Dr dalk ‘n voorstelle van in hierdie model hoe mens dit sal kan monitor waar is die platforms wat mens dit sal kan optel.

Sarah: Um ek dink wel een dink hier hang seker maar weer af van jou klas groote as hulle tipe van ‘n joernaal dalk by hou met hierdie tipe vragies wat hulle weekliks beantwoord dalk na elke klas of hie okal so dat hulle bepaal uh vragies het en daar is sulke vragies nogal ek het daar is nogal heel party sulke ruglyne uh dat hulle miskien in tere van ‘n joernaal dit byhou en een moontlikheid ek weet op efundi is daar ook die moontlikheid dat hulle uh ‘n bepaalde

stukkie ‘n poll of ‘n ding moet doen voordat hulle aangaan na iets anders toe amper daai afdelingkie moet afgehandel word anders kan hulle nie aangaan na ‘n volgende deel nie.

Interviewer 1: Dis oulik.

Sarah: Ja, so mens sou vir hulle daai vraelysie kon inbou met ‘n poll check ckech.

Interviewer 1: Dis baie oulik. Ek het dit nie geweet nie.

Sarah: Ja, ek weet nie eintlik hoe dit werk heeltemal, maar dis nie asof

Interviewer 1: Dis iets om na te vors dink ek, vir my.

Sarah: Vir my ook. Ek weet dis daar so as hulle kan nou glad nie van daardie deel na hierdie deel toe skip as hulle nie hierdie stukkie gedoen het nie so naastenby wat het ek nou gesê ‘n poll of ‘n opnametjie doen.

Interviewer 1: Is ek reg dat ‘n dosent daai kan monitor om te kyk wie het aangegaan na die volgendes toe?

Sarah: Ja, ja. En as hulle dit voltooi ek kan hulle aangaan so hulle moet ek meen dit voltooi en jy kan dit monitor ek uit die aard van die saak ja. Jy kan daai tipe dinge ook by wyse van google forms of wat okal maar ek bedoel dis op efundi in elk geval gesit daai uhm die ander uh moontlik is dat mens ook weereeens dit kan ‘n ou ook en daar is verskillende maniere sekerlik ook op efundi voor ‘n klas begin kan jy vir hulle ‘n knowledge survey doen met basiese vragies jy kan vir hulle kennis vragies ek weet uh wat die kom ons sê nou maar die verskillende soorte driehoeke wat ‘n mens kry ek weet wat die oppervlakte van ‘n sirkel is dat mens vir hulle sulke knowledge vragies vra.

Interviewer 1: Askies dr, aan die begin van ‘n klas?

Sarah: Ja, van ‘n klas en dan kan jy sien daar byvoorbeeld goed heelwat van hulle sê hulle is nie noodseker oor byvoorbeeld die toepassing van Pythagoras se stelling argumentsonthalwe nie so miskien is dit die moeite werd om gou gou aan die begin van die klas net weer daarna te kyk so hulle moet vooraf kan sê nadat hulle voor berei het uh ek jy moet daai vragies nou maar opstel as dosent, bepaalde kennis vragies uh dis eintlik maar die uitkomstes op die end ek kan ek kan dis goed of jy kan miskein op ‘n skaal van 1 – 5 of wat ek akn dit baie goed doen ek kan dit redlik goed doen ek is ondeker daarvan of wat okal dat hulle met bywyse van uh a,b,c of d kan uh voltooi en jy kan dit dadelik tot jou beskik hê en jy kan sien goed die algemene tendens is goed hulle weet baie van hierdie aspek maar hulle sukkel nog met hierdie

aspek so dit wat hulled an nou lag op geantwoord het kan ek dan nou dalk gou-gou aan die begin van ‘n klas aan aandag gee en so aan so ja dit is ‘n moontlikheid, maar weerens dit gaan nogal van die dosent bietjie uhm jy wet nuwe vaardighede ookverg en beplanning ja dat jy daai vragies moet opstel ja uhmmaar dit is mens kna dit p verskei wyses doen ek bedoel mens uh ek meen as dit ‘n groter klas is ek een hierdie klas is as ek reg onthou was hulle min of meer so 60 so dis moeilik om individueel te vra of selfs ek het al in kleiner groepe al voor ‘n klas gesê hull moet vir my op efundi sê waarmee hulle probleme het, maar dan moet jy dit gaan lees voor die klas en dit vat baie lank jy kan nie, jyt nie rerig tyd om dit te doen nie, maar as jy vinnige grafiekie ek bedoel google ag nie google nie, efundi gaan vir jou self daai

Interviewer 1: Haal hy sleutel woorde uit?

Sarah: Weet jy ek ja, ja

Interviewer 1: Sjoe dit sal nice wees.

Sarah: Dis by wyse van ‘n ja ek wil sê ‘n kolom grafiekie wat hy dan nou as dit ja nee is nou eintlik hoor so dis nie ‘n kwalitatiewe tipe van ontleding nie dis regtig ‘n uhm as hulle sê byvoorbeeld ja uhm ek sukkel ek is heeltemeal in beheer daarvan ek dink ek weet waaroor dit gaan ek is onseker ek sukkel baie daarmee so opgrond van ‘n skaal gooi hy vir jou dadelik in terme van ‘n tipe van kolom grafiek dan kan jy bywyse sien.

Interviewer 1: Vinnig sien. Okay

Sarah: Vinnig sien.

Interviewer 1: Dis ‘n goeie een.

Sarah: Okay Alaml sukkel hiermee kom ek kyk daarna, ja of kom ek gee meer aandag daaraan maar die ander goed is nie nodig om aan aandag te gee nie maar die feit is dan die onus by die student om te sê om daai in te vul uh ek meen jy kan tipies gaan soen ook wie het di ten wie het dit nie ingevul nie uh en dan goed soos ek sê jy kan dit maak dat hy dit moet invul voordat hy kan aangaan na die volgende aktiwiteit toe of so.

Interviewer 1: Na die volgende ding, ja

Sarah: Dis deel van efundi se uh een van sy uh funksionaltiete wat ek nou nog nie eintlik benut het nie

Interviewer 1: Dankie dr

Sarah: Maar dit verg regtig van ‘n dosent dit kan sulke wonderlike leergeleenthede wees maar dit verg baie van ‘n sosent in terme van hoe jy dit implimenteer, jou tyd en dit gaan vir jou op ‘n stadium jou lewe vir jou makliker maak en ek bedoel ek dink ons almal begeer om dit op daai manier te kan doen en dis wow en alles mar as jy terug kom in jou kantoor dan dink jy dis vat soveel tyd maar dit is iets wat mens maar moet op ‘n manier by uitkom al is dit net een afdelingkie van ‘n module begin daarmee en dan uh dit uit te bou na ander dele.

Interviewer 1: Dit sal die moeite werd wees.

Sarah: DIt sal die moeite werd wees dis net ‘n kwessie van iplimenteer en beplanning daarrondom maar ek ding iewers gaan dit vir jou gaan die paadjie voorentoe makliker raak vir jou aanvanklik gaan dit baie input verg van ‘n dosent

Interviewer 1: As mens saam met kollegas werk kan dit dalk nice wees. As paar mense dit dalk doen, mens het die ondersteuning nodig van jou tegniese mense, mens moet defnitief op first name basis wees met iemand by die tegniese span by efundi.

Sarah: Jae n ek bedoel daar is baie van hiredie efundi werkswinkels on swoon dit net nie by nie want weereens tyd is nie altyd daar nie maar uh daar is daai tipe van ondersteuning ja en die werkswinelks en dinge en jy moet dit gereeld gebruik want as jy een dag ‘n kursussie of ‘n werkswinkel bygewoon het en jy gebruik dit vir ses maande nie gaan jy dit in elk geval vergeet.

Interviewer 1: Is so, jy moet dadelik dit gaan

Sarah: Jy moet dadelik ff daai person moet na jou toe kom en vir jou wys, watokal, wys my hoe en so aan ja.

Interviewer 1: Dankie dr, interviewer 2?

Interviewer 2: Ek is net nogal nuuskierig toe jy nou aan die begin gesê het was aan die begin het daai DVD flipped classroom model nogal gewerk en daar was hoë motivering mar toe het dit afgeneem. Kan jy dalk moontlik redes gee hoekom dit afneem het.

Sarah: Weet jy ek dink nou een ding hoe sleg dis nou okal is hulle het aanvanklik die DVD of wat okal dit was DBS het Prof H dit genoem, hulle het dit saam met hulle studie gids gekry, so hulle is geissue daarmee: hier is jou studiegids, hier is jou DVD. SO ek dit gekry maar die oomblik as ek self ‘n ding moet doen, ek moet nou self na n skakeltjie toe gaan, ek moet elf ‘n bron gaan soek op ‘n ander plek as wat op my skot geval het daai self gaan soek.

Interviewer 2: Kom weer neer op selfgerigte leer.

Sarah: Daarsy hier is jou koffie hier is jou melk gooi dit net in maar die oomblik as ek nou noet kombuis toe stap om melk te kry dan drink ek nou maar liewer dit net so so hulle het dit regtig dit was regtig een van die uhm nogal die vragies wat nou dat ek daaraan dink uit daai navrsing stukkie wat daai student gedoen het uh dis alles goed en wel as hy dit het. Hy het die DVD of DBS hy het dit gratis gekry of was ingesluit in die paket maar as ek my hande uit my sak uit moet haal om self dit te gaan doen dan val di ten dit dink ek is die kurks van die saak. Dis nie vir jou gegee nie so sorry jy kan kan dit nie kry nie, wie gan dit vir my jy weet uh dis nie as dit nie self gemotiveerde student is wat uh plan maam om dit te gaaan soek en te besef maar ek ek wil ek het dit nodig kom ek gaan soek dit dan uh dit moet op ‘n vinnige manier kom, op ‘n kits manier.

Interviewer 2: Ek het nou heeltyd terwyl jy nou gepraat het gehoor eintlik is die probleem maar self gerigte leer.

Sarah: Absoluut. Dis die goue draadjie wat daar dwarsdeur uh kom.

Interviewer 2: Ek is net bekommerd ons die hele international word die flipped classroom appraoch gesien as ‘n metode om groot groepe te kan beter te kan diens.

Sarah: Ja.

Interviewer 1: En nou het ek so by jou gehoor hoe groter die groep hoe moeilker so ek is nogal weet opgrond van jou ervaring dink jy dit sal kan werk as mens dit nou as mens die tyd het in die ideale omdtandighede genoeg tyd het genoeg ondersteuning het, selfs in groot groepe, dink jy dit sou kon werk.

Sarah: Ja, dit sou, ek hoor presies wat jy sê dis juis of nie juis nie maar ek dink dit is uit en uit juis vir groot groepe uh ek dink die administrasie daar rondom moet net beter wees en ek dink ook soos ek eintlik een van die uitdagings en dis nou sleg mens moenie altyd uhm fout op ander plekke gaan soek nie mar die uitleg van bv die lokaal ek meen dit maak dit hulle kom nog amper steds met die verwagting ek gaan nou ‘n lesing kry ek gaan nou ontvang want ek sit nou in hierdie rye so

Interviewer 1: Ja.

Sarah: So, ek wil uit en uit sê ja dit moet werk of jy nou tien in ‘n klas het en of jy nou 100 of 200 in ‘n klas het dit moet kan werk want dit bly nogsteeds daai student wat voor die tyd die werk gaan bemeester en klas toe kom om uh hoër orde vaardighede te uh aan te leer so dit moet werk ek daar is nie ‘n rede hoekom dit nie met ‘n baie groot groep kan werk nie. Dit juis waarom prof Hennie noem dit aanvanklik die groot groep onderrig strategie uh en hy het dit

nooit nerens gepraat van die flipped classroom nie hu het gepraat van self bestuurde leer, maar op die einde kom dit daarop neer dis maar ‘n flipped classroom. So dis, dit moet werk uh ek dink dit gaan is die eerste plek, ja, oor die uitleg van die klas ek dink nou mmar net ook uhm soos ek nou al baie gesê het dis sleg dat jy werk met dtudente wat maar lae vlakke van motiveering het en ek moet sê dis erg om dit te sê don’t quote me maar dit word vir my half erger.

Interviewer 2: Ja, ek dink ook dat uh tydsgewys, ek meen die groepe word groter, die dosente word minder, en selfs op skoolvlak word die groepe groter en die onderwysers minder so as gevolg van finansiële impak en ons tyd word al hoe minder. Ek meen ek hoor jou praat van jou passie en jy wil so graag maar uiteindelik kom dit neer op jou tyd.

Sarah: Dis presies dit. Dit is so so sleg soos wat dit is dit ja dit is uhm daar is so baie dinge en op die ou end dink ek joh jy’s eintlik hier vir die studente jy stuur hulle in die veld in maar jou werk of jou tyd word so op gesit deur ander goeters dat hulle an die kortte speen op die ou einde jy weet agterspeen wil ek sê suig. Dan dink ek jinne waarmee is ons besig hier dit is rerig total nie wat dit moet wees nie nê as dit nou die ideal is jy wil so graag so ggraag dit doen maar jy het 103 ander goeters of jy het te veel klasse en soos jy sê finansiële goeters beplanning, struktuur wat okal die geval is dan praat ons nou nog van herstrukturering en al die dinge.

Interviewer 2: Ek het so goed verstaan toe jy nou sê van die tyd en sit voor die kamera en jy moet nou

hierdie jy weet mense besef nie as jy daar gaan sit wat het voor dit afgegaan nie.

Sarah: Absoluut

Interviewer 2: Want jy moet jou teks bymekaar kry dan moet jy na die tyd gaan en jy moet nog gaan

editing doen. So daai tyd wat dit vat om ‘n video te maak, niemand besef wat daaar in gaan nie, voor

die tyd, gedurende en na die tyd.

Sarah: Ja, daai dae ek onthou dit was regtig waar ek onthou ek was regtif emosioneel, fisies geestelik

ek was gedaan op klaar dit was so januarie. En dit is regtig waar.

Interviewer 1: En daai spanning van jy mag nie nou ‘n fout maak nie. Die inhoud is vasgelê vir ewig.

Sarah: Dis reg ja

Interviewer 2: Ek wil net by jou hoor, wat dink jy oor voorafgevaardigde uh videomateriaal byvoorbeeld sê nou maar jy gan dit nou nie self doen nie maar jy gaan soek nou so bietjie of jyt assisstente wat jy gaan vra om te gan soek na voorafvervaardigde video’s of youtube of wat okal

Sarah: Ja.

Interviewer 2: Dink jy daar is potential dat mens dit nie op jou self sit nie maar dit self gaan soek?

Sarah: Kyk, daar is potentiaal maar mens moet so versigtig wees ek het ook nou al gesien die goedjies wat op Youtube dis sommer enetjie wat in haar garage dan jy weet dan kamera spring op en af. Dit is regtig swak.

Interviewer 1: Jy moet dit mooi gaan deurkyk.

Sarah: Jy moet baie mooi gaan sif dit is rêrigtig so. Ek bedoel obviously die Khan Academy en goeters is ook oulik. Daar is rerig oulike goed moet net verskriklik mooi gaan sif en baie mooi gaan kyk want ek al regig baie ure gesoek ek sê dit is skies ek val myself weer in die rede want ek dink ook nie mense besef oor die algemeen altyd watter voorbereiding daar is selfs as jy materiaal gaan soek ek het al ure op oggend gesit vir een spesifieke klas of onderwerp wat ek in die klas wou hanteer het dan het ek die hele liewe dag gesoek vir goeters so jy soek so baie jy kry so min wat werk uh dis navorsing amper op sy eie wat nerens wys nie maar goed ek het mysef nou in die rede geval. Ja uhm daar is baie benaderings in die video’s ook wat ek nie noodwending van hou nie want hulle sal juis doen wat ek nie wil hê hulle moet doen nie byvoorbeeld sê nou maar ek wil hê in ‘n ander klas nou van my van die intermediere studente ek wil hê hulle moet kan aflei waar kom die formule van die oppervlakte van ‘n sirkel vandaan. Ek wil nie vir hulle die formule gee nie en dink wiskunde bestaan uit formules uit nie so ek wil hê hulle moet dis aflei hoekom is daai formule so en hoekom lyk dit so dan gaan die youtube videojie juis daaroor ‘this is the formula’ sê nou maar ‘whatever’ uh C=2pieR so the value for pie is this if the radius is this you do this and this and this so dis verskriklik resepmatig die aanbieding so dit druis eintlik in teen wat jy in die klas wil hê moet gebeur daai leerervaring wat moet daar gebeur ja dit is goed vir partygoed seker vir samevatting en vaslegging en so aan maar ;n mens moet baie mooi gaan sif. So om jou vraag

te antwoord, ja, ek dink daar is ‘n moontlikheid en potentiaal mens moet net baie mooi gaan sif voor jy goeters nie alles is

Interviewer 2: So as mens studente na die internet toe stuur op hulle eie, uh is dit gevaarlik?

Sarah: Ek dink dit is nogal gevaarlik hoor ek sink dis baie keer want huis wat jy nie wil hê moet gebeur nie word daar vasgelê uh ja tensy jy voel ag dis nie so bad nie dit maak nie saak watse uh demontrasie hulle kry van die oppervlakte van ‘n sirkel nie ek noem nou sommer dit uh solank hulle iets kry dan is dit fine hoe hulle seining gebruik word. SO dit hang ook af dink ek uh die doel waamee mens of wat jy wil hê hulle moet bereik as dit nou outjies is wat jy weet gaan self wiskunde vir ‘n laerskool of vir graad whatever aanbied dan wil jy hulle eintlik juis van daai goed af weghou. Jy kan vir hulle sê gaan google dit maar uh ja soos ek sê ek sal versigtig wees as mens bepaalde uh ek wil sê verdighede wil bevorder.

Interviewer 2: Filter ja.

Interviewer 1: En tog wil mens hê hulle moet juis kan onderskei tussen wat is goeie inhoud en swak inhoud.

Sarah: Dis reg.

Interviewer 1: So dis moeilik.

Interviewer 2: As mens byvoorbeeld vir hulle sou uhm spesifiek daarop wys, dat daar is sulke tipe videos en wys vir hulle een en daar is ‘n beter tipe video en dat hulle byvoorbeeld kan inkoop in dat dit is die manier wat ons ons leerders ook eintlik moet leer. Kom ons kyk wie kan sulke tipes video’s gaan bring vir my.

Sarah: Dis verseker want jy kan nie eintlik beheer uitoefen oor als nie nê so soos jy gan jou eie kind moet onderskeidings vermoë leer dis goed en dis verkeerd moet hulle self kan besluit want hulle gaan binnekort in hulle klaskamers. dit is soos jy sê dat mens dit eerder dan gebruik as ‘n leer gelentheid.

Interviewer 2: Metakognisie.

Sarah: Ja, jy moet self besluit is hierdie vir jou goed spreek dit aan wat jy graag wil hê dit moet aanspreek bring vir my ‘n voorbeeld van ‘n swak video, maar bring vir my ‘n voorbeeld van wat jy met gemak sal weet uh na kyk of watokal ja dit is miskien ‘n baie goeie ding wat jy sê.

Interviewer 2: Hulle moet kan motiveer hoekom hulle dink dis ‘n goeie video

Sarah: En dit bespreek krities

Interviewer 2: En hoe dit metakognisie bevorder

Sarah: Dis reg ja, om hom krities te bepreek ek bedoel by all means dit kan ‘n mens nou versekerlik doen in ‘n hoofvak tipe van module wat ‘n bietjie didaktiek insluit nê, dit is ‘n baie goeie idee. Ja dat jy, dat hulle moet motiveer hoekom hulle so sê jy weet dis uhm.

Interviewer 2: Ek het gewonder of jy enige idee het, of dalk raad kan gee, as mens dalk ‘n tipe van ‘n sosiale media of dit nou whats app of efundi of facebook posting is, hoe mens miskien daardeur studente in groepe veral as dit nou groot groepe is kleiner groepe kon maak wat hulle vir mekaar bietjie challenge oor sekere aspekte van die module byvoorbeeld.

Sarah: Ja, weet jy ek het dit nog nie self gedoen nie, maar dit is ek weet daar is dosente wat dit doen. Weereens daar dink ek, ek wil amper sê die outjies wat ek nou spesfiek van praat wat nie vreeslik ‘n saak het met die wiskunde nie weet ek nie of hulle regtig êrens gaan maak daarmee nie. Ek weet die ouens wat ek weet Rudi hy doen nogal whats app groepe, maar wat hy self administreer, maar jy weet dan sal die studente tot 12uur die nag whats app en maar hulle sal vir mekaar wat baie help daar is as hulle ‘n vraag sou vra met die verwagting dat die dosent dit gaan antwoord is daar baie gou-gou ‘n ander een wat antwoord en sê kyk bietjie daarna en daarna so dit is wonderlik ek bedoel whats app groepe kan ideaal daarvoor gebruik word. Hulle doen dit alreeds, die studente weet ondermekaar, sodat jy dit nie eers self te administreer nie gaan jy kan wel dophou en sien wat daar gebeur, maar dit is soos jy sê as dit ‘n groot groep is kan kan hulle dalk met kleiner groepe, dit is ‘n baie goeie idee eintlik dat hulle mekaar dalk daar uitdaag of vra wat hulle onderling met ondermekaar kan uitsorteer as jy dan nou nie dadelik antwoord nie. Jy is daar om te antwoord, maar jy, hulle kan dit ook maar of as jy byvoorbeeld en ek doen dit baie keer met skool kinders het al baie vir my baie keer sal hulle vir my ‘n som vra watokal en dan neem ek maar skryf ek maar die oplossingkie dalk nou maar of so en neem nou maar ‘n fototjie en stuur terug. Maar dieselfde met studente ek bedoel hulle kan vir mekaar weet, want dis altyd moelik om te tik in terme van Wiskunde maar as jy dan nou ‘n oplossingkie het en jy verduidelik en watokal en jy kan ‘n fototjie neem en die hele groupie kan dit sien so onmiddelik is dit sommer dan ‘n buite geleentheid en nog ‘n manier hoe mens ‘n oplossing kan kry.

Interviewer 2: Net so bietjie vrae vra, maar hoekom het jy daai manier gebruik en nie hierdie manier

nie dit leer hulle ook hulle eie denkprosesse en gee vir hulle ook bietjie insae oor ander mense se

denkprosesse want ek is partymaal.

Sarah: Dis reg of 2 of 3 kan ook sê het dit so gedoen watter een dink julle en ondermekaar onmiddelik

is daar hierdie, dis maar ‘n community of practice op ‘n ander manier net weer net dit kan in die aand

gebeur hoef nie eers as ‘n groep bymekaar te wees nie. Dit gee die moontlikheid om eintlik enige tyd

vir mekaar te uh ja, soos ek sê ek het dit nog nooit, ek bly weg daarvan op hierdie stadium, want ek

wil net nie whats apps van studente in die middle van die nag hê, want ek weet Rudi doen dit nogal.

Interviewer 2: Administreer

Sarah: Ek wil nie, maar dit is ‘n baie ja.

Interviewer 2: Mens kan dit ondersoek ja.

Sarah: Absoluut ja. Nog ietsie?

Interviewer 1: Dr van my kant af is dit al, baie dankie ek waardeer dit verskriklik baie dat dr die tyd gevat het.

Sarah: Dis ‘n plesier. Skree maar as daar nog iets is, ek hoop jy kan sin maak uit al hierdie gebabbel.

Interviewer 1: Defnitief.

Sarah: En jou transkripsie op die ou end vir jou nie ‘n nagmerrie is nie.

Micro-cycle 2

Petra – current lecturer interview

Interviewer 1: Baie dankie mevrou Petra dat mevrou ons help en voordat ek die eerste vraag gaan vra wil ek net gou agtergrond gee net gou van die studie vinning en dan net oor metakognisie weer wat ons fokus is en goed uitlig waarna ons gaan kyk in mevrou se klas en met mevrou se student. So oor die studie, wil ons graag ‘n design-based research om nou die flipped classroom soos hy geïmplimenteer word dan deur middle van fokusgroepe studente te help agterkom watter efffek het dit, die flipped classroom, op hulle metakognisie of watter dele van die flipped classroom bevorder hulle metakognisie en hoe kan mens dit dan verder uitbyt as ek dit so kan stel. En dan te analiseer en dan te kyk hoe kan mens aanpassings maak in die implementering om dit dalk verder te bevorder, hulle metakognisie. So, dit is wat ons beplan en dan aan die einde half tipe van ‘n raamwerk te gee van of ‘guidelines’ om te gee so as jy ‘n flipped classroom wil implimenteer, vir wiskunde in ‘n soortgelyke konteks, hier is min of meer hoe jy te werk kan gaan. Ons het gevind dat hierdie metakognisie bevorder. So, dit is min of meer wat ons wil doen so ons fokus is metakognisie, en dan, so vir metakognisie waarvoor ons gaan uitkyk is: vat hulle verantwoordelikheid vir hulle eie leer, kan hulle hulle eie leer dryf, weet hulle waar sukkel hulle, wat kry hulle reg, as hulle sukkel weet hulle hoe om dit reg te maak. Watter strategieë kan hulle toepas om ja, dan hulle leer te verbeter en hulle verstaan. Uhm, so dit is min of meer wat ons fokus gaan wees so nou wil ek graag by mevrou net eerstens hoor wat was mevrou se motivering om die flipped classroom te implimenteer?

Petra: Goed. As ek heeltemal eerlik is, in die begin van verlede jaar, onthou, het jy (Interviewer 2) gevra vir my, want jy het ‘n student wat belangstel om dit te doen. En ek is nogal oop vir iets nuuts, maar toe ek nou begin op die op kampus klas gee ook en toe dink ek ek gaan dit probeer doen en toe dit vir my lyk of dit so goed werk met hierdie student en aan die einde wat ek nog meer gevoel het dit het gewerk, is ek nou nogal begeestered om dit weer te doen. So dit is wat vir my in elk geval reg aan die begin, ek dink nie as julle dit nie opgehaal het vir my verlede jaar nie, sou ek nie noodwendig gedink het kom ek probeer dit doen nie. Ek sou maar gewoon traditioneel gaan klas gee het.

Interviewer 1: En toe Interviewer 2 vir mevrou aanbeveel, het mevrou bietjie daaroor gaan oplees, gaan kyk, is dit met kollegas bepreek? Hoe het mevrou te werk gegaan toe?

Petra: Ja, ek moet sê ek het bietjie daaroor opgelees, maar ek het eintlik ook baie wil ek amper sê, jy weet dis mos maar lees ‘n bietjie op en dan maak ek my eie opinie van hoe ek dit wou implimenteer. En ek het dit op my manier geimplimenteer verlede jaar sonder baie oplees en dit het vir my gewerk, ek voel dit het gewerk soos wat ek dit gedoen het, maar nou wat ek ook alweer verder opgelees het daaroor, is daar dinge wat ek verseker van verlede jaar net so wil doen, maar daar is ook ander goed wat ek sal bietjie ander goed bydoen of dit anders doen.

Interviewer 1: Sal mevrou dalk uitbrei wat sal verander en wat sal dieselfde bly?

Petra: Ja, ek sal. Wat dieselfde sal bly vir my, as ek nou sommer net dink aan die begin, ek dink dit het by my studente verseker ‘n rol gespeel, dat ek vir hulle voor die tyd presies vertel het ons gaan ‘n total ander ding volg, want daardie studente, onthou dis eerste jaar student, hulle het nou die eerste semester by iemand anders klas gehad. So, ek kom vat die tweede semester oor en hier kom ek met ‘n totaal ander strategie. So, ek gaan dit weer doen. Ek het reeds vir Dr Sara (previous lecturer), sy is by die eerste semester, vir haar gevra dat ek weer so by die laaste periode dan vat ek net so 10 tot 15 minute van hulle en dan vertel ek nou vir hulle, want onthou dit is die eerste keer wat hulle my sien en dis die eerste keer wat ek hulle sien. En dan sê ek vir hulle. Na die vakansie het hulle mos nou eers proeftyd ook weer so hulle begin nie eers al middel Julie nie, hulle kom eers basies middel Augustus hier aan. Dan vertel ek vir hulle, ek gee vir hulle al ‘n taak en dinge wat ons moet gee vir die tyd wat hulle weg is en dan sê ek vir hulle hoe ons gaan werk so ek vertel vir hulle so min of meer. So dit sal ek defnitief weer so hou, ek dink dit het gewerk en vir hulle so bietjie laat probeer inkoop in die ding en vir hulle sê dis ‘n ander manier en hierdie jaar gaan ek nou voel ek kan nou vir hulle sê, ek kan amper nou uit ondervinding sê dat ek het dit verlede jaar gedoen en dit het baie baie goed gewerk, jy weet verlede jaar. Ek het hulle ook motiveer om in te koop in die ding. So dit sal ek graag so hou. Wat ek anders gaan doen is ek dink my ‘power points’ en al daardie dinge sal ek baie so, want ek meen onthou dis enkele slides nou jy weet, ek dink daai tipe ding sal ek diesefde doen, maar wat ek anders gaan doen, is verlede jaar het ek vir hulle net *links* op efunde gesit, want dis mos ‘n egids en al daai dinge, waar ek gaan vir hulle hierdie jaar klasse opneem, want daar is basies 10 of 11 klasse as ek dit reg het. Dan en die verskillende konsepte in hierdie module is ook eintlik ingedeel in so 10 so ek gaan vir hulle vidoes maak voor die tyd en dit opsit. Oh en die ander ding ook, ek wil nou nie te breedvoerig alles nie, maar ek vertel maar en jy kan dan na alles kyk, wat ek ook sal verander, maar dit was omdat verlede jaar was die eerste keer, ek moes efundi leer en al daai goed, so ek het soos wat ons aangegaan het jy weet, met die eerste studie eenheid moes oplees het ek opgesit en dan het ek weer later, ek het al vir hulle klas gegee dan gaan ek weer aan op

efundi. Waar hierdie jaar wil ek graag, en veral ter wille van die afstandstudente, maar ek dink jy gaan konsentreer net op kontak student, ja, so ek wil dan vir die afstandstudente dat hulle ook al die klasse al van die begin af het. Weet so vir daai studente wat op sy eie wil werk, en wat ek dink wat veral baie goed vir metakognisie sal wees, jy weet, hulle sal jy weet dat dit moet daar wees, hulle moenie vir my moet wag nie, dis wat ek wil sê. Dit moenie klas vir klas gaan nie.

Interviewer 1: En dan mevrou, dit gaan in Afrikaans, gaan elke video dan in Afrikaans en in Engels moet wees?

Petra: Uh dit gaan ek nog oorweeg, jy weet. Maar ek glo ek sal moet, ek het al eintlik gedink dit moet ek ook vir hierdie studente vra, want die kontak klas kyk is Afrikaans, die afstand ouens is daar Afrikaans, maar daar is ook engelse kinders of student in.

Interviewer 1: Maar daar is ‘n tolk?

Petra: Daar is ‘n tolk, dis hoekom, jy sien.

Interviewer 1: Maar vir die video, gaan dit nou nê

Petra: Ja, dit gaan ‘n problem wees, maar ek is nou nog nie daar heeltemal nie. Maar, dit wil ek met hulle eintlik ook vra. Eintlik het ek gedink wat ek gaan doen en ek dink ek is amper seker dis wat ek gaan doen. As ek omtrent 10 videos maak, uh, jy weet, vir my gaan enige strategie wat ek volg wil ek hê en veral met hierdie tipe ding dit moet vir my, wat sê mens, wat is die woord nou mooi, maar uh, ek moet kan aanhou daarmee, jy weet.

Interviewer 1: Volhoubaar.

Petra: Volhoubaar wees, dis die ding. Ek moenie nou so ongelooflik baie insit dat volgende jaar, en dit werk alles baie goed, en volgende jaar ek weet net ek sal nie op die lange duur, want ek het ook nie net een klas nie. Want onthou die hele idee is mens wil kyk of jy dit na ander klasse ook kan vat. So, ek dink wat ek vir hulle en sommer daar waar ek hulle ontmoet, gaan ek klaar vir hulle sê, ek kan nie videos in altwee tale maak nie dis soveel kostes en ure en wat okal, seker nie kostes vreeslik as mens op efundi sit nie. Maar ek gaan ‘n klas in Engels en ‘n klas in Afrikaans. So, die Afrikaanse ouens moet nou maar bietjie verlief neem. Dit is vir almal goed dat hulle nou maar in altwee tale dit dan kry. Of ek moet die elke video heeltemal gemeng maak, maar ek dink nie so nie. Ek dink ek moet eerder een moet Afrikaans wees, een moet Engels een Afrikaans, so ek dink ek sal dit doen.

Interviewer 1: En as ek mevrou nou al reg verstaan het wat mevrou nou al gesê het, het die flipped classroom het defnitief mevrou se verwagting ‘gemeet’?

Petra: Absoluut.

Interviewer 1: Oortref selfs?

Petra: Weet jy rêrig, en uhm eintlik aan die einde het ek gevoel, want ek het daai 62 studente in daai klas gehad wat eksamen geskryf het, waarvan ‘n derde omtrent nie eers Wiskunde op skool gehad het nie, hulle het geletterdheid gehad. En dit is nie ‘n baie moeilke module nie, dit gaan mos oor 2 en 3 dimensionele voorwerpe en figure en goed. So, dis rêrig nie so moeilik nie, maar dit is moeilik vir studente wat nie daai goed verstaan nie en wat vir my op die ou einde was, was dat in die eerste geleentheid het net 3 studente nie geslaag nie. Verder het almal geslaag en selfs daai baie wat geletterdheid gehad het, en daai ander drietjies het met die tweede geleentheid geslaag. So, dit het vir my die as jy nou sê die verwagtinge oortref weet, dit het vir my absoluut verstom, rêrig.

Interviewer 1: So, dit was ‘n goeie slaagsyfer.

Petra: Baie. Ek meen ek het gedog dit was bitter goed.

Interviewer 1: Op watter ander manier dink mevrou het die studente gebaat by hierdie benadering?

Petra: Ek dink as hulle net kon, kom ons wees eerlik, wat is die eintlike ding van ‘n flipped classroom? Vir my, is dit die student kom voorbereid klas toe nê. Hy kom hoor nie by my vir die eerste keer iets nie. En ek dink daai ‘skill’ om dit te kan, of al is dit nie ‘n ‘skill’ nie, maar dit is eintik ‘n ‘skill’ as jy dit kan regkry. Maar daai, al is dit amper ‘n ‘attitude’ om so te wees. As ‘n student dink ek dit kan vir jou ongelooflik baat met alles wat jy doen.

Interviewer 1: Vorentoe in jou lewe, om nie net terug te sit nie.

Petra: Absoluut. En om te wag dat iemand iets vir jou moet verduidelik nie. En wiskunde is mos maar vir my, jy weet self, dis vir my daai as jy dit net al bietjie gehoor het en daai was nou vir jou moeilik, jy het nie lekker verstaan wat is daai nie. En môre as iemand dit dan sê, dan kliek jy, of dan kan jy ten minste vra hoor hier daai ding het ek nie vertstaan nie, maar ek het al so effense agtergrond.

Interviewer 1: So, het mevrou gevind dat hulle wel voorbereid klas toe gekom het?

Petra: Absoluut. Weet jy daar het studente vir my gekom, omdat ek net die links opgehad het, dan sal hulle vir my kom sê en die pragtigste goed uitgedruk dan sê hulle: mevrou hierdie het ons nou weer gekry. Want ek sê vir hulle op efundi hulle moet kyk vir nog ander *links*. Hulle bring vir my dan moet ek dit vir al die ander ook opsit en so. So hulle het defnitief.

Interviewer 1: So, baie het nog bronne gaan soek.

Interviewer 1: Ja, presies, presies. Daar sal altyd ouens wees wat glad nie iets doen nie. Ek meen dit weet mens jy weet. Maar ek het my uhm, wat ek raak gesien het was in elk geval en hulle het ongelooflik die klas bygewoon.

Petra: O, so die bywoning was ook goed?

Interviewer 1: Ja, ja. Bywoning was baie goed. Maar daar het ek nou miskien ‘n ander ding dit het dalk nou niks met die flip te doen nie, hoewel dit het dalk, want omdat ons nie vreeslik klas gegee het in die klas nie. Ek het absoluut net klas gegee as hulle vir my vra, maar hulle het darem elke keer iets gevra ook. Uhm so my een slide was spesifiek nadat ons mos nou gegroet en gewat alles het was gewees: enige vrae? Dis hoe ek die klas begin. Want hulle het mos nou klaar voorberei. En dan het hulle later agtergekom nee daar is goed wat hulle vir my wil vra en dan verduidelik ek bietjie op die bord en ons gaan aan. En dan het ons die grootste gedeelte van die klas het ons ‘n groepsopdrag gedoen en ek het dit ook met hulle, ek weet daar is ook seker maar ouens wat mens geboel het en so, maar ek het vir hulle, jy weet, ek is rêrig oop met hulle gewees en ek het vir hulle gesê hulle moet oop wees met my. Hulle sit in groepe en hulle werk en ons merk dit ook nog weer aan die einde van die klas en daardie gee hulle in, dit is hulle bywonings ding. Hulle kry nie ‘n ander punt daarvoor nie en vir die 10 klasse so dit was 10 punte klaar het hulle om by te gewoon het.

Interviewer 1: So, dit was vir hulle motivering so half?

Petra: Ja, dit het vir my gewerk.

Interviewer 1: Uh mevrou het nou genoem dat hulle ekstra *link*s, so ekstra bronne, na mevrou toe gebring het om vir die ander op te sit. Het mevrou gevind dat van hulle dalk agtergekom het: ons het hierdie bronne ook gekry maar dit was swak bronne. Kon hulle dalk onderskei tussen ‘n goeie bron en ‘n swak bron?

Petra: Ek kan nie onthou dat enige iemand vir my dit gesê het nie. Ek dink hulle sou net wat hulle dink wat oulik is vir my bring, jy weet. Hulle het dalk n paar ander ook gekyk, maar onthou ek het hulle maar net basies in die klas of na die klas gesien.

Interviewer 1: Okay. En dan watter, die Engels, ek weet nou nie wat is die Afrikaans, *concerns.* Soos watter bekommernisse was daar rondom die flipped classroom? Enige iets as mevrou nou moet sê. Van mevrou se kant af en van die studente se kant af.

Petra: Ek dink dit sal wees daai ouens wat nie voorbereid klas toe kom nie, want nou gaan hulle nie vreeslik in die klas kry nie en veral as hulle glad nie voorberei het nie, dan gaan hulle ook nie eintlik in die klas kom en sê verduidelik asseblief vir my daai stukkie, want dit het ek nie verstaan nie. Jy weet, toe ek gekyk het so hulle is nou half heeltemal *lost*. Dan dink ek uhm, dalk die feit dalk dat dit ‘n nuwe manier is dis rêrig iets om aan, of in te koop by, want anders gaan dit nie lekker werk nie.

Interviewer 1: Dis verandering.

Petra: Ja, dis verandering. [Pause] Uhm wat het vir my nog eintlik, ek kan nou nie. Dit sal seker, ek vat amper as ek die student aan die ander kant was, omdat ek nie so efundi gelettered was nie, dink ek dit sal moeilik wees om die goed te kry daar en natuurlik as jy nie internet of iets toegang het nie, dan gaan dit ook vir jou ‘n probleem wees.

Interviewer 1: En vir mevrou, om die efundi toe nou bietjie meer geskool te raak mee, was daar ondersteuning en hoe was dit?

Petra: Nee, kyk daar is altyd ondersteuning, maar ek meen ek het nou alweer alles vergeet ek het klaar gesê hulle sal my weer moet help. Maar nee wat, ek is seker daar is, jy gaan vra maar net iemand om jou te help. Ja, jy weet so.

Interviewer 1: En dan tydsgewys, as mevrou dit vergelyk het met ‘n meer traditionele benadering en nou hierdie. Het dit baie meer tyd gevat?

Petra: Dit het nie vir my verlede jaar noodwendig baie meer tyd gevat nie. Dit het aan die begin as ek dink aan daai Julie vakansie omdat hier in begin Julie moes die studie-eenheid een en dinge vir hulle opgelaai gewees het met hierdie eerste taak. So, dit het miskien bietjie tyd gevat en omdat ek nou nie met efundi lekker jy weet geken het nie, so daar moes ek baie ure insit en ek moes die *links* kry en jy weet en so. So ek moet sê dit het baie tyd gevat, maar toe ons eers aan die gang is, was dit nie vir my noodwendig meer tyd nie. Nee wat, glad nie. Want ek meen dan het ek die goed daar, ek het die take, ek gaan basies klas toe en ek het hulle ek dink drie toetse laat skryf deur die semester so ek het nog daarvoor tyd gehad, ja. So, daar was nie spesiefiek meer tyd nodig nie.

Interviewer 1: En dan nog van die bekomernisse, mevrou het nou genoem dat as jy nie voorberei het nie gaan jy klas toe kom en glad nie daarby baat nie nê, want almal is dan half

op die volgende trappe en jy gaan voel jy word agter gelaat. Maar jy moet dan kan besef: ek moet net gaan voorberei vir hierdie. Het mevrou ‘n voorstel hoe mens hierdie bekommernis kan aanspreek?

Petra: Kyk, ek het nog nie heeltemal die voorstel nie, maar ek het gedink hierdie jaar dis iets wat ek ook wil verander. Ek wil amper aan die begin van die klas vir hulle ‘n, nie ‘n werkkaartjie nie, maar amper ‘n vinnige *quiz* of ‘n ding gee om te kyk of hulle dit wel voorberei het. Weet om hulle so nie ook om te motiveer nie, dis amper meer ‘n *check* om te kyk, jy weet, want dat ‘n mens op die ou end kan sê weet daaruit behoort mens seker te kan sien ja, die ouens het bietjie voorberei deur na my klas te gaan kyk. Ek sal iets iewers iets in die klas dalk probeer inbou wat ek gee. Dat hulle dit wel gekyk het.

Interviewer 1: Sal mevrou oop wees daarvoor om dit ook op efundi te sit? Dat hulle na ‘n video daar op efundi iets kan invul wat mevrou ook toe sal toegang hê om te sien okay so hulle het, die quiz nou, en om te sien of het hulle dit gekyk?

Petra: Dalk is dit nou ‘n manier om dan moet hulle dit die aand voordat ons die klas het, moet hulle reeds. Dis seker ‘n moontlikheid op efundi, maar onthou ek is nou nog nie so skerp daarmee nie. Dit is miskien waar mens dit kan insit. Net ‘n twee of drie vraag dingetjie en kyk. Maklike goedjies, maar net om te sien hulle het dit wel gedoen. Maar met so iets, dit hang nou af kyk ek wil ook nie lang klasse opsit nie. Ek gaan 10-15 minute maksimum jy weet videotjies daar opsit wat daai dag se goed gaan oorgaan. En ek meen iemand kan maklik dalk veral as dit baie elementêr is, kan hulle in elk geval nie die video kyk nie en net gou daai goed doen. So, ek weet nie, jy weet. Ek is, eintlik is ek nie ‘n checker nie, jy weet. Ek wil hulle eintlik meer probeer motiveer, ek wil nie eers wonder nie en dis maar my tipe manier van praat met hulle ok in die klas dat ek vir hulle sê: ek check julle nie op nie, want jy is mos groot, jy kan doen wat jy wil, ek sê net vir jou ek dink dit gaan vir jou beter wees as jy hierdie goeters gaan kyk. En ek weet nie, dit het vir my verlede jaar gevoel net my gewone praat goed met hulle, vir meeste van die ouens het dit gewerk.

Interviewer 1: Hulle het ingekoop. En dan, mevrou verduidelik mevrou se rol in hierdie flipped classroom.

Petra: Oh ek dink dis baie belangrik nê. Uhm, wel voorbereiding en dan in daai mate se aanbieding van die klas nou maar. Dis mos nou maar heeltemal my verantwoordelikheid. Maar dis ook of my verantwoordelikheid is ook groot om om hulle spesifiek betrokke te kry jy weet. Ek meen, daai ding kan nie werk as die studente nie betrokke is nie, hy gaan rêrig waar en dan kan hulle nog steeds baie goed gedoen het maar ek sou nie dink dis as gevolg van

die flipped classroom nie. Hulle het dalk iets anders gaan doen. Videos of na die tyd gekyk, hulle het nie noodwendig dit in die klas optel nie.

Interviewer 1: Die betrokke, bedoel mevrou aktiewe leer?

Petra: Ja, ja, ja. Absoluut.

Interviewer 1: Okay. Dat hulle aktief betrokke is by die in-klas sessies, soos in die klas spesifiek?

Petra: Ja dit, en veral dit voor die tyd. Die in-klas sessie kan eintlik hulle, of hulle kan net daarby baat nou as hulle vooraf voorberei het. Want as ek nou nie vreeslik in die klas in detail weer verduidelik nie en hier kry hulle n klasopdrag om nou te doen in die klas, dan gaan hulle mos nie daarby baat as hulle nie voor die tyd nie. Maar wat jy gevra het my rol is defnitief, ek meen, ek dink die saamstel van die videos, die saamstel van die inhoud van die videos, want ek het al gedink ek wil eintlik my videotjies wil ek rêrig doen soos wat ek klas gee. Ek wil nie, dit moet nie soos ‘n ek wil amper sê ‘n formele video of *link* dink wees wat hulle nou na gaan kyk nie. Alhoewel daai ook nie formeel is nie, dis baie lekker ek meen gemaklik jy weet, inligting. Maar, ek wil vir hulle rêrig klas gee soos wat ek die klas sou gee oor daardie goed. En dit moet tot hulle beskiking wees. Dis maar al.

Interviewer 1: En

Petra: Die hele rede hoekom ek dit wil doen is, as dit weer vir my hierdie jaar so goed werk, dan wil ek my ander klasse ook so gee. Dis hoe ek dan wil klas gee, want dit werk vir my. So.

Interviewer 1: En dan mevrou se rol in die klas, soos vir die klas aktiwiteit as hulle nou kontaksessies het?

Petra: Kyk, dan het ek nou maar basies dit net aan die begin lei ek dit nou eers dat ek nou vra wat hulle het en ek het ook ‘n assisstent gehad in die klas so kom ons sê nou maar die laaste 40 minute minstens seker van die uur of wat, doen hulle nou die taak, die groepstaak, en dan loop ek maar tussen hulle rond ek meen ek help, ek is heeltyd daar bekikbaar vir as hulle vir my vra vrae. Want hulle sit in groepies van 4 of 5 en hulle werk saam en ek meen ek loop maar en kyk en vra.

Interviewer 1: Okay. Hoe het mevrou geweet of, of wanneer, die student geleer het wat mevrou wou gehad het hulle moet leer?

Petra: Goed. Ek het dit glad nie in die klas of so dink ek geweet nie. Ek het dit met die toetse sou ek dit agtergekom het, dink ek. Maar ek moet sê ek het veral in die eksamen dink ek agtergekom, na hulle eksamen geskryf het. Omdat hulle, kyk onthou hulle het nou nie 90% nie, maar ek meen om te kon slag het ek rêrig gedog weet hierdie ouens het geleer wat ek wou gehad het hulle moes leer in die klas. So, ek dink ek sou eers, want ek het niks anders in die klas gedoen nie. Want ek het nooit na daai groepstake gekyk nie, ons het dit mos, hulle het dit gedoen en ek het weer dit gemerk. ‘n Effense ietsie wat mens wat ek dalk sou agterkom, as ek nou met hulle deurloop die tipe vra wat hulle vir my vrae dan weet ek: hierdie ou het daai gekliek, maar hierdie nie. Jy weet, dis hoe, daai deurgans help. Maar ek sou nie toe dink, oh die ou het dit geleer of iets nie.

Interviewer 1: En dit is wat help met aktiewe leer as mens vir hulle die aktiwiteite gee in die klas dat die dosent nou juis daar is om hulle te kan ondersteun en te kan help wat hulle nou moeilike goed by die huis op hulle eie sou moes doen nê wat een van die flipped classroom, wat dit so voordeel van maak is dat hulle heeltyd iemand het wat heeltyd onmiddelik vir hulle kan terugvoer gee en nou vir hulle kan lei in wat hulle moet kry. Hulle is nogsteeds nie daar om die antwoorde te kry nie, maar net om vir hulle beter te lei. *Scaffolding* soos wat ons nou sê. En mevrou het gevind dat dit wel so was, dat dit het goed so gewerk?

Petra: Nee, absoluut. Ek dink die studente voel goed jy weet of dit was my ervaring. Hulle voel goed as hulle uit die klas uitgaan en presies soos daai huiswerk van vandag se goed is nou eintlik gedoen weet. Hulle huiswerk is mos nou moet hulle weer basies nuwe goed gaan kyk. Ek wil amper partykeer dink dis ‘n tipe van ‘n druk ook op hulle as hulle nou by die huis sit nou kan hulle nie die somme doen wat hulle vandag in die klas nog effens verstaan het, maar nou kon hulle dit nie doen nie, maar môre in die klas gaan die juffrou dit net merk en dan gaan sy alweer aan met nuwe goed, waar nou is die druk is vir my dalk moontlik van hulle af, want dit wat hulle nou by die huis gaan kyk, dis nuwe goed. Ek dink dis nie soveel druk nie. Dis nie dat hulle dit môre moet kom weergee nie. Hulle kan eintlik nou agterkom, maar as ek dit nie verstaan nie kan ek môre vra jy weet. Dis so half die tyd ding is so bietjie weet in ‘n ander volgorde.

Interviewer 1: En mevrou, die aktiwiteite wat hulle in die klas nou gedoen het, dis maar tipe aktiwiteite wat hulle in die verlede by die huis sou gedoen het nê?

Petra: Absoluut.

Interviewer 1: En die tipe vrae wat in toetse en eksamens is en so?

Petra: Ja.

Interviewer 1: Okay. En

Petra: En baie lekker *real life* goed, want hierdie module laat hom weet leen hom verskriklik daartoe.

Interviewer 1: Ja. En so wat, in mevrou se opinie, was die studente se houding teenoor hierdie benadering?

Petra: Ek het rêrig waar baie baie positiewe houding gekry by hulle.

Interviewer 1: Is dit?

Petra: Baie, ja. So ek sien eintlik uit dat ‘n mens kan half ‘n vraelys vir hulle vra, wat hulle daarvan gedink het, want ek het dit toe nou nooit gedoen nie. Maar die waarmee ek te doen gekry het en weet, hulle is baie oop ook in die klas en ek meen ek vra vir hulle van tyd tot tyd in die klas, ek het veral in die begin het ek vir hulle gevra ook. Elke week dan sê ek: onthou nou hierdie is ‘n heel nuwe benadering, sê vir my, julle moet vir my sê moet ons so aangaan of moet ons op die ou manier gaan en dan het hulle vir my gesê, die klas oorwegend, daar gaan een of vyf wees wat gesê het nee, maar ek meen oorwegend het hulle gesê nee ons moet so aangaan. So ek meen ek het hulle pertinent gevra.

Interviewer 1: Was daar een of twee klagtes oor iets spesifiek, of nie rêrig wat mevrou nou kan onthou nie?

Petra: Weet jy wat, ek het, ek gaan nie nou kan onthou nie, maar ek het want by op kampus het hulle mos daai evaluering vorms onthou ek nou en hulle het dit vir my gestuur dit is in my kantoor. Ek het tog gelees, maar daar was ook baie, alles was feitlik positief, ek moet bietjie weer gaan kyk wat het hulle gesê. Ek het dit nou verlede jaar gekry, maar daar sou wees jis ek onthou toe ek iets gelees het, maar ek kan glad nie onthou wat dit was nie. Ek sal bietjie lees voor hierdie jaar dat ek weet.

Interviewer 1: En dan, kan mevrou ook nou enige iets dalk wat na mevrou toe terugkom waar hulle wel hulle metakognisie moes gebruik het. Het mevrou êrens iets opgetel wat ‘n student ja, hulle metakognisie moes inspan. Of dan nou ook, watter dele van die flipped classroom kan dit moonlik bevorder?

Petra: Uhm, wel verseker as hulle nou nie vooraf verstaan het nie, sê nou maar kom ons sê dis ‘n bietjie van ‘n moeliker konsep en hulle het dit nie lekker verstaan op die video of iets nie, ek dink die feit om te kan weet ‘ek het hierdie nie verstaan nie, ek moet môre kan, ek moet nou mooi kyk wat ek moet vra’. Dis vir my metakognisie.

Interviewer 1: En hulle het dit gedoen?

Petra: Ja, jy weet, so ek dink daai dit kan vir hulle amper met die leer in die klas en die engagement in die klas kan dit vir hulle mee help dink ek wat metakognisie is. Ek dink as hulle bietjie verander. Die hele feit om dalk te verander het van tradisioneel en hulle hele houding om in te gekoop het in hierdie ding, is ook ‘n metakognitiewe *skill* wat hulle dink ek, want ek meen veral as hulle agtergekom het dit werk vir hulle of iets anders en hierdie werk beter en hulle het nou verander en nou gaan ek dit so probeer doen. Sou ek dalk dink.

Interviewer 1: En hoe sal mevrou dink, waar, watter aspekte van die flipped classroom kan mens dalk, ja kan dit bevorder, watter dele in die klas kan mens miskien implementeer of inwerk om metakonisie te bevorder en dalk selfs, ek probeer nou dink as mens op efundi ‘n quiz sit na die tyd om te kyk of hulle dit gedoen het byvoorbeeld daar kan mens ‘n leidende vraag vra om metakognisie uit te lok dalk?

Petra: Jy bedoel na die klas?

Interviewer 1: Ja, na die video.

Petra: Na die video, voordat hulle klas toe kom?

Interviewer 1: In ‘n *quiz* kan mens dalk iets inbring. Ek weet nie wat mevrou dink daarvan. Of hoe in die klas kan mens dalk nog verder hulle kry om te dink oor wat hulle besig is om te leer.

Petra: Ja, mens kan bietjie dink wat mens kan ekstra doen, maar soos ek sê ek wil net, wat okal ek doen wil ek hê moet ek môre weer kan doen en volgende jaar weer kan doen weet, as dit werk. Anders sal mens maar soos mens gaan maar kyk. Ek sal bietjie dink in hierdie jaar wat kan mens doen.

Interviewer 1: Want hierdie vraag sluit nou eintlik daarby aan, maar in die klas het mevrou gevind dat in vergelyking met die tradisionele benadering dat mens meer toegang het tot wat studente dink?

Petra: Moontlik omdat jy weet, ek het kom ek sê traditioneel in ‘n wiskunde klas as ek nou dink ek waar ek skool gehou het en as ek nou hier is. Eintlik teach ek die hele tyd want daar is so baie om vir hulle te, oor te gee of deur te gee en omdat as ek nou dink aan my ander klasse, my ander studente en so, dit voel vir my altyd waar hulle is, het hulle nie mense om hulle met die wiskunde te help nie, so ek wil vir hulle die wiskunde verduidelik nê. So, jy het min kans om agter te kom hoe leer hulle en wat het hulle geleer en wat dink hulle. Waar met

hierdie was nou vir my ‘n totaal ander ding van die afstandsonderrig omdat ek nou vir hulle baie gesien het. Ek meen ek sien hulle elke week vir ‘n uur en ‘n kwart of iets. En die feit dat mens nou in die klas, dat hulle sit en werk en ek deur hulle kon stap en alles, ek dink tog daar kan ek op ‘n manier agter kom wat hulle leer en hoe hulle leer en steeds daar is een of so in ‘n groep wat ek weet: daai ou is glad nie by nie, sit miskien sommer iets anders en doen jy weet of wat okal. Maar, nee ek dink dis maar die enigste manier.

Interviewer 1: So, daar is defnitief daai ruimte in die klas om toegang te kry tot wat hulle dink?

Petra: Ek glo so ja. As n mens spesifiek jy weet dink of ek kan dit doen en ek meen jy gaan nie elke keer by alle groepe nie, maar ek meen by ‘n groep of 2 weet om spesifiek bietjie te kyk wat gesels ‘n ou daar. Dis amper dat een van die studente hierdie wanneer ons nou die groepstaak merk, dat ‘n groep blykbaar ag byvoorbeeld vir ons kom verduidelik jy weet. Ek dink dit kan ook as jy dan op ‘n student of twee sit dat hulle kan sien.

Interviewer 1: En dan, het mevrou gevind dat die studente wel self-gereguleerd was en kan mevrou dalk voorbeelde gee?

Petra: Ek, weet jy hoekom dink ek, ek kan nou maklik sê ja nê ‘n rede hoekom ek nogal sal sê is as ‘n student veronderstel is om hierdie 4 of 5 *links* wat ek daar op gesit het deur te gaan, voor klas en dan kom ‘n student by my in die klas eintlik opgewonde en sê jinne ek het nog hierdie oulike goed gekry mevrou, van die goeters dan voel ek daai ou het nogal self-gereguleerd gewerk. Ek meen hy het bietjie *beyond* gegaan, hy het bietjie iets ekstra gedoen dit sê vir my, maar niemand gaan vir hom bevoor of benadeel as hy dit doen nie. So iets is vir my nogal bewys van dat ouens gaan. Ander manier ek weet nie vir my voel praat, van studente wat met my praat, oor die werk of jy weet wat in my kantoor in *hop* en iets kom vra, dis vir my ook ‘n bewys van hierdie rêrig, hy het in ‘n mate metakognitiewe *skills* of self-gereguleerdheid dat hy vir my kom dinge vra jy weet. Ek meen hy weet: jinne hierdie kry ek nou nie lekker by nie, ek is nie lekker by nie dit kos my een trippie na die vrou se kantoor toe en ek vra vir haar jy weet. So, ek weet nie dis maar wat ek sien wat ek sou dink. Daai ou lyk vir my of hy self-gereguleerd is.

Interviewer 1: En van die 62 studente as mevrou nou moet sê, was dit meeste van die studente wat darem sulke gedrag getoon het meeste van die tyd?

Petra: Ja, nou nie almal, wel daar was baie altyd by my in die kantoor, maar nie almal sal goed bring nie. Die positiwiteit of watokal wat ek in die klas gevoel het moet ek sê was by meeste, rêrig waar. Ja, dit het vir my so gevoel.

Interviewer 1: So, hulle het ook hulle verantwoordelikheid aanvaar as self-gereguleerde leerders?

Petra: Ek dink so. Ja, miskien was dit net vir hulle nie so abstrakte wiskunde module nie, jy weet, meen daai *link* so lekker met *real life*. Hoewel hulle sukkel, hulle weet nie altyd die verskil tussen ‘n volume en ‘n oppervlake nie of so, maar ten mniste dink ek as hulle ietsie verstaan kan dit vir hulle sin maak. Ons in nie met sinx of x tot die mag dit of jy weet daai wat hulle lekker nie verstaan nie, want daai is vir hulle abstrak. Want ek moet sê, die eerste semester module wat hulle doen, hierdie selfde klas wat ek dan nou oorvat, is baie abstrak eintlik weer en dis vir hulle ‘n moeiliker module dink ek jy weet en ek weet nie of mens so tipe of sulke tipe inhoud baie suksesvol met ‘n flip sal doen nie, maar ek het al gedink ek sal dit graag probeer as ek so tipe module doen.

Interviewer 1: Kan mevrou dink aan nog voordele wat ons nog nie aangeraak het nie van die flipped classroom dalk?

Petra: Weet jy ‘n ander voordeel is verseker soos ek sê, ek het nou vir hulle in die klas die toetsie, nie toetsie nie die take, saam laat doen en dit was hulle bywonings ding gewees maar as ‘n ou nou nie in die klas kan wees nie, dink ek dis een van die groot voordele van ‘n flipped classroom weet. Okay, hier by my het hulle nou ‘n punt verloor jy weet, omdat hulle nou nie klas bygewoon gehad het nie, maar ek meen dit gaan nou nie op die ou end so vreeslik daaroor nie, dit gaan oor jy kan nog steeds daai werk gaan kry, waar anders as jy nie in daai klas was nie en dis nêrens waar jy dit kan kry nie dan moet jy jou eie goed gaan soek maar nou kry jy basies presies wat die ander ouens in die klas gehad het. Jy weet so dis vir my ‘n groot voordeel.

Interviewer 1: Dis defnitief ‘n groot voordeel.

Petra: En ook die ding van, ek weet nie, ek glo maar as jy nie vandag so lekker is nie of daar het iets in jou lewe gebeur en jy is nie lekker by nie, al sit jy in die klas is jy eintlik nie daar nie en nou kan jy dit gaan doen of jy dit gaan doen of nie gaan doen hang nou van jou af maar jy kan, jy weet, dit is daar. En dis dieselfde goed wat daai ouens geleer het. En ek dink ook, ek weet nie, ek het jare terug toe hulle so met die groepwerk ingekom het, was ek nie baie *keen* op die groepwerk in wiskunde nie, maar seker modules leen hulle daartoe en hierdie flipped classroom ek dink tog jy weet hulle baat deur in die groep te sit en veral nou het hulle die geleentheid. Jy doen eintlik saam huiswerk, dis wat jy doen. En ek dink dit help die swakker ouens verseker, maar dit help die sterker ouens ook, want as hulle die leiding vat en nou kry

hulle die geleentheid om vir hierdie ouens te verduidelik jy weet. Ek weet nie, ek dink sulke goeters is verseker voordele.

Interviewer 1: Defnitief.

Petra: En dis daar of dit altyd gebeur, is dalk nou nie, dit gebeur dalk nou nie by elke tafel en elke keer nie, maar dit, die omgewing is reg daarvoor.

Interviewer 1: Interviewer 2, het dr enige vrae?

Interviewer 2: Ek het eintlik ‘n opmerking, ek het besef, want ek ken haar en haar entoesiasme en die flipped classroom gaan baie afhang van die dosent se ingesteldheid. En ek dink as ‘n dosent so entoesiasties is gaan jy defnitief dalk ander resultate kry as met ‘n dosent wat half verplig word om dit te doen. Of wat nie oop is vir nuwe maniere nie of wat net wil jy weet dit moet nou gebeur. Ek dink in elk geval dit gaan, die navorsing gaan baie beteken vir die afstand, want dit gaan die afstand en op kampus op dieselfde vlak kan sit. Kyk, jy gaan nie voel jy skeep die afstand af nie, want hulle het dieslfde geleentheid, hulle moet net nog meer self-gereguleerd werk. Ek het net gewonder as, ons het nou gevra, dink jy daar is ‘n ander manier wat mens kan kry om hulle byvoorbeeld meer sê nou maar soos sosiale media, whats app groepies sê nou maar een kry ‘n *link* en hy wil dit *share* op daai whatsapp, dink jy dit sal hulle help om bietjie meer...?

Petra: Ek dink dit sou ja. Nou ek het nogal gehoor, by uh op efundi kan ‘n mens amper soos jy nou noem ‘n *chat* groep of ‘n ding hê. Nou onthou ek is nou nog nie gevorderd tot daar nie en uh ek het ook gedink dat toe iemand nou dit sê toe dink ek, maar ek wil nie daar gaan nie, want ek kan nog nie daai goed ook run nie, en ek meen ek kan dit nou met hierdie klas probeer, maar ek gaan dit nie volgende jar met meer klasse of so kan doen nie.

Interviewer 1: Dit moet volhoubaar wees.

Petra: Daars hy. Toe is die ding spesifiek, toe sê hulle dis juis die ding, jy hoef eintlik nie daarby betrokke te wees nie, hulle het hierdie *chat* groepe en so hulle kan mekaar dan eintlik nog uit die klasse jy weet, mekaar ook help. So ek weet nie, ek gaan dit verseker ondersoek, jy weet maar soos ek sê as dit vir my en dit gaan nie oor tyd nie, maar dit gaan eintlik in effek oor tyd jy weet, as ek moet die verantwoordelikheid vat van daai ding en nou moet ek dit vir hulle run en wat okal, dit gaan ek nie doen nie. As ek, as dit kan so geskep word en ek sal met die mense by efundi of wat okal praat. As dit so geskep kan word dat hulle amper in een groot groep of die engelse outjies saam en die afrikaanse outjie saam of hoe okal hulle sou

wou. Maar ek meen as dit 60 is, 60 kan maar saam wees dan leer almal van almal daar, jy weet. En dan kan dit net nog n verdere pluspunt wees.

Interviewer 2: Ek het nou gewonder sê nou maar daar is die wat nou nie belangstel nie, wat nou miskien minder weet leiding neem of minder deelneem. Sou mens as mens nou wil ‘n klein groupie hê en jy sê maar met ‘n assisstent en jy vra vir ‘n assisstent om nou daai goed bietjie te bestuur en dit elke week moet iemand anders byvoorbeeld terugvoer gee op wat op die groep gebeur het. Dat hulle moet roteer, hulle moet ander woorde betrokke bly. Ek dink aan maniere om hulle bietjie meer weet *continuously* ondersteuning.

Petra: Ons kan bietjie dink. Daai gaan ek natuurlik nou nie by afstand kan doen nie jy weet.

Interviewer 2: Dink jy so?

Petra: Nee, kyk ek gaan byvoorbeed met hierdie selfde klas wat ek elf klasse van ‘n uur en ‘n kwart het, het ek twee 45min klasse by afstand so ek moet. So die terugvoer, die whatsapp groepe sal dalk werk en hulle met mekaar, maar ek meen niemand kan terugkom nie. Maar dat hulle dan almal saam net soos op efundi en ek het dit mos nou verlede jaar mos gewerk daar is ‘n afstand groep, ek het een vak maar ‘n afstand groep op efundi en ‘n kontak groep en weet hulle sien nie mekaar se goed nie maar uh nou gaan die videos goed wat ek wil doen, die videos wat gaan opwees is op die groot *site*, sê dan nou maar vir almal, maar uh dan kan mens die groepies. Maar eintlik dalk kan, hoekom is hulle nie almal een groep dan nie? Die afstand ouens kan mos in die ander groep wees, mens kan dit ook eintlik ondersoek, dat almal saam in een groep is. Maar dit kan dalk baie groot raak, ek weet nie, kom ons sê nou net daar is 100 altesaam, 100 is te veel dink ek want ek meen daai ding gaan so besig wees. Maar ek weet nie.

Interviewer 2: Ek wonder, ek het nou miskien so uh amper in effek soos *buddies* dat jy selfs op en afstand groepeer en dat hulle amper almal NWU studente almal saam leer, of dit ‘n manier is of nie.

Petra: En dink jy dalk dan 100 kan mens sê, maar kyk ek kan nie voorsien dat daar in my klas meer as 100 gaan wees nie.

Interviewer 2: Dan doen jy 10 in ‘n groep? Want om 100 mense se posting te lees.

Petra: Dis te veel.

Interviewer 2: As jy 10 mense in ‘n groep het en jou assisstent dit vir jou kan *manage* en daai person kan daai mense nogal uitbring. En help groepe stig.

Petra: Ek sal dit bietjie ondersoek. Maar dit is vir my nogal waar ek nou is en verlede jaar dit was nie vir my uhm ‘n hoof fokus nie.

Interviewer 2: Ja, ek dink nou maar sommer aan moontlikhede en goed wat mens nou aan kan dink ek het gewonder hoe dink jy sou ‘n mens in die flipped classroom meer metakognisie kan assesseer maw kan hulle bietjie dink oor hulle eie leer, kan hulle weet, kan hulle dink oor hoe hulle die beste leer, wat het die beste gewerk, kan die flipped classroom iewers metakognisie assesseer?

Petra: Ja, kyk vir ‘n, ek weet nie. Daar is seker een of ander vraelys wat ‘n mens vir hulle kan gee om te meet van die begin na die einde, maar uh en jy kan ook seker as jy dit spesfiek wil weet, wil meet wil ek amper sê kan jy dalk maar aan die einde van ‘n klas maar altyd of aan die eide van elke 2de klas of iets bv ‘n tipe van ‘n vraelysie gee.

Interviewer 1: Refelksie vorm.

Petra: So ietsie. Dat hulle net vir jou bietjie refelekteer, want dit is vir my nie, dit het nie met die klas te doen nie, die effek van die flipped classroom te doen, maar dis.

Interviewer 2: Maar ook hulle dink oor hoe hulle wiskunde die beste leer. Hoe, jy weet watter strategie moet ek toepas om dit beter te verstaan. Moet mens miskien, ek het gewonder moet mens dalk voor die tyd dit met hulle kon bespreek: ons in hierdie journey wat ons het gaan ons ons eie leer ook bietjie ondersoek. Hoe verstaan ons wiskunde, want dan sal dit die kinders ook beter kan help om hulle eie leer te verstaan so miskien.

Petra: Ons kan bietjie daaraan dink. Ek sal tog net weer gaan kyk soos ek sê daai evaluasie vorms van laas jaar sal ek net kyk wat het hulle daar geskryf. Ek kan nou rêrig nie nie meer onthou nie, maar ek weet dit was interresant. Ek meen, ek is oop daarvoor. Dan as mens bv einde van elke klas of elke 2de klas of so vir hulle uhm ‘n vormpie uitgee of miskien ook op ‘n plek op efundi waar hulle kan jy weet dat mens daar amper ‘n onderdoek doen en vra hulle moet.

Interviewer 2: Jy gee nou die lesing en jy gee *links* ook nog.

Petra: Ja, ek gaan basies maar wat ek gehad het jy weet, sit ek maar weer daarop.

Interviewer 2: As mens miskien sou kon sê okay goed hier is verskillende tipe maniere en hulle moet dit gaan kyk dan kan hulle terugkom en sê: watter manier het julle die beste verstaan? Watter verduideliking of benadering, wat het die beste vir julle gewwerk?

Petra: Dit is miskien ‘n baie goeie idee, want omdat ek dan nou oor elke konsep basies ‘n klassie het jy weet, my klas oor gaan gee en hierdie ander goed wat hulle kyk is ook maar klasse of jy weet inligting dat hulle sê ja wat dink hulle.

Interviewer 2: En dan forseer dit hulle ook verder om te gaan kyk, want hulle moet dit beoordeel. En daaroor gaan dink.

Petra: Ja, dis miskien dat hulle spesifiek sê en dan kan ‘n mens gaan. Dan moet ‘n mens amper vir elke klas, ek wonder nou skielik of ‘n mens dit nie in die begin van die klas dan kan gee nie weet want hulle moet aan die begin die ding beoordeel, want dan sê ek vir hulle. Want soos ek sê ek glo absoluut hulle moet weet wat ek doen en hoekom dit of so doen so as ek vir hulle sê ook weer en ek meen ek sal hulle rêrig sê as jy nou die keer nie voorberei het nie jy gaan elke keer in die klas gaan jy vir my ‘n vormpie moet invul van hoe jy dit gevind het die goed en dan sit ek daar bv ‘n vraag of ding by maar net soos wat ek vir hulle gesê het moenie as jou maatjie vandag nie hier is sy naam op die lys skryf nie. As hy rêrig nie hier kon wees nie, sê vir my want ek wil nie vir jou uitvang op dit nie jy weet dit gaan oor eerlikheid ook. So ek is mos maar eintlik jy weet dit moet oor die algemeen gaan. Want ek sê vir hulle jy wil nie hê ‘n kind in jou klas moet eendag vir jou lieg nie jy weet. So as n mens in hierdie dingetjie skryf, ek sê vir hulle ook weet as jy nou glad nie hierdie keer iets gaan kyk het nie, of dalk gaan kyk jy nooit nie, moet dan net die die ding invul nie, moet dan nie vir my nonsense skryf nie jy weet jy moet as jy daar skryf en jy beoordeel daai paar goedjies, dan wil ek weet dit is hoe jy dit ervaar het. So ek kan dit vir hulle ook, want ek *trust* nogal op dit jy weet as ek vir hulle vra.

Interviewer 2: Dit kom eintlik alles neer op *self-directedness, self-directed learning* speel ‘n verskriklike groot rol. En ek dink die dosent se motivering om *self-directed* te wees en die, jy half sê, ek vertrou jou om self-gereguleerd en self-gerig te wees en omdat hulle jou nie wil teleurstel nie gaan hulle dit doen so dis goed.

Petra: My ervaring verlede jaar was rêrig so. Ek dink nie hulle het vir my gejok nie, daar was dalk een of twee of vyf soos ek sê daar was enetjie een keer sy’t gesit en met haar rekenaar ander goed gedoen dit was ‘n taak wat sy moes doen. Dan het dit gebeur, ek het dit ook al gedoen jy weet so.

Interviewer 1: Ek het ook nou sommer ‘n gedagte gehad wat mevrou nou sê die idee vir voor die klas. Ek dink ook as mens net na ‘n video as jy vir hulle vra uhm het jy iets uit die video uit geleer dan kan hulle net sê ja of nee en dan net hoekom vrae te vra. Het jy van die video gehou. Nee, hoekom nie? Ook om so, dit sal ook goeie metakognisie net half uitlok dat hulle

begin kan agterkom maar hoekom het ek hiervan gehou of hoekom nie. Ek dink dit is baie interessant.

Interviewer 2: Die oomblik wat jy daai ahha oomblik gehad het, in hierdie video, watse oomblik het jou laat snap en hoekom dink jy het jy dit op daai oomblik gesnap? Maar dan gaan dit sommer uiteindelik na hulle onderigstrategieë toe ook deursyfer eendag as hulle vir ‘n kind moet dit verduidelik.

Interviewer 1: Presies. Dis goeie refleksie vermöe da nook hopelik dat hulle in dei toekoms beter in staat sal wees om goeie inhoud van slegte inhoud sal kan onerskei wanneer hule eendag onderwysers is.

Interviewer 2: En die strategieë wat jy moet volg om iemand te laat snap, soos sy nou gesê het in wiskunde is maar ‘n snap en as jy nie weet, jy weet by daai ahha oomblik uitkom nie, dan leer jy die reëls dan verloor jy die kinders as hulle net later reëls leer. So, as mens daai ding kan kry. En ek het gewonder as jy nou bv vra aan die begin en hulle vrae vra sal jy vir die ander studente vra is daar iemand wat dit wil antwoord, dat jy dit nie self antwoord nie?

Petra: Ja, dit sal ‘n goeie plan wees. Ek het dit nooit gedoen nie, maar ek sou dit kon doen.

Interviewer 1: En as iemand dan in die klas nou vir mevrou ‘n vraag vra wat mevrou voor mevrou se siel weet was in daai video, hierdie persoon het die tien teen een nie gekyk nie, gaan mevrou die vraag ignoreer?

Petra: Nee. Ek sal nooit dit ignoreer nie.

Interviewer 1: Is dit?

Petra: Ek verduidelik dit maar.

Interviewer 2: Jy moet net sê: Soos in daai video was. Sê vir hulle dit was daar.

Petra: Ja, miskien as ek nou goeters doen wat ek self die klas gaan gee het wat ek weet jy weet dan sal ek sê ek het dit mos daar gedoen, maar dit is so.

Interviewer 2: *Sorry*, kan ek jou nog vra, taal, dink jy taal het ‘n invloed op sê maar die Afrikaanse studente en die *links* is nou half Engels. Dink jy dit het ‘n invloed op hulle verstaan?

Petra: Ek glo so, dit kan verseker hê. Dis hoekom hulle sal dalk nogal vra in die klas, maar in die klas het ek mos nou in Afrikaans. Uhm ja, ek sou dink dit moet ‘n probleem wees, want veral met sekere wiskunde goeters wat kyk, daai terme, hulle ken nie die Engelse goed

noodwendig nie, maar dit is maar waar hulle dan moet optel ons kan nie, wel ek is seker dit sal ‘n invloed hê.

Interviewer 1: Nog enige vrae Dr (Interviewer 2)? Mevrou (Petra) enige laaste aanmerkings?

Petra: Ek moet sê dit was vir my julle wat my nou geken het verlede jaar, dit was vir my die hoogte punt van die week. Dit was baie lekker om daai klas aantebied, rêrig waar weet. Ek het dit baie geniet en net rêrig vir my die *cherry* op die koek op die einde toe almal deurkom. Afstand hoewel het nie almal deurgekom nie, daar was so ek dink 17 of ietsie ek dit toe geskryf en ek dink 14 het deurgekom. So, hulle 2de geleentheid kom mos nou eers nou. So, ek hoop dat hulle nou gaan deurkom. Maar die afstand, ek dink eintlik die idee kan vir hulle baie help weet. Want hulle was nooit een keer, verlede jaar het ek hulle 5 keer gesien. Daar was nie een keer van die 5 keer iemand in die klas terwyl ek dit gegee het nie. Niemand. Maar hulle was redelike goeie studente, take was goed soos ek sê 14 van die 17 het deurgekom.

Interviewer 2: Hulle kan nou natuurlik die videos gaan kyk op die internet so hulle hoef nie eers in die klas te wees nie hulle kan dit *live stream* ook as hulle wil. So, dis nie te sê hulle, maar dink jy nie tog die oogkontak en die wees in die klas in die flipped classroom proses maak ook ‘n verskil nie?

Petra: Verseker, maar hierdie ouens is nou afstand en nou gaan hulle net baie meer dieselfde kry wat die op-kampus kry, of hulle kan met die flipped classroom meer dieselfde kry waar ek hulle verlede jaar glad nie ‘n flipped gedoen het nie, maar ek wil hulle hierdie jaar ook nou so doen jy weet. Nee, want hulle ja, want selfs die take en als jy weet wil ek nou vir hulle ook opsit. So inelkgeval, dis dit.

Interviewer 1: Okay, dis goed. Dankie.

Petra: Dis ‘n plesier.

Micro-cycle 3

Focus-group interview 1

Interviewer: Okay. Eerstens, kom ons begin sommer by Vera hierdie kant. Vera, hoe oud is jy?

Vera: Ek is nou 19.

Interviewer: Okay 19, so jy is eerste jaar akademies en in ouderdom dan. Huistaal Afrikaans?

Vera: Ja.

Interviewer: Kan jy nog tale praat?

Vera: Engels.

Interviewer: Verstaan jy dit goed en jy praat dit goed?

Vera: Ja.

Interviewer: Okay waar was jy op skool?

Vera: Hoërskool Linden in Johannesburg.

Interviewer: Okay, dis ‘n Afrikaanse skool so jy het sover nog net in Afrikaans geleer?

Vera: Yes, net Afrikaans.

Interviewer: Goeie toegang tot tegnologie op skool?

Vera: Ja.

Interviewer: So jy het baie met rekenaars gewerk, jy sal sê jy is rekenaarvaardig?

Vera: Ja.

Interviewer: En jy het toegang gehad?

Vera: Ja, en ek het CAT ook gehad op skool so dit het my baie gehelp.

Interviewer: En dit was die volgende vraag so jy is rekenaarvaardig. Het jy behalwe CAT nog iets bygehad, rekenaar iets?

Vera: Nee, nie rêrig nie. Ons is net nou besig met IGO doen ons ook op rekenaars ons tekeninge so dis dalk iets wat ek nou by het.

Interviewer: Okay, het iemand jou geleer om bietjie met Efundi te werk toe jy op kampus gekom het?

Vera: Nee.

Interviewer: Okay so was daar geleentheid jy het net nie gegaan nie?

Vera: Ek dink daar was geleentheid?

[Res van die groep sê nee, nie waarvan hulle weet nie]

Interviewer: Okay dankie Vera. En Rachelle, ouderdom?

Rachelle: 19.

Interviewer: Okay, Huistaal Afrikaans?

Rachelle: Afrikaans.

Interviewer: Hoe is jou Engels?

Rachelle: Goed, ek dink.

Interviewer: Okay, waar was jy op skool?

Rachelle: Pretoria, Overkruin.

Interviewer: Okay, het jy toegang gehad tot tegnologie, baie daarmee gewerk?

Rachelle: Ja, ek het ook CAT gehad as ‘n vak op skool.

Interviewer: Okay, so jy is dieselfde as Vera. En het jy geleer om bietjie met Efundi te werk of het jy jouself geleer?

Rachelle: Ja, self.

Interviewer: Okay en het jy al voorheen bietjie te doen gehad met die flipped classroom?

Rachelle: Nee.

Interviewer: Askies, Vera ek het dit nie vir jou gevra nie, het jy?

Vera: Nee.

Interviewer: Okay. Elise, ouderdom?

Elise: Ek is 19 maar ek word 20 in Oktober, ek weet nie of dit saak maak nie.

Vera: Ja, ek word ook 20 ek weet nie of maak dit saak nie.

Interviewer: Okay, so het julle iets anders voor hierdie jaar gedoen?

Vera: Nee, ek is net ‘n jaar terug gehou.

Elise: Ja, ek ook.

Interviewer: Okay, want dit sou saak gemaak het. Ek sou wou geweet het wat het julle dan gedoen. Afrikaans?

Elise: Ja.

Interviewer: Engels?

Elise: Ja.

Interviewer: Nog iets?

Elise: Baie min woorde van Sepedi en Seswati, maar baie min.

Interviewer: Okay, Hoërskool?

Elise: Pietersburg Hoërskool.

Interviewer: Okay, goeie toegang tot tegnologie?

Elise: Ja.

Interviewer: Jy het nie CAT gehad nie?

Elise: Nee, ek het nie CAT gehad nie.

Interviewer: Okay, maar jy is rekenaarvaardig?

Elise: Ja.

Interviewer: Enige ander kursusse in rekenaars soos enige excel kursus of enige iets anders?

Elise: Nee.

Interviewer: Niks. Efundi, het jy geleer hoe om met dit te werk toe jy hier aangekom het?

Elise: Ja, en mense het gesê hulle het dit uitgefigure so ons het mekaar gehelp.

Interviewer: So julle het mekaar gehelp. En dan het jy enige ervaring met die flipped classroom gehad voor hierdie module?

Elise: Nee, ons ander ons Wiskunde dosent Mr X het so bietjie aan dit geraak wat ons bietjie gehelp het.

Interviewer: Bedoel jy hy het daaraan geraak soos vir julle vertel daarvan of wou hy dit inbring?

Elise: Nee, hy het dit bietjie ingebring en bietjie geïmplementeer ook.

Interviewer: Hoe het hy dit gedoen?

Vera: Ek dink ons het dit nou opgetel nadat jy dit nou begin bepreek het, weet ons okay.

Interviewer: So dis wat hy gedoen het. Okay, so hy het nie vir julle gesê dis wat ek gaan doen nie.

[Almal sê nee]

Interviewer: Dink jy, of enige een van julle, dit is nogal belangrik om voor die tyd te sê dis wat ek gaan doen, dis hoekom ek dit gaan doen, dis hoe dit gaan werk of dink julle dis okay soos Mr X dit gedoen het, hoef jy nie eintlik te weet nie. Wat sal jy sê Elise?

Elise: Ek sal sê in ‘n mate is dit, want ek het nogal aan die begin toe dink ek wat is hierdie ek weet nie wat moet ek nou doen nie en al sulke goed, maar later toe besef ek okay hy wil ons leer om self te sukkel en so aan en toe ons nou, toe ons nou uitgevind het dat dit is wat hy wou doen het ek gesien mens kan baie daarby baat.

Interviewer: Okay, daar is wel ‘n verskil tussen sukkel om te weet wat gaan aan en sukkel met die inhoud. Maar jy het jou kop geskud Nina, wat dink jy?

Nina: Ja, vir my was dit net, hy het soos vir my baie daaraan geraak dis soos om vir ‘n student te sê jy gee nou môre klas. So hy het nie eintlik gesê die res van die klas gaan berei ook voor nie. Hy is net van jy gaan nou klas gee. Waar party van ons het ons eie inisiatief gevat en gaan kyk het wat is in die inhoud, wat gaan hulle doen, waar kan ons haar bietjie help as sy sukkel en so aan.

Interviewer: Ek verstaan so jy moes daai eie inisiateif neem. So sien julle die flipped classroom as ‘n element daarvan is dat hy, dat daai person die klas moes gegee het en ‘n nuwe konsep gebring het?

[Stilte]

Interviewer: Verstaan julle my vraag, skies. So julle sê nou dat Mr X julle, hy het een “gepick” en gesê jy gee nou môre klas of so, dink julle dit is deel van die flipped classroom om student te kry om nuwe konsepte aan te bied?

Elise: Ja, ek dink so.

Nina: Vir my, dis nie so erg nuwe konsepte nie, want ons het in altwee die vakke wat ons nou het, in Wiskunde, doen ons dieselfde basies en dis ook wat jy gedoen het op skool. So dis nog nie dat ons nuwe konsepte leer nie so, ek dink nie vir my voel dit nog nie of ek die flipped classroom gevoel gehad het nie, want ek het nooit gegaan en goeters op my eie gaan uitsort nie, dis net van ah ek het dit gedoen op skool, so ek verstaan wat hier aangaan.

Interviewer: Okay.

Michelle: Ek moet nogal sê ek het nogal te doen gehad met die flipped classroom in my Biologie klas, maar ek het ook nie besef dis flipped classroom nie.

Interviewer: Op hoërskool?

Michelle: Nee, nou eerste semester en tweede semester in eerste jaar. Ek het nie besef dis flipped classroom totdat ek blootgestel is aan die definisie van wat dit is nie. Maar ek het nou weer gevoel dit was nie vir ons nodig om te weet dat dit eintlik ‘n flipped classroom is nie, want soos sy het vir ons gesê wat ons moet voorberei vir die volgende dag. En as jy dit nie gedoen het nie, het jy die volgende klas, ek sou nie sê, jy het nie gesukkel met die aktiwiteite nie, maar jy sou beter gevaar het en jy sou meer vra kon

vra as jy wel self voorberei het. So, as jy nie voorberei het nie, het jy maar ‘n agterstand gehad. Jy sou nogsteeds geweet het wat in die klas aangaan en met die aktiwiteite en so, maar jy sou stadiger gewees het as die ander student wat al klaar weet.

Interviewer: Okay, Michelle en sal jy, was jou voorbereiding, was dit ‘n video of was dit leeswerk?

Michelle: Dit was eintlik van altwee. Jy moes in die handbook die hoofstuk gaan deur lees en dit begryp en sy het ook soos youtube videos gepost en ander webtuistes gepost wat jy kon na gaan kyk het. Maar toe ons haar vra of sien sy dit as ‘n flipped clasasroom toe sê sy nee. So, ek weet nie.

Interviewer: Okay, ja want baie mense sien dit as dit moet net ‘n video wees en van tegnologie gebruik maak om ‘n nuwe konsep oor te dra. Okay maar ons het anyway by jou opgehou, want ons het met Elise klaar gemaak. So Michelle, hoe oud is jy?

Michelle: 19.

Interviewer: Taal?

Michelle: Afrikaans en Engels.

Interviewer: Sou jy sê dis goed. Jou verstaan van die altwee is goed?

Michelle: Ja.

Interviewer: Skool?

Michelle: Fichardpark Hoërskool, Bloemfontein.

Interviewer: Okay. Goeie toegang tot tegnologie?

Michelle: Ja, maar ek het nie CAT gehad nie.

Interviewer: Jy het nie CAT gehad nie so jy het begin deur te huiwer toe jy gesê het ja.

Michelle: Ek kom reg met tegnologie, maar dis nie my sterkpunt nie.

Interviewer: Okay.

Elise: Ek wil ook bysê, askies, toe ons besig was met ALDA en goed, moes Zara my baie help om soos die bronnelys in te sit en sulke goed, want ek het nou nie dit geweet wat hulle blykbaar in CAT geleer het. So ek moet dit nou aanleer.

Interviewer: Okay.

Vera: Ek het dit ge-youtube.

Michelle: Ek is goed met rekenaars ek weet waar om MS Word te kry en daai tipe dinge, maar as jy nou vir my ‘n nuwe program gaan gee dan gaan ek dit nie sommer regkry nie.

Interviewer: Okay, jy het nou gedeel van jou vorige ervaring van Biologie. En Efundi, het jy jouself ook maar geleer om met dit te werk?

Michelle: Ons dosente was nogal oulik. Hulle het vir ons op hulle efundi blad opgegaan en dan gesê hierdie is waar jy dit kry, hierdie is waar jy dit kry.

Interviewer: Dink jy die dosent moet dit doen? Spesifiek vir elke vak?

Michelle: Ek glo so. Ek sou sê, soos as die formate min of meer dieselfde is, is dit nie nodig nie, want jy kom nogal vining agter waar jou dosent waar hulle dit post sal ek sê. Maar dit help nogal veral as jy eerste jaar is en als is nuut en jy is maar bietjie “geshake” oor alles so dan help dit as elke dosent net sê maar hierdie goeters gaan ek daar sit hierdie goed gaan ek daar sit, want elke dosent dink anders so hy gaan dit onder ander opskrifte sit.

Interviewer: Okay. Nina, ouderdom?

Nina: 19.

Interviewer: Taal?

Nina: Afrikaans, Engels en klein bietjie Sotho.

Interviewer: Okay. Skool?

Nina: Hoërskool Fichardtpark in Bloemfontein.

Interviewer: So, wat was jou ervaring van die toegant tot internet of tegnologie daar?

Nina: Ek het kursusse gaan doen in EGDE waar ek verder gaan uitbrei het oor turbocat. Dis ‘n tekenprogram en ek het CAT gehad op skool en ek het verdere kursusse ook gaan doen saam met my ma as sy gegaan het.

Interviewer: So jy is rekenaarvaardig, jouself geleer met Efundi dan?

Nina: Ons het ‘n inligtingsessie gehad by die koshuis in RNO, maar toe verder het ek myself gehelp.

Interviewer: Okay. En die flipped classroom, jy was in Mr X se klas wat hy bietjie van dit ingebring het. Zara, hoe oud is jy.

Zara: 19.

Interviewer: Taal?

Zara: Afrikaans en Engels.

Interviewer: Okay, skool?

Zara: Hoërskool Dinamieka, Alberton.

Interviewer: Okay. Jou toegang tot tegnologie by jou skool? CAT? Internet?

Zara: Nee ek het nie CAT gehad nie. Ons het internet gehad.

Interviewer: Het jy baie daarop gewerk, het jy dit gebruik, die tegnologie wat daar was?

Zara: Nee, nie rêrig nie, want ek het die nie rêrig nodig gehad met my vakke nie.

Interviewer: Ek hoor jou. Of die onderwysers het die nie van jou verlang nie nê?

Zara: Ja.

Interviewer: Was jy in Mr X se klas?

Zara: Ja.

Interviewer: Okay, enige ander ervaring met die flipped classroom, was jy dalk in die biologie klas?

Zara: Nee.

Interviewer: Okay, enige verdere kursusse om met rekenaars te werk?

Zara: Nee.

Interviewer: Het jy jouself geleer om met Efundi te werk?

Zara: Nee, ons het mekaar maar by die koshuis gehelp.

Interviewer: Okay, Lisa?

Lisa: Ek is 18.

Interviewer: 18. Taal(e)?

Lisa: Afrikaans en Engels. Ek ken ‘n paar Duitse woorde.

Interviewer: Okay, mooi. Skool?

Lisa: Hoërskool Seunda, in Secunda.

Interviewer: Okay, en hoe was jou toegang daar tot tegnologie?

Lisa: Baie goed, ja hulle was nogal, ons skool was erg op tegnologie hulle het baie, al ons onderwysers het net van smartboards gebruik gemaak en so aan so ons het ook geleer hoe om met dit te werk.

Interviewer: Okay. So tegnologie sien jy nie net as ‘n rekenaar nie?

Lisa: Nee.

Interviewer: So, wat is nog vir jou tegnologie?

Lisa: “Basically” alles wat jy gebruik om jou...soos en uhm....soos tegnologie is ook soos ja alles link aan rekenaars maar dit is nie net rekenaars nie. Ek weet nie hoe om dit te beskryf nie.

Interviewer: Okay. Jou smartboard. Hi Anet.

Anet: Jammer ek is laat.

Interviewer: Dis reg.

Lisa: Ek het ook CAT gehad op skool.

Interviewer: Okay, so jy het ook CAT gehad op skool. En die flipped classroom?

Lisa: Ek was maar net in Mr X se klas. Op skool was die onderwysers nie baie groot daarop nie. Ons het net in Biologie altyd soos het die meneer vir ons gesê soos ons moet soos byvoorbeeld veral met evolusie, want hy hou nie van evolusie nie, want hy glo dit is klomp bol. So toe het hy dat ons by die huis deur dit te gaan lees en dan het ons soos die volgende dag ‘n klastoets geskryf. En dan verduidelik hy vir ons.

Interviewer: Okay. In beginsel sal dit klink soos ‘n flipped classroom maar ‘n flipped classroom is nie veronderstel om iemand uit hulle verantwoordelikheid uit te kry om te “teach” nie. Die idea van die flipped classroom is dat mens hoër kognitiewe vlakke kan bereik so mens is geneig om iemand leer net vir jou iets nuut en as ek genoeg oefen gaan ek goed doen, dan kom jy op universiteit dan kan jy nie daai kennis toepas of in die praktyk nie, en dit is wat die flipped classroom probeer doen. Dat jy daai hoër vlakke om vir jouself te dink, om krities te dink om “actually” dit te kan regkry. Want jy is in die klas, met onderstuening jy kan die vra moeiliker maak, jy kan bietjie toepassing vra, jy kan bietjie saamwerk. Okay, in elk geval. Anet, hoe oud is jy?

Anet: 22.

Interviewer: Wat het jy gedoen voordat, want jy is nou eerstejaar akademies so wat het jy gedoen voor dan?

Anet: Ek het laasjaar ‘n gap jaar gevat en die vorige twee jaar het ek geswot.

Interviewer: Okay, wat het jy in jou gap jaar gedoen?

Anet: Gewerk.

Interviewer: Okay, bietjie werkservaring. Tale? Afrikaans en Engels magtig?

Anet: Altwee.

Interviewer: Nog iets?

Anet: Nee, dis al.

Interviewer: Okay, waar was jy op skool?

Anet: Ferdies.

Interviewer: Tegnologie gebruik, het jy toegang gehad, het jy dit gebruik? Was daar verwag van jou om dit te gebruik?

Anet: Ons het basies soos die smartboard gehad. Ons was nie videos gegee om by die huis te gaan kyk nie en so. Ons was net, die onderwysers het die tegnologie gebruik, ons het nooit.

Interviewer: Het jy toegang gehad tot die lab?

Anet: Ja, as ons gaan vra ja.

Interviewer: Het jy dit gebruik?

Anet: Waar dit nodig was ja, nie rêrig nie, nie ekstra navorsing nie.

Interviewer: Okay. Het jy enige ekstra kursusse gedoen in rekenaars, excel?

Anet: Nee.

Interviewer: Okay.

Anet: O, nee ek het ITRB gehad in die een jaar.

Interviewer: Is dit ‘n universiteitsvak?

Anet: Ja.

Interviewer: Okay, het jy jouself geleer om met efundi te werk of het iemand jou gehelp, kursus by gewoon of so?

Anet: Iemand het my gehelp, maar meer my sussie.

Interviewer: Okay. En dan het jy vorige ervaring met die flipped classroom?

Anet: Nee, nie rêrig nie.

Interviewer: Is daar iemand wat al bietjie gaan lees het oor die flipped classroom?

[Almal sê nee]

Interviewer: Ek vra sommer. Okay kom ons begin weer hier by Vera, jou gevoel teenoor Wiskunde?

Vera: Ek het ‘n goeie gevoel teenoor Wiskunde.

Interviewer: Hou jy daarvan?

Vera: Ek het dit baie op skool geniet. Ek moet sê van Graad 8 en 9 het my onderwysers tot die eerste kwartaal klas gegee dan skyf hulle skole of dit was baie so gewees en dit het baie groot invloed op my gehad en my punte, maar dis nie asof ek opgegee het op dit nie. Eers in Graad 10 – 12 het ek beter gedoen in Winskunde en ek voel ook my opinie van Wiskunde is dat baie kinders het nie ‘n goeie ervaring daarvan gekry nie en nou sê hulle hulle hou nie daarvan nie. Dis dalk die onderwyser wat dit swak aangebied

het en nou hou hulle nie daaravan nie. So, dis my opinie daaroor so ek voel dat almal wiskunde kan doen.

Interviewer: Okay, is daar iemand wat daar wil bylas? Verskil?

Michelle: Ek hou van Wiskunde, maar ek hou nie van wiskunde nie. In die sin van ek hou meer van die werk wat ons nou doen soos die oppervlakte en areas en trigonomtrie en daai wat jy die hoeke moet kry, meetkunde. En daai goed, algebra het ek nogal ‘n negatiewe ervaring daarvan, maar ek dink dis as gevolg van onderwysers.

Interviewer: Okay, brei bietjie uit daarop.

Michelle: Ek het net nie baie goed gedoen nie en die onderwyser wou gehad het ek moes die vak gelos het maar ek wou nie.

Interviewer: Hoekom het jy nie goed gedoen nie?

Michelle: Ek weet nie, dis nie dat ek nie geleer het of nie opgelet in die klas nie. Ek het net nie goed gedoen nie. Graad 8 en 9 was ek baie goed in Wiskunde en toe kom Graad 10 en toe doen ek net nie goed nie ek weer rêrig nie. En toe Graad 11 ek het maar baie hard gewerk om terug te kom, maar ek het darem nie gedruip nie en ek is deur. So ja, vraestel twee het my altyd deurgebring.

Interviewer: Ek wil by julle hoor. So wat beteken die flipped classroom vir julle, ek wil dit by julle hoor. Dink nou bietjie aan julle ervaring by die dosent (lecturer participant), as jy dit moet opsom, as jy iets daaroor moet sê? Positief? Negatief? Goed? Sleg?

Vera: Okay, uhm ek voel soos nou eerste jaar was dit nogal ‘n goeie ervaring gewees, want ek voel hier is iets wat ons wil swot ons wil onderwys gee so nou doen jy daai ekstra moeite as sy vir jou sê gaan doen hierdie by jou huis, berei voor vir die klas so jy gaan doen daai moeite. Maar ek voel by die skool as jy nie van wiskunde hou nie, hoekom gaan jy dan by die huis voorberei en hulle wil nie eers huiswerk doen nie so hulle gaan nie vir die klas voorberei nie. Maar my opinie is dis iets goeds so as mens dit by skole kan implementeer.

Interviewer: Maar dit klink, of vir my, jy dink dat motivering ‘n probleem gaan wees dat dit dalk nie gaan werk by ‘n skool, want as hulle nie huiswerk doen nie.

Vera: Ja, want hulle hou nie van die vak nie.

Interviewer: Is daar dalk iemand wat dink dit kan werk by ‘n hoërskool?

Elise: Ek dink dit kan werk as die kinders besef dit kan hulle help. As hulle nie dink nee hierdie juffrou praat nou tjol hoekom moet ons dit nou gaan doen nie en al sulke goed. Want ek dink as iemand dit vir my gesê het op hoërskool dit gaan beter werk as ure en ure spandeer om vraestelle na vraestelle na vraestelle uit te werk en te oefen, want dis wat ek gedoen het. Ek het my gat af gewerk om net iewers te kom in wiskunde. Dan sou ek dit defnitief eerder gedoen het, maar soos met my eerste proef dan het ons nuwe goedjies geleer dan is ons opgewonde om nuwe goed te probeer en al sulke goed. Toe het ek by my ou skool gaan proef en toe wou ek die nuwe goed probeer het en toe het my ou Wiskunde-onderwyseres, sy is departementshoof , toe sê sy daar is nie ‘n manier dat ons dit gan doen nie, want dit werk nie. So ek dink die gevoel van die ouer onderwysers is ook, hulle wil nie dit doen nie en dit gaan moeilik wees om verby hulle te kom omdat hulle departementshoofde en sulke goed is.

Interviewer: Ja.

Vera: Skies, en alles is met tyd. Periodes is baie kort, jy kan nie dit doen nie, want daar is nie tyd om dit te doen nie, dis altyd ‘n rede.

Interviewer: Ja, tyd is ‘n probleem vir als. Maar hierdie is veronderstel om te help met die tyd ding.

Elise: Ja, want dis wat hulle vir ons gesê het, daar is nie tyd vir sulke goeters nie.

Interviewer: Daar is nie tyd om nuwe goed te probeer nie, jy hou by wat werk.

Rachelle: As die leerders wel gemotiveerd is om dit te doen sal dit dalk werk, maar soos om hulle eers te kry om self te gaan studeer oor hulle werk wat die volgende periode gaan behandel word dan kan dit dalk nog werk, maar anders is die periodes baie kort.

Michelle: Ek dink nogal dit sal werk as jy byvoorbeeld nou in Wiskunde nou spesifiek en jy gee vir die kinders die Wiskunde somme vir huiswerk, maar van die nuwe werk wat jy nog nie verduidelik het nie. Hulle gaan nie weet dis nuwe, tensy jy nou oorgaan van algebra na meetkunde, maar soos dat hulle eers self gaan sukkel en dan die fout maak en dan in die klas dan nou merk en dan gaan die kinders nou sê okay, maar hoekom doen juffrou dit nie so nie, want ek het dit so gedoen wat doen ek verkeerd hoe moet ek redeneer. Ek dink dit sal werk as jy dit so doen.

Interviewer: Doen mense dit nie in elk geval tot ‘n mate nou so nie? En is dit nie wat maak dat mense baie moed verloor nie? Nou sit hulle alleen by die huis, weet nie eintlik wat om te doen nie?

Michelle: Dit is dalk so, ja maar ek dink nogal. Maar as jy soos sy nou gesê het, as jy vir ‘n hoërskool kind gaan sê berei voor vir môre se klas, jy gaan nie dit doen nie, jy gaan sê jy het dit gedoen al het jy nie.

Interviewer: Ja, so jy bring ‘n baie interessante punt nou op. Daar is al eintlik 2, 3 goed. Jy sê die motivering. Dink julle nie die feit dat dit ‘n video is gaan bietjie motivering wees nie? Jy moet net ‘n video gaan kyk, 15 minute video dink julle nie. Jy skud jou kop?

Lisa: Nee, ek dink nie dit is so nie, want kinders gaan nog altyd ‘n verskoning hê van ek het nie data gehad nie, daar moet nogsteeds in ag geneem word dat almal nie in die bevoorregte posisie is om internet te hê of selfs ‘n selfoon of iets te hê nie. En hulle gaan dan outomaties benadeel word as jy vir hulle sê okay gaan kyk die video.

Interviewer: Jy kan dit nie implementeer as al jou student nie toegang het nie. Jy gaan ‘n ander plan moet maak.

Michelle: Ek dink ook byvoorbeeld kinders wat baie lief is vir sport en so as jy laat by die huis kom na sport dan doen jy gewoonlik net die huiswerk wat die belangrikste is eerste so as jy gaan kom by ‘n video wat jy moet kyk vir 15 minute of jy kan 15 minute langer slaap, gaan jy verseker gaan slaap en dan gaan jy by iemand anders vinnig hoor wat het hulle gesê in die video.

Interviewer: So, nou maak ons ‘n ander “can of worms” oop oor die issue van sport, okay, maar kom ons los dit nou maar eers daar, ek kan nogal afgaan op ‘n “tangent” as dit daarby kom. Ek gaan nou vir jou vra Nina, ek probeer nou dink die laaste sin wat jy nou, Michelle, gesê het toe ek sê dis ‘n interessante punt toe ons terugkom na Vera toe, toe jy gesê het. Hoe gaan mens seker maak of iemand iets gekyk het, mens moet iets in plek stel en sê hoe kan ek gaan kyk of my studente dit gedoen het. Nie om hulle te versplig om te sê ek wil sien hoe het jy dit gedoen of iets soos dit nie, maar hoe kan mens dalk op ‘n ligter manier, selfs as mens nou dink aan julle vak wat julle het. Dink julle dit sal help as daar ‘n vorm is, gou-gou op efundi, as jy nou klaar gekyk het, om te sê wat het jy gedink van die video, wat het jy gedink is goed van die video, wat het jy gedink is sleg. Net so vinnige refleksie, net so vinnige...ja...nee. Dink julle dit sal help? Wie dink dit sal help?

Michelle: Ek dink dit sal help, want dan kan die kinders dadelik soos sê ek verstaan nie die deel van die video nie of ek het die person hierso verloor dan kan jy ook in die klas al dadelik weet, okay maar die kind wat die verste agter is in die klas hak al daar vas so

ek kan hierdie vinnig verduidelik en dan van daar af kan ek werk dat jy dan optimale tyd gebruik.

Interviewer: Dankie Michelle. Jy wou iets gesê het Nina, jy het jou hand op gehad askies.

Nina: Dit is nou heeltemal op ‘n ander punt as die.

Interviewer: Gaan jy hom onthou?

Nina: Ja.

Interviewer: Anet las jy hierby aan?

Anet: Ja, ek wil basies net sê hoekom, dis net ‘n voorstel, as jy nou soos ‘n video sou opstel jy persoonlik self en dan tussen in werk jy nou byvoorbeeld 3 somme wat vir ‘n taak ingegee moet word, maar op random tye ja verskillende tyd van elke video en dan as hulle vir jou die 3 somme kom wys van die verskillende afdelings dan kry hulle soos ‘n sweetie of so iets.

Interviewer: Dink jy dit gaan hulle motiveer?

Anet: Wel, sweeties kom nogal ‘n baie vêr pad.

Interviewer: Maar, verstaan ek jou reg dat jy voel die dosent moet self die video maak?

Anet: Dit hang af as daar sekere goed ingewerk is, dan ja.

Interviewer: Okay, gaan nou terugkom daarna toe.

Vera: Ek wil net bylas by die vorige punt wil ek net ietsie sê. Ek het nou geproef toe is ek by Graad 8 tegnologie toe sê meerderheid van die Graad 8’s hulle gaan nie my huiswerk doen nie. Toe het ek net baie meer entoesiasme gehad om te sê ag man asseblief doen hierdie. Die volgende dag was einlik almal happy om dit vir my te wys. So, ek dink dis ook hoe die juffrou dit aanbied. As sy ook meer entoesiasme dit aanbied en sê ek is so opgewonde ek wil julle goed môre sien dan dink ek wil hulle dit doen, want hulle moes prentjies gaan kry het, wie wil dit doen? Dis boring. Hulle het actually moeite gedoen om dit te kry om vir my nou dit te kom wys.

Interviewer: Dit het ‘n effek op student as hulle actually dink die juffrou hou van hulle.

Vera: En soos ek dink ook nog ‘n ding om hulle te motiveer om dit te gaan doen is soos sê nou maar ‘n vinnige aktiwiteit as jou klas nou begin. Soos ons het daai een keer in ALDA dan doen ons ‘n vinnige Kahoot dingetjie oor die eenheid. Dis fun dan doen ons gou vining ‘n kompetisie teenoor wie weet wat of so ietsie. Dis ook nogal oulik dink ek.

Interviewer: Okay, so om te toets of het mens die video gekyk?

Vera: Of ‘n word search of so ietsie so as jy nou voorberei het vir die volgende dag dan begin jy met ietsie fun oor daai eenheid wat jy nou gedoen het.

Interviewer: Dan gaan mens vining agterkom wie dit nie gedoen het nie.

Vera: Ja.

Interviewer: Okay.

Nina: My siening oor die flipped classroom is dis, ek gaan weer by dit kom dat die werk wat ons nou doen het ons al gedoen. Maar sê nou maar ons gaan terug na laas semester waar ons in Wiskunde induksie gedoen het, dis die eerste keer wat ek so iets gedoen het en as ek, as Mr X vir my gesê het gaan huis toe en kyk wat is wiskundige induksie en “try” somme, as ek die eerste som so gekyk het sou ek dit gelos het. Ek sou gesê het ek weet nie wat hier aangaan nie. So, vir my voel dit ek weet nie of dit gaan werk met moeilike of nuwe konsepte nie, want vir my voel dit ons het hierdie klaar gedoen ons het klaar die agtergrond so ons weet wat om te doen. Maar wat as dit kom by ‘n hele nuwe konsep, jy kyk daai ding so en jy het klaar ‘n blok want ek kry dit klaar nie reg nie.

Interviewer: Okay, as dit in ‘n video vorm was en iemand wys dalk vir jou interresant waar kom dit vandaan en doen dalk vir jou ‘n voorbeeld of twee, sal jy die video gaan kyk oor ‘n nuwe konsep?

Nina: Na 3 weke van Wiskundige indukdie sukkel ek nog steeds daarmee so....

Interviewer: Jy antwoord nie my vraag nie.

Nina: Ek sal videos gaan kyk oor wiskundige induksie, dit het nie rêrig gehelp nie.

Lisa: Dit bly sleg, want soos almal jy kan videos gaan kyk maar hulle doen dit heeltyd anders.

[Almal sê ja]

Interviewer: Op daai punt, wie van julle sal dit verkies as jou eie dosent die video maak?

[Meeste student sê ja]

Michelle: Ek dink dit sal help, maar die ding kom nou weer in dat Wiskunde is ‘n ding wat soveel antwoorde het. Almal gaan by die antwoord 8 uitkom, maar soos die manier hoe jy daarby uitkom is so verskillend. So as jou dosent self die video maak dan gaan dit help want dan gaan jy dit in die regte manier doen vir wat jy punte voor gaan kry, maar dit gaan jou nie help om hoër kognitiewe denke te hê om self dan die verskillende paadjies te volg om daar uit te kom nie. So dan voel dit vir my jy word half geleer hoe om te dink.

Interviewer: Ja, okay.

Nina: Okay, maar ek sien dit nou weer in die lig van hy kan sy eie video opsit en sê as jy nog verder inligting wil hê hierso is nog videos.

[Almal sê ja]

Interviewer: Want, is ek reg as ek sê dat die videos alles in Engels is?

[Ja]

Nina: Party.

Interviewer: Is party in Afrikaans?

Nina: Ja, toe ek in Wiskunde met die proeftydperk het ek baie Afrikaanse video’s gaan soek om vir die kinders te wys. So dit hang af van die konsepte en die eenhede.

Interviewer: Okay. So vir julle ‘Mathematic Module’?

Nina: Engels.

Interviewer: Alles Engels?

Nina: Ja.

Michelle: Ek het nog nie videos gekyk in ‘Mathematic Module’ nie.

Lisa: Ek ook nie.

Interviewer: Okay, wie het nog glad nie eers een video gekyk nie?

Michelle: Soos vir Wiskunde?

Elise: Vir enige wiskunde?

Interviewer: Vir ‘Mathematic Module’, vir hierdie module. Ek wil weet van ‘Mathematic Module’.

Interviewer: Michelle, Elise Vera, Anet, Lisa, Zara. Sorry ek sê julle name so, want ek moet weet as ek transkribeer. Okay sho dis interessant.

Rachelle: Kan ek ietsie sê oor ‘Mathematic Module’?

Interviewer: Ja.

Rachelle: Ek is jammer maar ek vind daai vak verskriklik vervelig.

[Almal stem saam]

Lisa: Ons doen dieselfde werk in module Y as in ‘Mathematic Module’ en so ek voel ons almal is nou al op ‘n hoër vlak as dit.

Vera: Dis oppervlakig.

Interviewer: Okay, Vera sê dis oppervlakig, Lisa sê julle is bietjie op ‘n hoër vlak.

Elise: Dis graad 10 werk.

Interviewer: Elise sê dis graag 10 werk. Okay.

Michelle: Ek persoonlik het nie Wiskunde as ‘n vak nie, ek het Skeinat en Biologie so ek doen dit nie dubble nie, maar soos ek voel ook dis half onnodig om klas toe te gaan. Dit klink verskriklik ek bedoel dit nie lelik nie.

Interviewer: Nee, sê jou sê.

Michelle: Ons kry nou vooraf ‘n aktiwitiet wat ons moet voorberei vir die klas en dan doen jy dit en jy verstaan wat daar aangaan en dan gaan jy klas toe dan word dieselfde werk behandel.

Interviewer: Wow, stop daar. Baie belangrik ek wil vir jou vra oor dit. Voel jy ek hoef dit nie te kyk nie, want die werk gaan in elk geval “reteach” word in die klas?

Michelle: Nee, so ons word nie videos voorgeskryf en gesê gaan kyk die video nie, soos ons word.

Interviewer: Ek praat van ‘Mathematic Module’.

Lisa: Ja. Ons kry nie videos nie. Kyk ek dink as jy seker gaan kyk dan gaan jy videos kry.

Elise: Daar is vidoes wat jy kan gaan kyk.

Interviewer: Een op ‘n slag, sorry julle. Lisa jy sê daar word nie eintlik vir jou gesê jy moet die videos gaan kyk nie?

Lisa: Nee.

Interviewer: Ja. Zara stem jy saam?

Zara: Ja. Daar is videos, ek het dit netnou raak gesien.

Lisa: Daar is videos, maar ons word nie gesê nie.

Michelle: Ek het nie geweet van die videos nie.

[Meeste student se hulle ook nie]

Interviewer: Elise, jy ook nie?

Elise: Nee.

Interviewer: Rachelle?

Rachelle: Ek ook nie.

Interviewer: Nina?

Nina: Okay, maar sy sê elke keer op haar slides wees geduldig ek weet nie hoe efundi werk nie. So, hoekom gaan ek die moeite gaan doen en gaan kyk op efundi as ek weet sy weet self nie wat daar aangaan nie?

Interviewer: Okay.

Nina: Voor ons toets vandag het sy blykbaar vandag op efundi gesê dat dit in ons toets gaan wees en toe skryf ek ons moes dit nie geleer het nie. Toe gaan kyk ek op efundi dieper in alles in toe sien ek hier staan dit, dit gaan in ons toets wees.

[Almal gesels onderlangs]

Michelle: Sy het in die klas gesê ons moet eenhgeid 1-3 leer vir vandag sê klastoets en ons het vandag in die klas eenheid 1.4 behandel en toe skryf ons ook oor eenheid 1.4 maar ek het glad nie soos ek het voorberei vir die klas, maar ek het nie dit gaan leer nie so. Ek was soos uhm…

[Ander stem saam]

Interviewer: Rachelle wat het jy gesê nou vir Vera, het sy gister eers opgesit?

Rachelle: Blykbaar het een meisie gesê dat sy eers soos die werkkaart, want ons kry nou werkkaarte wat ons voor die tyd kan gaan kyk na, soos vir voorbereiding. En dan in die klas kry ons ook ‘n groepsopdrag wat ons doen, maar sy het gister dit eers opgesit en daarby het sy eers gesê, daar het sy eers gesê dat ons moet daaroor ook toets skryf. Maar meerderheid het dit nie eers gesien nie.

Interviewer: Okay so wow. Ek wil net seker maak ek verstaan reg. Ek voel nou deurmekaar. So daar is ‘n werkkaart wat jy weet jy moet gaan kyk vir voorbereiding.

[Almal sê ja]

Interviewer: En as jy in die klas kom, doen jy ‘n werkkaart wat lyk soos daai werkkaart?

[Almal sê ja]

Michelle: Jy merk die werkkaart en dan vra sy gewoontlik het enige iemand enige vra en dan 80% van die tyd het niemand vra nie, want almal, dis half ou werk wat ons in skool behandel het.

Interviewer: Okay

Michelle: So, dan as niemand gevra het nie dan gee sy vir ons somme wat ons in die klas kan doen om te kyk of ons dan nou in groepswerk dan nou regkom daarmee. So, as jy dan nou vashaak kan jy vir iemand vra of wat okal.

Interviewer: Okay.

Michelle: Maar niemand haak rêrig vas nie.

Interviewer: Okay, so as dit nie ‘n flipped classroom was nie sou ‘n nuwe konsep vir jou in die klas gebring geword het so die dosent sou “geteach” het en geskryf het en

voorbeelde gedoen het en wat okal. En dan sou jy so tipe werkkaart by die huis gaan doen het nê, waar daar nie ondersteuning is nie. So die hele idee is dat daar ‘n video, so ‘n nuwe konsep moet gebring word by die huis in ‘n video en daar dalk bietjie dieper, meer kognitief uitdagend is in die klas waar jy saam met iemand kan werk en die dosent. Is daar iemand wat voel die werk is uitdagend wat julle in die klas doen?

[Almal sê nee]

Interviewer: Okay, is daar iemand wat voel dit is? Niemand.

Lisa: Ons het haar al gevra om dit moeliker te maak en sy sê sy het, maar dis nogsteeds dieselfde.

Interviewer: Wie dink mens kan dit moeiliker maak?

Zara: Ek doen.

Interviewer: Nina, Zara, Lisa, Michelle, almal, okay. Nina?

Nina: Okay ek nog ‘n ding, sy sukkel met die dissipline in die klas. Ek voel, ek weet nie hoe voel julle nie, dis vir ons, ons ken hierdie hoekom moet ons nou luister end dan praat ons onder mekaar.

Interviewer: Okay. Ek hoor jou.

Nina: Want ons het al baie keer gesê ons ken hierdie goed, want sy letterlik herhaal alles.

Interviewer: Okay. Okay, metakognisie. Enige iemand, “any takers”, wat beteken die woord metakognisie vir jou, as mens?

Elise: Ek weet kognitief is met die brein, maar dis al wat ek wees.

Lisa: Is dit nie die manier hoe jy dink nie, en ontwikkel nie?

Interviewer: Okay, die manier hoe jy dink en ontwikkel. Wie het nog nooit daai word gehoor nie? Anet Nina, Zara, Vera. Okay. Ek het nou hier ‘n vraag wat sê as jy na die video kyk is dit toegangklik, julle voel dis moelik om dit optespoor op efundi.

[Studente sê ja]

Interviewer: Okay, julle sê ja. Wat ek nou eintlik wou gevra het is, as jy nou ‘n video kyk, as daar iets is wat jy nie verstaan nie, gaan jy pause en okay. Nina sê ja.

Michelle: Okay ons het baie, en skeinat het ons videos gaan kyk, en as ons nie iets verstaan nie, het ek gepause en weer gekyk of as ek sê nou maar ‘n oulike manier van opsomming gebruik het dan het ek sommer gepause en afgeskryf.

Interviewer: ‘n Voordeel van as jy video’s by die huis gaan kyk is as jy siek was kan jy nogsteeds by bly met nuwe konsepte wat gedoen is en jy kan gaan pause as jy, jy het netnou gepraat van Integrasie en Calculus, is dit waarvan jy gepraat het, wat julle by Mr X gedoen het?

Lisa: Wiskundige induksie.

Interviewer: So, dan kan jy as jy sukkel kan jy pause en weer gan kyk wat jy nie noodwengid met ‘n dosent in die klas gaan doen ongelukkig nie. Okay, Nina?

Nina: Partykeer dan neem hulle ook aan jy weet dit, sê nou maar soos met wiskundige induksie, hy praat baie keer in Engels dan is ek van wag net gou. En as ek ‘n video kyk en ek hoor daai woord weer pause ek die video, gaan tik dit in op google kyk wat is dit in Afrikaans, gaan bietjie dieper in.

Interviewer: Okay. Vera?

Vera: Ons laaste klas het ons radiale mos gedoen, eers soos op die einde toe snap ek dit en hy het dit soos so hoog verduidelik, daai hele klas het hom eintlik aangeval omdat hulle nie gesnap het nie. So toe het ek na die tyd na hom toe gegaan, toe vra ek vir hom moes jy net eintlik dit gedoen het, toe sê hy vir my ja. Toe is hy soos jy moes lankal net gesê het jy verstaan nie dan het ek vir die klas verduidelik. Toe is ek soos maar...

Vera: Is dit nou by Mr X?

Vera: Ja, so ek voel partykeer dat hulle dalk op ‘n te hoë vlak dit probeer verduidelik en net soos bietjie moet afskuif en net by stap 1 moet begin.

Interviewer: Okay, en dis die hele idee van die flipped classroom dat stap 1 by die huis moet plaasvind dat ons saam daai hoër goed doen. Okay, elk geval. So voel julle nou dat, dit klink nie vir my, help my as ek verkeerd is. Die flipped classroom eintlik alles moet verander, als moet anders voel. Voel hierdie vir julle anders, want wat ek van julle verstaan is jy gaan doen ‘n werkkaart by die huis en jy doen ‘n werkaart in die klas.

[Almal bevestig dit]

Interviewer: Dit voel vir my niks is eintlik anders nie, die flipped classroom moet heeltemal anders wees. So hierdie voel nie vir julle anders nie?

Nina: Ek dink dis omdat ons die konsepte klaar verstaan.

[Die res sekondeer]

Interviewer: Ek dink jy is heeltemal reg.

Michelle: Ek dink tog as ons nuwe werk gaan behandel dank an ons eintlik sê hoor hier dit werk dit werk nie. Want huidiglik kom ons in die klas ons het nie rêrig vra nie, want ons het dit al behandel op skool.

Lisa: Al baie!

Michelle: Ons het dit al toegepas, jy het dalk net jou geheue verfris van hoe dit werk, maar dis al, jy't nie rêrig.

Interviewer: So, ek wonder nou Nina, want jy't gesê jy dink dit gaan moeilik wees om dit te doen met 'n nuwe konsep, maar dalk okay. In elk geval, okay. Ek wil net vir julle so vinnig vertel oor metakognisie so hulle sê metakognisie is 'n baie goeie bepaler van akademiese sukses. Dit is om te kan reflekteer, om te kan dink oor wat ek besig is om te dink. So as ek besig is om 'n som te doen of enige iets in die lewe kan jy agterkom, ek is nou besig om tyd te mors, ek moet nie nou hierdie doen nie. Of ek is nie besig om goed te doen in hierdie vak nie, ek moet my strategie verander, dit wat ek nou doen ek kan nie net harder werk nie ek moet eintlik my strategie verander. Om bewus te wees van jou denke en om anders te werk te gaan en eintlik kom dit maar neer op refleksie en weet ek wat werk, weet ek wat werk nie en om vir sekere goed uit te luister, julle wat ook eendag studente gaan hê, om uit te luister vir 'n student wat vir jou kan sê, daai wat by jou tafel gaan aankom en sê: ek verstaan niks. Strooi, wat verstaan jy nie? Toe ek dit en dit en dit gedoen het, het ek agtergekom hierdie is wat ek nie verstaan nie. Die rede hoekom ek dit en dit en dit nie verstaan nie. Dit is metakognisie. As jy vir die naweek vir 'n leierskapkamp was en iemand stop jou en vra vir jou: hoe was die kamp? "It was fine". My student doen dit met my. Weet jy wat, hierdie was vir my lekker, hierdie was nie vir my lekker nie, eintlik maar om vir jouself te kan dink op die ou end van die dag. Okay, is daar iets wat jou keer dat jy goed kan leer in hierdie module, 'Mathematic Module'?

624 Michelle: Soos goed kan leer soos nuwe goed of net effektief kan leer?

625 Interviewer: Net goed effektief kan leer. Zara, wat sal jy sê?

626 Zara: Ek weet nie.

627 Interviewer: Voel jy, jy kan goed leer?

628 Zara: Ja.

629 Interviewer: Is daar iets wat dit kan beter maak?

630 Zara: Nee, want soos ons al gesê het, dis goed wat jy reeds weet.

631 Interviewer: So, dis omdat dit iets is wat julle reeds weet.

632 Vera: Kan ek iets by dit las?

633 Interviewer: Ja, jy kan.

634 Vera: Ek voel sy moet vir ons meer leer hoe om dit meer beter aan te bied en soos klein
635 tegniekies te gee soos met die handleiding, gee vir my ‘n manier om dit vir ‘n kind
636 makliker te maak.

637 Interviewer: Stop gou. Is dit die doel van hierdie module? Is dit om julle te help om
638 hierdie inhoud beter vir…

639 Vera: Om te verstaan en te kan aanbied dis hoe ek dit het, dis goed wat ons eintlik weet.

640 [Paar student stem saam]

641 Interviewer: Okay, so jy voel nie hierdie is nou vir jou, want dit gaan jou nie na hoër vlak
642 wiskunde toe vat nie.

643 Vera: ‘Mathematic Module’ nee, module Y is defnitief ‘n hoër vlak.

644 Interviewer: Okay, dit maak sin. Wie voel die formaat van efundi is chaos en hulle kan
645 nie sin maak van ‘Mathematic Module’ se formaat van efundi nie?

646 Lisa: Ek dink nie die probleem is die format daarvan nie, dis redelik uiteengesit, dis net
647 daar is heeltyd sulke lang stuk wat ek moet lees en dan heel onder is die belangrike
648 goed en niemand wil deur die lang stuk lees nie.

649 Interviewer: Zara voel jy dieselfde? Lees jy nie daardeur nie?

Zara: Ek lees glad nie daardeur nie.

Nina: Dit is wat gebeur het met die toets, want daar was ‘n paragraaf en onder die paragraaf: ek gaan hierdie vra in die toets.

Lisa: Ja.

Interviewer: Okay, so mens moet als dan gaan lees om by die inligting uit te kom nê?

Michelle: En wat ook vir my sleg is, is soos die ander dosente sal byvoorbeeld as hulle iets post op resources dan kry jy ‘n notification wat sê daar is nuwe inligting opgesit of die “announcement” sê die “assignment” se datum dan weet jy daar is nou ‘n “assignment” ek moet gaan kyk. By ‘Mathematic Module’, jy weet nie wat daar aangaan nie, jy weet nie watter aktiwiteit is daar teenwoordig nie so as soos ja, jy is nou gereeld op efundi so jy sal nou maar daar gaan loer of iets, maar as jy net so vinig loer dan sien jy nie iets nuuts nie dan mis jy baie keer goed soos dit, want dan weet jy nie waar sy dit, onder wat sy dit gesit het, of waar sy dit gesit het of dis tussen ‘n klomp ander goed gesit so jy mis nuwe goed wat op is. Ek dink dis hoekom ons nie weet van video’s en daai goed nie.

Interviewer: Okay.

Vera: Ek voel weer of ons by ander wiskunde, by Mr X, ons ander dosent, hy sal byvoorbeeld in rooi noodbelangrik sulke hoofletters maak: onthou hierdie of hierdie gaan ook gevra word.

Interviewer: So dit het tog met die formaat te doen nê. Okay.

[Studente sê ja]

Interviewer: Askies Rachelle ek gaan nou vir jou vra.

Nina: En ek het. Skies. Vandag toe ek nou gaan rondsoek het vir waar sy gesê het van die toets, toe kom ek af dat sy soos 5 eenhede en in eenheid 1 is daar soos klomp, maar toe dink ek ons is nou al by eenheid 3 toe gaan ek by eenheid 3 in toe is daar klomp “hyperlinks”. Toe ek kliek op die hyperlinks toe werk nie een nie. So dit was rêrig, daar is soos niks.

Interviewer: So, jy probeer om die video’s te kyk, maar dit het nie gewerk nie.

Nina: Ja, maar staan net vir meer inligting kliek hier en as ek kliek daar dan werk niks.

679 Interviewer: Okay. Ja, okay dankie Nina.

680 Vera: En het het gesien by ‘Mathematic Module’ ek het gesien sy het so hele semester
681 beplanning ding vir ons gegee, so ons is eintlik eers by 1.4, “by the way”.

682 Interviewer: Julle begin nou “vent”, stop. Sho ek moet sê ek het nou nogal baie ander
683 inligting gekry as wat ek nogal gedink het, maar ons gaan nou begin klaar maak. So,
684 ek wil net by julle weet, enige nog gedagtes, nie “vent” nie.

685 Elise: Ek wou nou-nou al gesê het.

686 Interviewer: Elise, askies.

687 Elise: Wat vir my nogal baie opvallend was wat ek gedink het wow hierdie is nogal cool,
688 wat ek self sal wil gebruik, in ons module Y by Mr X, een vrydag het ons oor driehoeke
689 gewerk toe het hy vir ons klomp afmetings gegee van driehoeke se sye wat ons nou
690 moes gaan probeer het om die driehoek te trek met dit. Toe probeer ons toe is ek soos
691 jis hierdie ding werk glad nie uit nie, ek weet nie wat hier aangaan nie. En toe het hy vir
692 ons ‘n hele nuwe soos ‘n eienskap van ‘n driehoek gegee wat ek nog nooit eers geweet
693 het van nie, so dit was vir my baie cool. En ek dink ek gaan dit nou onthou, want ek het
694 gesukkel daarmee en dit was vir my baie nice. So, ek hou van daai wat hy ons bietjie
695 laat sukkel en dan op die ou einde help hy ons daarmee.

696 Interviewer: En dit kan jou help, want jy kan dit eendag met jou studente gaan doen.
697 Rachelle?

698 Rachelle: Ek wou net nou-nou bygevoeg het by Vera, wat sy gesê het oor die belangrike
699 inligting wat Mr X in rooi sit. Dalk moet hulle net soos die belangrike inligting eerste sit
700 en dan die goed wat volg. Sodat jy half weet waaroor dit gaan gaan en nie aan die
701 einde is dit dalk dat jy toets skryf oor iets en dan weet jy nie eintlik daarvan nie.

702 Lisa: Ja, en ek dink ook as jy actually die belangrike inligting eerste sien gaan jy half
703 wees van okay maar dalk moet ek net deur die res lees dalk moet ek net sien wat word
704 verwag want “I mean” as jy daai stuk van wat van jou verwag word is jy net soos
705 hoekom? Dan kom jy onder dan weet jy eers hoekom waar as jy dit eerste kry gaan jy
706 ten minste weet hoekom of jy moet aanhou lees.

707 Interviewer: Okay. Michelle?

708 Michelle: Ek dink wat die flipped classroom meer effektief sal maak in die huidige
709 ‘Mathematic Module’ sal wees soos sê nou maar as ons nogsteeds vooraf die aktiwiteit

kry om te doen dan voel ek dit werk lekker as jy in die klas kom en jy weet klaar of jy verstaan als of ek verstaan niks nie dat jy weet waar jy staan. Maar dan “even” al verstaan jy als moet sy vir jou kan sê okay die hele klas is op dieselfde vlak, almal verstaan als, maar kom ek wys vir julle iets interessants byvoorbeeld om herleiding makliker te maak of hier is ‘n interessante manier om dit te onthou. Of onthou hierdie en hierdie is dieselfde so as jy dit na hierdie moet herlei is dit ‘n korter pad om dit eers na hierdie toe te herlei of so iets.

Interviewer: So, jy sluit aan by wat Vera vroeër gesê het dat julle voel die vak kan aangebied word om jou te help hoe jy dit beter kan aanbied vir jou studente.

[Studente sê ja]

Michelle: Nie net dit nie, nie net die aanbieding nie, maar dit gaan jou ook self help. Deur dit beter te kan doen en beter te verstaan. Huidiglik, okay herleiding vat ek nou as ‘n voorbeeld almal van ons leer net uit ons koppe uit, of jy google dit, of jy leer dit uit jou kop uit soos ‘n pappagaai so niemand verstaan eintlik wat daar aangaan jy het eintlik net die inligting so ek voel as dit actually in ‘n manier aangebied kan word wat jy dit op ‘n manier kan verstaan dat jy dit nie soos ‘n pappagaai net gaan leer nie.

Interviewer: Okay, so voel dit vir julle ook dit, was dit anders vir julle op skool aangebied, was dit beter op skool aangebied?

Michelle: Ons het maar nog altyd net geleer, dis pappagaai werk.

Interviewer: Zara het jy die werk op skool presies op dieselfde manier geleer? Het jy ook werkkaarte gekry, uit jou kop uit geleer, hoe was dit vir jou?

Zara: Nee, nee. Die juffrou het voor die tyd vir jou eers voorbeelde gegee en dan doen jy bietjie op jou eie en dan huiswerk. Gewoonlik.

Interviewer: Maar selfs hoe dit aangebied is, soos wat Michelle nou van praat. Is daar dalk maniere van waar kom dit vandaan, het julle “nets” gehad wat julle oopgevou het 3 dimensioneel of is dit.

[Nee]

Interviewer: Is dit altyd maar nog net vir julle gewys maak so.

Lisa: Ek moet sê soos op skool het ek dit bietjie anders ervaar. Ek het Admaths gehad in Graad 8 en 9, en Graad 10-12 het ek Alpha Wiskunde gehad en ek het gewone

Wiskunde gehad. En in Admaths was ons juffrou baie daarop dat jy dit fisies sien en hoe dit gebeur en alles en sy het in diepte verduidelik en ook in Alpha Wiskunde was die juffrou ook baie erg daarop om vir jou konneksies te wys tussen die goeters en dit help soos nou met soos Wiskundige Induksies, ek weet almal sukkel daarmee, maar vir my is dit baie maklik, want die juffruo het vir my die konneksies gewys wat gemaak moet word. So dit.

Interviewer: Okay. So ons gaan klaar maak. Elise?

Elise: Ek wil net vinnig aanlas by die Admaths. Ek het ook AP gehad, maar ek was nou weer heeltemal anders. My juffrou het self gesukkel met AP so ons het almal nou maar net aangeploeter daarmee so ek het baie gesukkel met AP. So, ek het maar die goed soos ‘n pappagaai geleer en 180 vraestelle uitgewerk wat ek kon kry, video’s gekyk, maar ek ook maar net soos geleer, geleer, geleer. En nou soos met Mr X toe ons nou bietjie gesukkel het, hy het ons bietjie verwantskappe gewys toe kon ek dit baie beter verstaan. Ek weet nou actually wat daar aangaan. Maar ek dink dalk, weet nie of dit gehelp het dat ek eers gesukkel het nie, maar ja.

Interviewer: Nog enige gedagtes? Laastes? Okay, dankie.

Micro-cycle 3

Focus-group interview 2

Interviewer: Okay, dankie dat julle hier is. Eerstens… ek gaan sommer by jou begin, Hannah.

Hannah: Ek wil net weet hoe oud is jy?

Hannah: Ek is twintig.

Interviewer: Al twintig.

Hannah: Ja.

Interviewer: Akademies, eerste jaar?

Hannah: Eerstejaar, ja.

Interviewer: Het jy iets anders gedoen?

Hannah: Ek het 'n gap-jaar gevat, ja.

Interviewer: Wat het jy gedoen?

Hannah: Ek het atletiek geoefen in my gap-jaar.

Interviewer: O…Okay. Ek wil eintlik nou, maar ek gaan nie nou … ons kan nie nou daaroor praat nie.

[groep lag]

Interviewer: En jou taal - praat jy Afrikaans en Engels?

Hannah: Afrikaans ja. Engels ook, maar meestal Afrikaans.

Interviewer: Okay. Sal jy sê jy verstaan as jy onderrig moet word in Engels?

Hannah: Ja, ek verstaan.

Interviewer: Okay. En waar was jy op skool?

Hannah: In Hoërskool Stellenbosch.

Interviewer: Okay. En het julle goeie tegnologie gehad by die skool? Soos toegang tot tegnologie?

Hannah: Daar was projektors gewees, maar hulle het nie baie daarvan gebruik gemaak nie. So dit was meestal nog, hulle het maar op die bord geskryf as hulle verduidelik het.

Interviewer: Okay.

Hannah: En hulle het van slideshows ook gebruik gemaak.

Interviewer: Het jy toegang gehad tot 'n rekenaar daar?

Hannah: Uhm, daar was 'n rekenaarlokaal waar ons kon gaan werk as ons sou wou.

Interviewer: Sou jy sê jy is rekenaarvaardig?

Hannah: Jaaa, tot 'n mate. Ek is nie baie goed daarmee nie, maar ek kan die basiese goed doen.

Interviewer: Okay. Kom jy reg met eFundi?

Hannah: Ja… ja.

Interviewer: Kom ons gaan na Jade toe. Ouderdom?

Jade: Ek is negentien.

Interviewer: Okay. Taal of tale?

Jade: Taal… Afrikaans en Engels. Ek is vaardig in altwee. Ek was in 'n Engelse kleuteskool. So...

Interviewer: Okay. So, jy verstaan goed. Skool?

Jade: Ek was in Hoërskool Monument in Krugersdorp.

Interviewer: Okay. En tegnologie toegang. Het jy baie van tegnologie gebruik gemaak daar?

Jade: Daar was baie toegang tot tegnologie, maar ons het nou nie rêrig soveel gebruik gemaak daarvan nie. Hmm… meestal maar oorhoofse projektors, PowerPoint slides.

Interviewer: Okay.

Jade: Maar nou nie…ons het nie Smartboards of enigiets gehad nie. Meestal het die onderwysers maar net met die hand geskryf, want dit was makliker en vinnig. Ons het met harde kopieë gewerk.

Interviewer: So daar was ook nie van jou verwag om take elektronies te doen nie, of te e-pos... sulke goed nie?

Jade: Nee, glad nie… nooit nie.

Interviewer: Okay. En dan Ann. Jy is twintig?

Ann: Nee, negentien.

Interviewer: O, ek dog jy het vir my gesê jy is twintig.

Ann: Nee…

Interviewer: O…dis omdat ek gedink het jy is volwasse. Taal(e)?

Ann: Afrikaans huistaal… en Engels addisionele taal.

Interviewer: Okay. Skool?

Ann: Hoërskool Standerton.

Interviewer: Okay. En tegnologie by die skool? Het die onderwysers dit baie gebruik en jy ook?

Ann: Nee, hulle het dit nie baie gebruik nie. Al wanneer ons dit gebruik het, is, sê nou maar, wanneer ons antwoorde gemerk het, het hulle die memo half soos op die bord gegooi, maar verder was alles handgeskrewe gewees.

Interviewer: Okay. Dan....kom ons kom by Henda. Ouderdom?

Henda: Negentien.

Interviewer: Negentien. Taal?

Henda: Afrikaans is my eerste taal en Engels is addisionele taal.

Interviewer: Okay, sal jy sê jy verstaan Engels goed?

Henda: Ja.

Interviewer: As jy moet leer in Engels?

Henda: Dis heel okay.

Interviewer: Okay.Skool?

Henda: Ek was in Hoërskool John Vorster in Nigel gewees.

Interviewer: Okay. En jou tegnologiegebruik of toegang daartoe?

Henda: Ek voel ons het… ek was baie bevoorreg om op Smartboards klas te kry.

Interviewer: Okay. Skies, kan ek jou stop daar? Hoekom dink jy dit is so 'n voorreg?

Henda: Ek dink dit is 'n voorreg, omdat, veral met vakke soos in my vak het ek in Fisiese Wetenskappe dit gekry. En dit, en in Wiskunde, en dit gee aan onderwysers die vermoë om simulasies vir jou te wys, en om mooi sketse te teken en om vinnig vir jou iets te demonstreer sonder om dit met kryt of met 'n projektor te doen wat bietjie… Dit… dit werk nie so gerieflik soos wat smartboards werk nie.

Interviewer: En ja, goed kan lewendig gemaak word… nè?

Henda: Ja, defnitief.

Interviewer: Jy kan iets op 'n ander manier vir iemand aanbied, want as ek nou dink tegnologie, dan dink jy joe daar is soveel ongelooflike maniere wat 'n mens goed so visueel vir mense, spesifiek in Wiskunde kan wys deesdae. As jy dink aan iets eenvoudigs soos vierkantsvoltooiing. Almal wys vir jou dis 'n vergelyking. Hy lyk so. Dan doen jy dit, stap twee. Maar eintlik kan jy dit briljant gaan uitbeeld. Okay. Elk geval. Ek het nou vir jou als gevra wat ek wou. Ja.

Interviewer: Hannah, het jy vorige ervaring met die flipped classroom gehad voor ‘mathematics module’?

Hannah: Nee. Glad nie.

Interviewer: Henda?

Henda: Nee.

Interviewer: Ann?

Ann: Nee, glad nie.

Interviewer: Jade?

Jade: Glad nie.

Okay. Sê vir my… en in enige volgorde as jy iets daaroor wil sê. Wat is die flipped classroom vir jou?

Henda: Die flipped classroom vir my is dit meer gerig op selfstudie, en hmm… slegs die moeilike dinge, en die dinge waarmee mense rêrig sukkel, word dan in die klas behandel. So ja by die huis, onderwyser sê vir jou gaan berei hierdie voor vir die volgende les, alles opgelaai, gaan doen hierdie oefeninge, hmm… en berei voor vir die volgende les. Kom na my toe met vrae. Kom na my toe met probleme. Dan behandel ons dit in die klas.

Interviewer: Okay, en ek stem saam daar wat jy sê, want die idee van die flipped classroom is as jy basiese konsepte by die huis kan gaan leer, soos leer hierdie deel, of lees hieroor of gaan kyk 'n video daaroor. En dan om in die klas te kom dat 'n mens by die hoër kognitiewe vlakke uit te kom - by daai moeilike goed, want studente sê altyd: in die klas lyk dit so, en in 'n toets lyk dit so. En die rede daarvoor is, want die toepassing wat jyself moet gaan oefen, doen jy by die huis, dan het jy geen ondersteuning nie, dan sukkel jy, dan verloor jy motivering. En die hele idee met die flipped classroom is dat basiese konsepte vir jou by die huis in 'n video-vorm gewys word, dat jy kan klas toe kom en daar saam kan toepas wat jy... toepassings doen, wat jy ondersteuning het van jou maats en van jou dosent. So...

Ann: Wat vir my lekker is van dit is soos… sê nou maar jy het nie net een metode om iets te doen nie, maar met flipped classroom dan doen jy mos ietsie soos in klastyd, dan kry jy soos, okay, die persoon doen dit op hierdie manier, en daai een kyk nou weer uit hierdie oogpunt uit, en doen dit op hierdie metode. So, daar is nie net een metode wat gevolg word nie. Almal doen dit maar half anders.

Interviewer: So dit klink vir my of jy sê julle werk lekker saam in die klas.

Ann: Ja.

Interviewer: Okay. Ervaar die res van julle dit ook so?

[Ja]

Hannah: En om uit mekaar se foute uit te leer. Dan sê ek het ook daai fout gemaak of ek het so daaraan gedink soos sy sê.

Interviewer: Okay. Jade?

Jade: Dit werk as almal wil werk… by jou tafel… bygesê. So…sê nou as jou vriend 'n afdag het, en hy wil nie nou hierdie groepstaak doen nie, en dan word jy op die ou einde gelos om aan jou eie genade oorgelaat te word, om maar self hierdie ding uit te figure. Want ek het nou 'n slegte dag gehad. Ek het nou… ek is nie nou lus om hierdie te doen nie ... ek is nou nie lus om met julle te praat nie.

Interviewer: En daar is sulke mense. Okay.

Jade: Ek is sommige dae daai mens.

[Lag]

Henda: Ek wil net sê van die flipped classroom… wat ek beleef het, is soos wat daardie ander man laas keer met ons gepraat het, gesê het… jy leer of jy gee skool soos wat jy geleer is. Ek het al besef soos as 'n onderwyser vir my 'n spesifieke vak aanbied soos wat hy geleer is, dan reageer ek nie noodwendig dieselfde op hoe hy vir my verduidelik, en wat hy vir my sê nie, soos ek is dalk nou visueel meer as oudiotief, of wat ookal die woorde is. Maar ek het ervaar met die flipped classroom kry ek vir myself maniere om goed uit te “figure” en te verstaan. En as ek in die klas is, alhoewel die onderwyser of die fasiliteerder dit verduidelik soos wat hulle wil, verstaan ek dit, want ek het my eie manier, soos ek het my eie voorbereiding gaan doen om dit te kan verstaan. Want, as mens... as die onderwyser die hoofbron van inligting is, dan gaan dit veroorsaak dat jy as student nie altyd alles gaan verstaan nie, want hy gaan aanhou skoolgee soos wat hy skoolgee. En jy gaan aanhou nie verstaan wat hy sê nie.

Interviewer: En soos jy besef, luister maar ek moet self bronne gaan soek. Daar is verskriklik baie bronne wat vir my beskikbaar is op die Internet, ensovoorts. Ek kan nie altyd op ander mense staatmaak nie. Okay. Dan… het julle al van die woord gehoor metakognisie?

[Nee]

Interviewer: Nog glad nie gehoor nie? So… metakognisie…dit is eintlik nogal ‘n ingewikkelde konsep, maar waarop dit neerkom, is om bewus te wees van jou denke. So dink oor wat jy dink. Soos terwyl jy byvoorbeeld besig is met wiskunde-probleemoplossing, dan kan jy dalk dink maar sjoe, hierdie wat ek nou doen, maak nie eintlik sin nie. Ek moet gaan dink oor wat maak sin. Meeste mense kan glad nie daaroor dink nie. Hulle gaan net aan, het nie eintlik ‘n “clue” wat hulle doen nie. Hulle is nie bewus van hul strategieë nie. Hulle is nie bewus van wat hulle besig is om te doen nie. En dit is ‘n baie belangrike bepalende faktor vir akademiese sukses – is metakognisie. En dis soos byvoorbeeld om jou strategieë te verander. Sê nou maar jy doen nie goed in ‘n vak nie. Om dan te sê, okay so “obviously” hoe ek leer vir hierdie

vak of hoe ek te werk gaan, werk nie. Ek moet dit aanpas. Ek moet my strategieë verander, en om te reflekteer. Om te reflekteer sê maar ek wat ‘n juffrou is. Was hierdie ‘n goeie les? Was dit goed vir my leerders? Het hulle bereik wat ek wou gehad het hulle moet bereik, of sit hulle net daar soos papegaaitjies, en ek moet net vir hulle sê. So dit is om te reflekteer en om verbeteringe te maak op grond daarvan. So, is jy bewus van jou denke, weet jy wat jy dink, kan jy dit verteer en kan jy aanpassings maak op grond daarvan? So, die idee van my studie is ook om te kyk hoe die flipped classroom dalk kan help om metakognisie te bevorder. So, hou dit ook in gedagte.

Interviewer: Dan die videos. Ek het gister nogal... was ek nogals… ek moet sê ek het ‘n navorsingsfout gemaak. Almal waarsku jou altyd met navorsing, jy moenie sekere goed verwag nie. Jy moet oop wees. En ek het sekere goed verwag, en ek het nie gekry wat ek verwag het nie. So, die videos. Weet julle daar’s videos op eFundi wat julle moet gaan kyk?

[Onseker lag met “nee” tussenin]

Ann: Watse video’s?

Jade: Daar is nie. Ons het al gaan kyk na resources ook. Ek onthou, wat ek onthou… ek… dis hoekom ek spesifiek …want ek het dit gaan navors bietjie…ek het ‘n bietjie flipped classrooms gaan nagaan, en toe sê hulle… o daar is gewoonlik videos en toe is ek van?!

Interviewer: Okay, so sê jy nou, Jade, dat op ‘mathematics module’ se…op eFundi…dat daar is nie videos nie?

Jade: Nie wat ek gesien het soos videos van… nie wat ek gesien het nie.

Interviewer: Okay. Is daar in die klas vir julle gesê gaan kyk daar’s videos?

[Nee, dink nie so nie, nee]

Ann: Nee, sy het nie dit gesê nie.

Interviewer: Okay. En is die flipped classroom bietjie vir julle verduidelik?

Hannah: Ja, eintlik is die proses daarvan verduidelik.

Interviewer: Sal jy vir my verduidelik hoe jy dit dan nou verstaan op grond daarvan?

Hannah: Ja, sy het vir ons, soos sy vir ons verduidelik het…het sy vir ons gesê sy gaan nie die werk vir ons in die klas verduidelik nie. Ons moet self die werk gaan opsoek en self die

onderwerp gaan opsoek wat ons gaan behandel in die volgende klas. En dan…hmm… gaan sy, in die klas, gaan sy vir ons aktiwiteite gee, en ons moet vir haar vra oor die dele van die werk waarmee ons gesukkel het.

Interviewer: Okay. Dan…so as julle nie nou die video's gaan kyk het nie, hoe weet jy dan wat om in die klas te doen?

Jade: Jy volg maar net die moduleplan wat sy vir ons opgelaai het.

Interviewer: So jy het gaan voorberei?

Jade: Ja.

Hannah: Ja.

Interviewer: Wat gebruik julle dan om voor te berei?

Henda: Dis uiteengesit in die moduleplan. In hierdie les gaan ons hierdie onderwerp behandel. Hierso is die… wat jy moet gaan doen. Hierso is skakels wat jy kan volg.

Interviewer: Stop gou daar. Gaan jy na daardie skakels toe?

Henda: Ja. Gewoonlik. Dit is maar meestal goed soos Maths is fun, goed…hmm definisies weet…hmm…

Interviewer: G'n videos daar nie?

Henda: Nee, niks wat ek al gesien het nie.

Interviewer: Okay. So jy voel jy is voorbereid as jy klas toe gaan?

Henda: Ja, want dis maar… dis, ek gaan dit nou maar sê. Dit is maar elementêre Wiskunde soos Pythagoras, en dis Graad nege Meetkunde. So… dis redelik eenvoudig. Jy kan dit… jouself help as jy goed gedoen het op skool ook. So…

Interviewer: So, voel julle dat 'n mens dalk kan klas toe gaan in hierdie vak sonder om enigsins voor te berei?

Ann: Ek het al, ek het al baie klas toe gegaan sonder om voor te berei.

[Jade knik]

Interviewer: Henda, wat sê jy?

Henda: Ek het al… ek het al vir ‘mathematics module’ voorberei, en dan was daar goed wat ek nie geweet het nie, soos ek moet bieg… dan was daar ‘n spesifieke definisie of iets wat ek gemis het toe ek in die hoërskool was wat ek wel gekry het deur voorbereiding, maar ek het ook al ‘n paar keer klas toe gegaan sonder om my behoorlike voorbereiding te doen.

Interviewer: Okay, en is die werk in die klas uitdagend?

Ann: Nie rêrig nie. Dis rêrig maklike Wiskunde.

[Ander knik en stem saam]

Interviewer: Kan iemand dalk vir my gou die… soos jou gedagteproses verduidelik in die klas? Soos julle nou “face-to-face” is. Dis klastyd. So bietjie jou gedagteproses met die werk. Julle kan bietjie dink.

Ann: Soos in begin van klas of wanneer ‘n opdrag gegee word?

Interviewer: Enigiets.

Jade: Die begin van klasse is chaos gewoonlik. Dis maar studente. Hulle gesels mos maar. En hulle gaan aan, en dan weet ek… die dosent gaan weer raas en sê ons moet stilbly en ons respekteer haar nie... so ek wag vir dit om te kom. Dan… dit berei my half…dan maak ek myself half “mentally” negatief al klaar. Ek het hierdie gedoen op hoërskool. Hoekom moet ek hier wees, en alles. [Lag verleë]. Dis letterlik dis daai, en dit voel ek probeer met elke klas met ‘n positiewe houding ingaan. Vandag gaan ons iets nuuts leer, en dan doen ek dit nie…dan is ek teleurgesteeld.

Interviewer: So, jy voel daar kan meer uitdagende werk dalk wees in die klas?

Jade: Ek voel ‘mathematics module’… persoonlik voel ek ‘mathematics module’ kan net die dinge wat in ‘mathematics module’ behandel word, wat nie in ‘module Y’ behandel word nie, kan net so wel geïntegreer word by ‘module Y’, dat ons een minder module het. Jy hoef minder te betaal vir jou universiteitsfooie. Dan is daar nie… verstaan… dis nie ‘n onnodige module dan … want dis hoe jy voel…

Interviewer: Jy voel dis onnodig.

Interviewer: Dat dit baie oorvleuel.

Jade: Baie oorvleuel…dis al wat vir my, want basies, letterlik, as jy iets in ‘mathematics module’ in die week gedoen het, ag in ‘module Y’ gedoen het, dan doen jy dit weer in ‘mathematics module’.

Interviewer: Ek verstaan. Okay. Henda?

Henda: Ek voel ‘mathematics module’ is baie vir intermediêre fase-kinders, want dit is, ek dink dit frustreer ons want ons almal het Senior en VOO en ons verwag hierdie moeilike Wiskunde. Maar wat ‘mathematics module’ vir my verskriklik oulik maak, en ek het dit eers hierdie semester besef, was voor elke eenheid is daar ‘n aktiwiteit gegee wat jy saam met die kinders kan doen. Oulike goed, soos … daar was een wat hulle ‘n driehoekie moet vat, en dan moet hulle die driehoekie se hoekies afskeer, en die hoekies konstruktueer op ‘n reguit lyn, sodat die leerders kan waarneem dat die binnehoeke van ‘n driehoek is 180 grade. En ek voel sulke goed is belangrik om, selfs vir hoërskoolkinders te kan verduidelik dat hulle dit gemis het in laerskoolfase, want sulke goed is praktiese goed wat laerskoolkinders… jy kan nie net vir hulle sê dat die binnehoeke van ‘n driehoek is 180 nie. Jy moet sulke goedjies vir hulle wys, en die ander dingetjie was die konstruksie gewees en sulke goed. So daar is… daar’s tog interessante goed wat ek nie sal heeltemal wegvee van die module af nie.

Interviewer: Maar dit klink vir my dat wat jy sê, is die vak kan jou help om jou te leer hoe jy dit eendag vir jou kinders kan gaan verduidelik.

Henda: Ja, maar laerskoolkinders.

Jade: Ja, dit is nie rêrig baie van toepassing op hoërskoolkinders nie.

Interviewer: Okay. So, nou by die huis, as jy nou dink met ‘n ander module of ‘mathematics module’ wat julle in die eerste semester gehad het. Sou julle sê jy spandeer meer tyd daaraan by die huis nou met ‘n flipped classroom of nie?

Ann: Nie rêrig nie. Ek dink dit hang maar af soos die moeilikheidsgraad van die werk.

[Ja, ander stem in]

Ann: So dit is maar, ek sou sê, dieselfde.

Interviewer: Okay. So is daar enige manier wat julle dosent gebruik om te toets of het julle gaan voorberei?

Hannah: Ja, sy gee vir ons aan die begin van ‘n klas, gee sy vir ons ‘n aktiwiteit…dan moet ons dit invul en ingee. En dan… ja… merk sy dit en dan kyk sy watse punt het ons gekry.

Interviewer: Okay.

Hannah: Sy kyk dan of ons voorberei het. Sy sal dan kan sien of ons voorberei het of nie.

Henda: En sy kyk na ons werk… groepsopdragte. Maar ons hoef dit nie noodwendig in ‘n groep te doen nie. Want die hele aktiwiteit is waar ons die voorbereiding van die werk moes doen, maar dan… sy gee nie die… ek dink nie sy gee die memo van dit nie, maar as jy dan gesukkel het met iets, dan help sy jou of sy gee vir jou die memo verbaal. Maar sy merk nie daai goed nie. Dis maar net vir jou eie voorbereiding.

Interviewer: Okay. Lyk dit wat julle in die klas doen baie soos dit wat julle voorberei by die huis?

[Almal sê ja, dit stem ooreen]

Interviewer: Is dit? Okay. Sou julle sê in hierdie module is daar iets wat sal maak dat julle beter kan leer? Soos jy wat nou praat van daar is ander maniere om goed te verduidelik. En Wiskunde is eintlik baie so. Ons is almal gewoond daaraan dit word net vir jou gesê, en jy moet onthou en jy moet goed gaan leer, en jy dink as jy net oefen en oefen en oefen, dan gaan jy… So, al wat jy dan geoefen het, is om goed te memoriseer en om patrone raak te sien, en om heeltyd dieselfde ding oor te doen, maar het daar eintlik rêrig konsepte by jou gevorm? So, sal julle sê nuwe konsepte word by julle gevorm al is dit ouer werk?

Jade: Nie nuwe... nie noodwendig nuwe konsepte nie, maar nuwe maniere hoe ons dit kan gebruik vir aanbieding, veral… soos dit… my idee het baie verander oor hoe ek Wiskunde kan aanbied eendag as ‘n onderwyser. So, ‘mathematics module’ het in daai opsig baie gehelp, en Wiskunde ook. So, hmm... dit gee jou… dit gee jou half ‘n ander perspektief van die saak om dinge eenvoudiger te kan stel vir die leerders wat sukkel, maar tog nog steeds kan fokus op die moeiliker probleme vir die hoër presteerders in jou klas.

Interviewer: Nou my vraag vergeet. Ek het ‘n goeie een gehad. Hmm, okay, hoe selfgerig sal julle sê is julle?

Hannah: Ek berei baie voor vir my klasse, want dan voel dit vir my ek is meer in beheer, en dan sien ek, want as ek nie voorberei nie, mens weet ook nooit, want die dosente kan nie alles in die klas behandel nie. So, party goed gaan jy nie regtig weet jy mis dit nie. So, ek voel ek berei liewer voor, want dan weet ek wat ek als moet weet. So, dis vir my belangrik om….

Interviewer: Hoe berei jy voor? Watse bronne gebruik jy als?

Hannah: Ek sal… hmm… dit gaan google of ek sal in my handboek gaan kyk, en as ek nie verstaan wat in die handboek aangaan nie, dan sal ek dit gaan google. Ek sal eerstens my handboek en dan google gebruik.

Interviewer: Okay. Kyk jy videos?

Hannah: Ja. Ek kyk videos, ja, ja, ja op youtube.

Jade: Khan Academy help baie.

Hannah: Ja, Khan Academy.

Interviewer: Okay. En dan, Hannah, okay, so vind jy dat jy dit vir ‘mathematics module’ ook doen? Of vind jy vir jou meer vir vakke wat meer van ‘n uitdaging is?

Hannah: Ja, ek sal meer vir ‘module Y’ dit doen, en vir ‘mathematics module’… hmm… nie regtig nie, maar ek sal vir ‘module Y’ dit doen.

Interviewer: Okay. Henda, sou jy sê jy is selfgerig?

Henda: Ja, ek sal definitief sê ek is vir selfgerigte leer, want ekke probeer altyd… youtube is my ding wat ek gebruik. Ek kyk permanent youtube videos. Ek “worry” nie eers om op die skakels te druk van …as ek sien daar staan byvoorbeeld nou Pythagoras of Wiskundige induksie, dan tik ek op youtube in “Wiskundige induksie”, en ek kyk so sewe videos en ek kyk wat is gemiddeld omtrent dieselfde, en dan “figure” ek dit vir myself uit, want ek… ek het al gesien ook dat… soos die dosent is geneig om te aanvaar baie keer ‘n mens verstaan iets of jy verstaan nie altyd iets nie of hulle verwag jy moet dit al ken. So, dan het ek al klaar my voorbereiding in daai opsig gedoen deur te kyk hoe word dit gedoen en so…nou ja baie videos…ek kyk baie, baie videos.

Interviewer: Okay, en jy Ann?

Ann: Ek sal soos as met ‘mathematics module’ reg is, sit sy ‘n opdrag op wat nou jy as jou voorbereiding tel, wat jy moet doen. En as ek dit nie kan doen nie, dan sal ek eers google gebruik, maar as ek dit self kan doen, dan google ek nie of iets nie. Maar as ek nie iets nie verstaan nie, dan kyk ek in die… ons… wat is nou ons ‘mathematics module’-handboek?

[Mathematic Practices]

Ann: Ja, dan kyk in hom, want hy verduidelik baie goed.

[Die res stem in]

Interviewer: Is daar enige voorstelle wat julle het vir hierdie module?

[Stilte]

Jade: Soos ek gesê het, is… dalk moet die module geïntegreer word in Wiskunde, in met die konsepte wat oorbrug is en of dan dit net vir die intermediêre fase of vir die wetenskapleerders wat nou nie noodwendig vir... want die realiteit in Suid-Afrika is… jy gaan dalk nie aangestel word vir die vakke wat jy geswôt het nie. Hmm… en sê nou maar jy word aangestel … jy's 'n Senior en VOO –onderwyser en jy het Wetenskap gehad, dan neem hulle outomaties aan …maar as jy Wetenskap gehad het, is jy mos Wiskunde-vaardig ook. So kom ons gee my Graad 8 Wiskunde mense, want ons kort 'n Graad 8 Wiskunde-onderwyser ook. Dit was met my eerste proef het ek by so 'n onderwyser opgeland. Haar vakke was Biologie en Geografie, en nou is sy 'n Wiskunde-onderwyser. So vir daai mense kan dit baie help vir as jy nie 'module Y' het nie. Dan help dit veskriklik baie. Maar vir die van ons met 'module Y', vir my persoonlik, is dit 'n mors van my tyd.

Interviewer: Okay.

Ann: Ek dink dit is baie frustrerend, want as mens vang soos ons Matriek Wiskunde was eens rêrig soos geweet het wat in Wiskunde aangaan, en dit was redelik moeilik gewees, en van dit af het jy nou … okay, ek gaan nou universiteit toe… ons gaan dalk gaan moeliker Wiskunde… So jy het jouself "mentally" voorberei vir, okay, ek gaan moet op dit wees, want dit gaan moeilike Wiskunde wees. Dit is nie meer hoërskool Wiskunde nie. En nou vind ek dit 'n bietjie frustrerend, want dit voel of ek terug is in Graad 8.

Interviewer: Okay.

Hannah: Ek voel ook soos wat sy voel. Ek voel dit is 'n baie lang periode wat jy daar moet sit vir 'n uur en 'n half wat ons die heeltyd praat oor die stelling van Pythagoras. En dis vir my baie erg, want ons het dit al in Graad 8 onder die knie gekry. En nou verduidelik die dosent dit aan ons asof dit die eerste keer is wat ons dit doen, en dit is nie die eerste keer nie.

Interviewer: Stop gou daar. So word die werk wat julle dan moes voorberei, in die klas ge-"teach"?

[Ja – almal stem saam]

Henda: Nog steeds. Sy doen die hele uur en vyftien minute.

Jade: Ja, dis soos die vraag word beantwoord. As iemand ‘n vraag het, dan word die vraag beantwoord. Maar dit stop nie net daar nie. Dit gaan aan, en dit gaan aan.

Interviewer: Nou wanneer doen julle dan die groepstaak? Is daar genoeg tyd?

Hannah: Ja, aan die begin van die periode doen ons. Ons doen eers die groepstaak.

Interviewer: Hoe lank vat so ‘n groepstaak?

Hannah: Nie baie lank nie. Omtrent tien minute. Dis nie so moeilik nie.

Interviewer: En dan, Hannah, wat gebeur in die res van die periode as ‘n groep? Praat julle van die groepstaak? Is dit wat, toe ek netnou gevra het… gee sy vir julle iets om te kyk of het julle voorberei?

Hannah: Ja.

Interviewer: Het julle verwys na hierdie groepstaak?

Hannah: Nee, die groepstaak is ‘n… sy noem dit ‘n groepstaak, maar dis ‘n aktiwiteit wat nie punte tel nie, maar dit doen ons vir onsself. Dit tel nie punte of enigiets nie. Dan kom ons in die klas, dan kry ons soos ‘n toetsie tipe.

Henda: Ja, dis ook ‘n taak wat jy in groepe ook doen.

Henda: Maar ons kan nie altyd groepswerk toepas nie. Baie keer mag ons nie praat met mekaar nie.

Interviewer: Maar askies, wag, help my gou. Sorry, ek is nou onnosel. Julle… julle… julle doen iets ter voorbereiding, ‘n Werkkaart voordat jy klas toe gaan.

[Ja]

Hannah: Dis reg, dit is ‘n groepstaak, maar ons doen dit individueel.

Interviewer: Okay, en dan kom julle in die klas, en dan doen julle ‘n klein aktiwiteit van tien minute op julle eie.

[Ja]

Henda: Op ons eie of in ‘n groep…hang af.

Interviewer: Of in ‘n groep wat dan toets om te kyk wat is soortgelyk aan dit wat julle by die huis gedoen het. Okay, en dan, vir die res van die periode na daai tien minute?

Jade: Dan is daar… dan begin sy gewoonlik met ‘n slide show. Slides is gewoonlik so ses of sewe. Dan net die basiese inligting wat soos in rêrig belangrik is, vir as jy nou, soos ek soms sê .. jy het nie gaan voorberei nie, dan het jy nou al die belangrike inligting of wat ook al daar mag wees. Dan vra sy is daar enige vrae.

Interviewer: Met ander woorde, al het jy nie gaan voorberei nie, weet jy dit gaan vir jou ge-“teach” word in die klas.

[Ja]

Ann: Ja, basies.

Interviewer: Hannah, stem jy saam?

Hannah: Jaaa, ek dink so, want… dalk nie heeltemal alles in die voorbereiding nie, maar die meerderheid sal, ja… die meerderheid sal jy definitief kan verstaan in die klas, want na die slide is daar altyd weer ‘n aktiwiteit, nog ‘n klas-aktiwiteit ook. En dan merk ons hom ook. So, jy sal kan weet wat aangaan met die werk as jy nie voorberei het nie.

[Ja]

Interviewer: Okay. En dan enige raad oor eFundi... van die uitleg en wat daar moet wees en wat daar nie moet wees nie? Dit wat goed is.

Henda: Ek dink die videos sal help. Ek dink …

Interviewer: Hannah, stem jy saam? Dink jy, in plaas van jou wat jou eie te gaan soek, want ek sê net my bekommernis rondom dit. Ek sal niks daarvan hou nie, want ek wil hê my studente, en ek wil hulle nie beheer nie, maar daar is sekere goed wat ek wil hê hulle moet sien. Daar is sekere videos wat nie goed is nie. Hmm…wat… wat ek, ek sal wil hê… ek sal graag wil weet watter videos dit is wat my studente kyk… dat ons kan praat oor die video. Wat het julle gedink van daai video? Wat was vir jou goed van daai video. Wat was vir jou sleg van daai video. Hoe dink julle kan ons daai video verbeter byvoorbeeld. So, wat sê jy? Dink jy jy verkies nog steeds om jou eie te gaan soek, of sal jy hou van “ek wil hê julle moet hierdie video sien”?

Hannah: Ja, ek hou meer daarvan. Ek is oor die algemeen meer ‘n tipe persoon wat daarvan hou as iemand vir my sê presies wat ek moet doen. Dan voel ek ek weet wat aangaan. So, ek sal daarvan hou, en as ek nie dan die videos verstaan nie, dan sal ek net nog een gaan kyk, maar ek sal daarvan hou.

Interviewer: Okay, nog raad vir eFundi? Want eFundi is nou die hoofmiddel van leer hier voel dit vir my. Dit voel vir my eFundi kan dit maak of breek - ‘n flipped classroom, want eFundi is jou… moet die kanaal wees van waar jy jou basiese konsepte moet gaan weet… presies wat moet jy weet. Alles moet tot jou beskikking wees wat jy nodig het om sukses te kan behaal in die module, nè?

Henda: En dan is daar net, wat ek net gesien het, ek weet nie of dit dalk my laptop is, en of julle dit al ervaar het nie. Van die skakels, as jy op dit kliek, en dan is daar niks nie. So dis nou… (lag)…dan… dan kliek jy soos… dan gaan jy op die… dan is die studie-eenhede so hmm… opgestel uhh… pages, en dan kliek jy op die skakel soos van… vir meer inligting, klik hier, en dan …

Ann: Niks inligting nie.

Henda: Okay, so daar is nie meer inligting nie. Okay… kom ons gaan kyk of dit dalk onder is, of ek dalk mis…misgelees het, gaan kyk of daar onder skakels is. Gaan kyk maar na daai skakels. Hmm…en dit was net… nou die dag s’n, het onkant gevang… met die toets ook. Toe het sy… baie van ons het nie geweet dat ons oor omskakelings ook skryf nie, want sy het dit eers gelaai die vorige aand voor die toets opgelaai, en nie baie van ons het geweet nie.

[Onderbreking in opname]

Henda: En ek wil ook net sê ek… ek… dit gaan dalk negatief klink teenoor leer, en ek is nie negatief om te leer nie, maar ek voel die flipped classrooms gee die studente, soos die geleentheid om die werk op hulle eie te kry. So hulle hoef nie vir so lank klas toe te gaan nie. Want ek gaan beslis nie kans sien om op my eie te studeer, in my eie tyd te leer, en dan nog vir ‘n uur en vyftien minute klas toe te gaan nie.

Interviewer: Kan ek jou gou daar stop?

Hannah: Ja,

Interviewer: Wat van, as jy in die klas kom, en daar is vir ‘n uur en ‘n half ‘n baie uitdagende, stimulerende aktiwiteit?

Hannah: Ja, dan is dit die moeite werd.

[Ander sê ja]

Ann: Dis wat ons sê…dis wat ons eintlik wil hê.

Hannah: Maar ek wil nie op my eie werk, en gaan, en dieselfde les wat ek moes voorberei het, en self moes leer, nou weer hoor, omdat ander mense nie selfgerigte leer toegepas het nie.

Interviewer: Ek verstaan.

Ann: Ek dink sy kan, soos sê nou maar, net die basiese konsepte kan sy soos vir ons sê, okay, berei hierdie voor. En dan in die klas, dan… sy kan dalk twee minute gou-gou "recap"… okay dit en dit en dit, en dan…want almal het nou voorberei of moes, en dan kan ons eerder die werk wat, soos sê nou maar dis vlak een, nou die basiese konsepte, en dan kan ons opwerk na die hoër vlakke toe om dit half moeiliker te maak. Dan dink ek sal dit die moeite werd wees.

Interviewer: Okay. So, wat sien julle as julle rol in 'n flipped classroom? Julle kan bietjie dink.

[Stilte]

Ann: Ons is ons eie leerders en ons eie onderwysers basies by die huis ook. As jy basiese goed vir jouself eers kan uitpluis, voel ek jy leer beter as wat iemand net vir jou gaan sê.

Interviewer: So, jy dink dit is 'n goeie ding?

Jade: Dit is 'n goeie dink as dit reg toegepas word.

Interviewer: Wat van 'n meer uitdagende module? Kom ons sê ons pak nou een of ander "hectic", "advanced calculus". Dink julle dit gaan werk? Sê nou maar ek is julle calculus-dosent. En ek gee vir julle videos. Ek sê ek wil hê jy moet eerste hierdie video kyk, dan daai video, dan daai video. Dan wil ek hê julle moet vir my die refleksievorm invul dat ek kan sien of julle dit gedoen het. En dan, as ons in die klas kom, gaan ek niks vir jou "reteach" nie. Ek gaan vir julle 'n uitdagende aktwiteit, wat 'n toepassingsvraag sal wees, wat jy moontlik in 'n, jy weet, 'n level 4 tipe vraag in 'n toets sal kry. Kan julle saam dan werk of op jou eie.

Jade: En as jy dan vrae het...

Interviewer: En as jy dan vrae het, is jy daar vir ondersteuning. So, dink julle die flipped classroom kan werk? Dink julle, omdat hierdie ‘n maklike ding is, werk dit? Dink julle dit kan vir ‘n uitdagende vak werk? Henda?

Henda: Ek het dit definitief beleef… beleef, laas… laas semester, want ek het baie keer voor klas gaan kyk wat… wat doen ons, en dan, in moelike vakke, en dan het ek videos solank gaan kyk om seker te maak. En dan as ek in die klas stap, dan het die lektor, alhoewel hy bietjie vaagweg verduidelik het, het ek presies geweet wat hy van praat. Waar ander mense wat nie voorberei het nie, het daar gesit soos wat? … waarvan praat hy? Soo…dit het definitief gehelp.

Interviewer: Okay, Hannah, en jy?

Hannah: Ek voel persoonlik ‘n flipped classroom is bietjie moeilik vir, sê nou, kinders wat aandagafleibaar is, en so. Want hulle kan maklik voel dat daar nie orde in die klas is nie, want dit kan… dit kan moeilik raak vir hulle, maar vir kinders wat goed kan konsentreer en goed op hulle eie kan werk, kan dit voor werk. Maar kinders wat sukkel om te konsentreer, kan moeilik raak voor.

Interviewer: Ja, okay. En dan, skies nog terug na my eerste vraag. Ek het myself onderbreek… van jou rol in die flipped classroom. Enige iemand wat daar iets nog wil bylas?

Ann: Ek dink jou energie speel ‘n baie groot rol, want hmm…Mr X se klas is ook ‘n redelike flipped class vir my, en soos ek, ek “love” dit om in sy klas, want hy’s heeltyd… hy’s… sy energie… ‘n Mens kan sien hy is passievol oor wat hy doen. Soos ek het… ek gaan definitief… as ek ‘n onderwyser is, wil ek presies soos Mr X klasgee.

Interviewer: Okay.

Ann: Ek voel dit gaan dalk net soos, ja, jou energie, en hoe jy self teenoor die leerders is, speel ‘n baie groot rol.

Interviewer: Okay. Nog enigiets oor jou as student se rol in die flipped classroom?

Henda: Ja, ek voel net jy moet… jy moet rêrig baie verantwoordelikheid hê en selfdissipline, want jy het nie altyd die tyd om te gaan sit voor jou boeke nie, en as jy die tyd het, het jy nie die energie of die lus daarvoor nie. En ‘n mens moet net… ‘n mens moet gaan sit en ‘n mens moet dit doen om… want dit… die flipped classroom, voel ek, gaan nie ‘n sukses wees as ‘n student nie sy kant ook bring nie, want dis tog….

Interviewer: So, daar moet dalk tipe van maatstawwe wees om beter te gaan toets hoe berei hulle voor, sonder om hulle nou weer te forseer, sonder dat jy hulle nou weer … nou weer spoonfeed, en dat hulle nie leer om selfgerig te wees nie. Daar moet ‘n maatstaf of twee wees om te gaan kyk het hulle voorberei. En wat van die dosent se rol in die flipped class? Wat dink julle moet die dosent se rol wees vir ‘n suksesvolle implementering van ‘n flipped classroom?

Jade: Ek het beleef … in een van my ander vakke was daar… ons het elke week op eFundi ‘n toets geskryf oor daai week se werk, en dit het my gedwing om te leer, want ek het die helfte van die tyd in die klas het ek geslaap, want die vak het my bietjie verveel.

Interviewer: Kan ek jou gou stop? So, met ander woorde, eerder as om ‘n toetsie in die klas te skryf, sommer om op die internet ‘n toetsie te skryf?

[Almal stem saam]

Henda: Ja, soos byvoorbeeld, die Maandag was die sluitingsdatum. So, dan het jy die hele naweek gehad om daai week se werk wat behandel is, daai hoofstuk, moes jy voorberei en dan het hy begin met die toetsie. En dan was die toetsie se multiplechoice vrae uit die…daai hoofstuk se werk uit. En dit het my rêrig gedwing om te leer, want ek kon nie anders nie, want ek moes goed doen in die toetsie. So, alhoewel ek nie lus was om te leer of iets te doen nie, moes ek, want ek het ‘n toets geskryf daaroor.

Interviewer: Okay, so jy sien die rol van die dosent is dalk om op so ‘n manier seker te maak jou studente bly by en leer.

Henda: Ja. Dis nie lekker nie, maar dit gebeur. (Lag verleë)

Jade: Ek dink ‘n dosent moet ‘n fasiliteerder wees. Meer as ‘nchalk-en-dolker soos wat ons gewoond is. So, hy moet daar wees om te assisteer as jy op die verkeerde pad is, jou uit te daag om op nuwe maniere te dink, maar hy moet nie net die primêre bron van inligting wees nie. Jy moet, jy moet self gaan inligting doen en moet die agtergrond inligting doen, moet die basics ken. Jy kan nie dit weer in die klas… verduidelik… as jy nie…as jy nie lus was om voor te berei nie, want dan mors jy nie net jou eie tyd nie, maar jy mors die ander studente se tyd ook.

Interviewer: Ja. Hannah?

Hannah: Ekke dink die dosent se rol in so ‘n flipped classroom sal wees om, wanneer hy vir jou ‘n aktiwiteit gee, wanneer hy vir jou die aktiwiteit gaan gee om jou kennis te toets, dan

moet hy baie breed kyk na wat alles, wat hy als daar insluit, sodat jy ‘n goeie idee het van wat jy alles kan verwag. So ja…

Interviewer: Okay. So, verstaan ek jou reg as jy sê ‘n refleksievorm sal nogal goed werk voor die tyd om ‘n idee te gaan kry… oe, baie het daai gesê, baie het daai het gesê. So ons gaan dit aanspreek in die klas… nie als nie.

Hannah: Ja … Ja….

Interviewer: Okay. Nog iets vir die rol van die dosent vir ‘n suksevolle implementering?

[Stilte]

Ann: Ek weet nie.

Interviewer: Daai goed kan goed werk. Enige laaste… Henda, wil jy nog iets sê?

Henda: Ja, ek voel. Sorry ek het nou net daaraan gedink. Ons het dit in een van ons ander vakke geleer van die dosent… soos die onderwyser se energie en liefde vir die vak soos kom uit sy energie, en hulle moet my… soos hoekom wil ek leer wat ek leer. Ek verstaan ek moet leer, want ek moet deurkom. Maar wat maak dit nuttig vir my om… om te gaan sit en iets te verstaan. Hoekom wil ek dit verstaan sonder om net te dink ek moet goed doen daarin.

Interviewer: Te “worry” oor ‘n punt, nê?

Ann: Ja, in die tyd wat… want die dosent speel tog ‘n belangrike rol, want hulle… hulle… die rekenaar is nie dieselfde as die… as die persoon wat dit vir jou aanbied nie. En as hulle vir jou… hulle gaan vir jou ‘n rede gee hoekom jy daai werk moet leer, en hoekom dit lekker is, en hoekom dit interessant is, en wat sê hulle mos… in… hmm… jy kan nie die kinders lief maak vir die vak nie, maar hulle kan dit lief maak vir jou.

Interviewer: Ja.

Ann: Deur daai proses, ek voel in die tyd wat ons spandeer saam met die dosent, moet hulle ons ‘n rede gee hoekom hierdie ‘n “awesome” vak is, en hoekom ons wil gaan studeer, en hoekom dit “cool” is om dit te leer.

Interviewer: Ek dink nou sommer aan iets toe jy praat oor die videos. “Obviously” die videos wat julle self gaan google, is alles Engels. Is ek reg?

[Ja]

Interviewer: Okay. Pla dit een van julle? Sal julle verkies, as julle nou sê, jy wat sê, Hannah, jy hou daarvan as jy weet presies “scaffolding”… wat word van jou verwag, stap een, stap twee, stap drie, en dan is jy reg. Dink jy jy sal dit verkies dat die dosent self jou video maak of dink jy jy sal dit verkies dat die video eerder in Afrikaans moet wees, of voel jy “happy” met die bronne in Engels wat jy daar kry?

Hannah: Ek is gelukkig met die bronne in Engels, want ons handboeke is alles in Engels. So dan leer ek in elk geval die terme in Engels, en dan is dit eintlik makliker so.

Interviewer: Ek weet, jy kan seker nie praat namens ander mense nie, maar ‘n algemene gevoel van jou klasmaats? Dink jy hulle deel jou gevoel?

Hannah: Baie mense verkies eintlik om in Afrikaans te leer. Baie van my klasmaats waaraan ek kan dink.

Interviewer: So, jy dink hulle sal die video’s in Afrikaans verkies?

Hannah: Ja, ek dink die meerderheid sal dit wel in Afrikaans verkies. Jade, ek sien jy skud jou kop so. Dink jy…Afrikaans…

Jade: Ja, die Afrikaanssprekendes. Dit is…dit was vir my nuut. Ek het nou vir die eerste keer hierdie jaar, hmm… fisies klas gekry in Engels…Wiskunde gekry in Engels vir die eerste keer, maar ek het… my pa is ‘n Wiskunde-onderwyser. So ek het hom gehelp met die vertaling en alles. So ek ken die terme al van die hoërskool in Engels. So, dis net… dis vir my hartseer half nou dat ek, ek skryf nie meer net in Afrikaans of net in Engels nie. So, ek meng my taal verskriklik. En dis nie ‘n baie goeie eienskap vir ‘n onderwyser eendag nie, en jy kan nie jou tale meng nie. So dis… dis al wat my nou bietjie pla daaromtrent. Maar… ja, as ek… ek voel dat ek leer… ek leer in Afrikaans. Ek leer gewoonlik in Afrikaans. Ek gaan vertaal my handboeke. Maar as ek nou vining ‘n nota moet maak of ek kry daai aktiwiteite uit die handboek, en die handboek se aktiwiteite en die vrae is altyd in Engels, dan, voor ek myself kan kry, dan is ek klaar besig om te antwoord in Engels. Soos met die toets nou die dag. Voor ek myself kom kry, toe begin ek die Engelse kant lees, want die Afrikaanse kant was nie so informatief…toe begin ek die Engelse kant lees, en ek begin in Engels antwoord. So…

Interviewer: Dit gebeur. Wil jy iets sê Ann?

Ann: Ek voel ek verkies dat die video’s in Afrikaans is, want ek leer nog in Afrikaans, maar soos die definisies leer ek in Engels, want die handboek is Engels.

Interviewer: Ja. Okay. Ek wou nou vir julle een laaste ding gevra het. Hmm… voel nou vir my dit was belangrik. Okay. Enige laaste gedagtes? Okay. Dankie julle.

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Micro-cycle 5

Petra – current lecturer semi-interview

Interviewer: Dankie mevrou, die klas is darem nou weer ‘n maand aan die gang so ek wil net vinnig terugvoer hê van hoe gaan dit sover?

Petra: Okay, ek dink die klas is vir my nog nie heeltemaal, ek wil nie sê hulle het nie ingekoop in die ding nie, want hulle het almal gesê jy weet hulle koop in in hierdie idee maar dis vir my asof hulle nie so verskriklik ‘involved’ is as wat ek sou wou hê. Ek wil die nie vergelyk met verlede jaar se klas nie, maar op hierdie stadium dink ek verlede jaar het die kinders baie meer, of die studente vir my baie meer wil ek amper sê, opgewonde oor die ding gewees. Daar sou studente wat sou gekom het en sou sê hierdie het ons nog ekstra gekry en so. Ek het dit nog nie hier gekry in hierdie klas nie. Maar ek dink nie dit gaan sleg nie en ek dink dalk het dit hulle al bietjie gehelp soos ek sê want ek het die manier van skryf en met die baie klas, ek wil dit amper nie ‘n toetsie noem nie, maar ons doen ‘n toetsie aan die begin van die periode mos dat dit eintlik ook my bywonings ding is en dan ook om te sien wat hulle voorberei het en ek dink dit wat hulle al daar gedoen het jy weet hulle leer tog om dit ten minste dan reg te skryf so ek dink nie dit gaan slegter nie, ek dink dit gaan beter.

Interiewer: Wat dink mevrou is dalk ‘n faktor dat hulle nie so ingekoop het soos laas jaar se groep nie?

Petra: Sjoe ek sal nie weet nie. As ek so van buite kyk sal ek rêrig dink dis wil nie sê dis ‘n tipe kind nie, want daar is nie ‘n tipe kind nie, of studente nie dit is ‘n groepsding dalk jy weet. Weet nie of dit, weet net soos jy by ‘n skool klas kry of by enige plek klas kry. Hierdie is hulle, is nogal reg om te leer en hulle wil dinge self ook doen waar hierdie vir my mos baie is dat hulle is daar want kyk ons skryf ‘n toetsie en dit tel ‘n punt elke keer maar hulle is baie ingestel om te weet tipiese eksamen goed. Hulle wil op die ou end die ding *pass* dis wat, dit voel dis presies, dit voel nie vir my of hulle voel ons moet nou hierdie goed rêrig goed verstaan nie miskien kan dit wees omdat dit eintlik redelik maklik is en hulle dink hulle verwag nie om sulke maklike goed, ‘n hele module te hê oor hierdie goed eintlik nie.

Interiewer: So, dit gaan nie vir hulle oor die leer op hierdie stadium nie, dit gaan net oor die punt.

Petra: Ja, ek dink so.

Interviewer: En dis eintlik hartseer. Want hulle kan die geleenthied aangryp om hulleself regtig op hierdie stadium te bemagtig oor hoe hulle hierdie gaan aanbied eendag vir hulle studente.

Petra: En al is dit so relatiewe maklike module wil ek amper sê, dis ‘n baie belangrike module, want baie goed gaan daar op bou. En hoe beter jy hierdie goed verstaan, want ons weet almal hier gaan hulle weet nou opperlakte van ‘n reghoek is lengte maal breedte en driehoek sin is dit en wat okal, maar op die ou end oor ‘n jaar as hulle iets moet doen en ‘n reghoek of van enige vorm al wat hulle onthou van opperlak is lengte maal breedte. Dan gaan hulle dit sommer vir ‘n sirkel ook sê. Ek meen ek het dit al gesien.

Interviewer: Defnitief.

Petra: Ek het dit gesien by ouens wat ‘n onderskeiding vir wiskunde in matriek gehad het, vra hom vier jaar later dan weet hy nie wat dit is nie.

Interviewer: Mevrou, maar julle fokus is nie didaktiek nie julle fokus nie en sê luister wat het vir jou gewerk, hoe sal jy hierdie vir die kinders dalk verduidelik. Dis nie julle fokus nie?

Petra: Nee, dis nie die fokus nie, maar dit is geïntegreer, dit moet daar in wees.

Interviewer: So, dit kom tog uit?

Petra: Ja, dit moet daar in wees.

Interviewer: En dan, hoe is deelname sover, kom hulle klas toe?

Petra: Absoluut ja.

Interiewer: En hulle is maar gemotiveerd ook oor klas toetsie en daar word punte daaraan gekoppel. Sal interessant wees as mens dit eintlik wegvat.

Petra: Ja, dit sal.

Interiewer: Enige terugvoer van hulle kant af, positief of negatief of albei.

Petra: Kyk, daai papiere wat ek elke week vir jou ingevul het, ek maar ‘n punt en vra vir hulle aan die einde, die laaste 10 minute vra ek vir hulle, vertel vir my, hoe ervaar julle die klas, wat is vir julle goed. Wat ek daar geskryf het is eintlik wat hulle maar sê, ek probeer dit elke keer so onthou, dit was hulle voorstel dat ek vir hulle op efundi reeds ‘n opdrag ook sit en nie net die *links* nie weet en toe nie die laaste twee drie keer dis nou die derde week wat ons dit het.

So, en hulle het vir my gesê dis vir hulle gaaf, maar ek moet sê, want die volgende week skryf ons toe toets dan sal hulle ook dit wat hulle eintlik wil weet, is daai nou tipies soos wat dit in die toets gaan gevra word, waar ek nou weer voel vir my maak dit nie eintlik saak wat ek, hoe dit in die toets gevra gaan word nie, ek is nie daar om hulle vas te vra nie, dit was nog nooit en ek dink nie dit behoort enige iemand, enige dosent se uitgangspunt te wees nie. So, ek wil hê jy moet, al is dit basies of al is dit maklik dit gaan eintlik vir my oor die *basics*. Ek wil eintlik hê jy moet die basis verstaan weet dis wat jy moet leer in hierdie klas. Sodat jy hierdie, weet ons praat nie van ‘n *toolbox* met die dinge nie, maar ek wil amper sê ons bou aan jou *toolboksie* sodat wat jy het en hoe meer goed jy het, hoe meer het jy om te gebruik. Wat jy okal gevra word.

Interiewer: Okay. En dan hoe verloop die klas. Algemene verloop van die klas van begin tot einde min of meer.

Petra: Okay. Onthou nou hulle het nou of is veronderstel om op efundi die links te kyk, en so dan begin die klas met eerste ding skryf ons daardie toetsie oor dit wat hulle voorberei het, maar baie baie direk en maklik ook daai. Rêrig waar dis nie moeilik daai nie, want daar is ouens wat vir wie dit moeilk was om voor die tyd die goed te gesien het so daai is dit tel op die ou end 1 punt maar, in elk geval net die idee so dit is die toetsie en dan as hulle klaar is, dit neem ek in en dan soort van bietjie admin reëlings bietjie praat jy weet of iets. En dan vra ek vir hulle of as ek nou sê die slide kom wat sê vandag se klas gaan dan nou oor byvoorbeeld oppervlak en omtrek van vlak figure dan sal ek vra want hulle het mos nou al die goed gaan kyk klaar dan sal ek sê wie het enige vraag oor enige iets wat jy nou in voorberei het of wat okal as daar enige iets oor ‘n omtrek of ‘n oppervlak is sê dan nou maar van veelhoeke is wat jy vir my wil vra, nou is die tyd en as hulle nie vra nie, die ideaal is darem iemand moet iets vra jy weet, maar goed. As hulle nie vra nie neem ek eintlik aan want dis hoe ek verstaan dis die hele idee van die flipped classroom, dan gaan ek hulle nou nie verveel om vir hulle te *reteach* nie, want hulle het mos nou daai deeltjie geleer dan gee ek nou vir hulle ‘n moeiliker opdrag in die klas en gee hulle dan so 10-15 minute afhangende van hoeveel dit is en in daai tyd stap ek deur en dan vra hulle my nogal jy weet en dan merk ons daai opdrag in die klas en dan gewoonlik praat ons oor die jy weet, hoe ervaar hulle die klas en daai dinge en dan is dit klaar.

Interiewer: En dan, so dit lyk of hulle darem bietjie voorbereid is en kan mens op ‘n manier dalk inbring wat mevrou nou al aan gedink het hoe mens kan monitor om te kyk of hulle dalk beter voorberei?

Petra: Nee ek weet nie, ek meen ek, die feit dat hulle die toetsie skryf dis my manier om te kyk of het hulle voorberei, want as ‘n ou nou glad nie voorberei nie en jy weet nie iets van wat ek daar vra nie, al is dit maklik dan gaan jy dit nie kan doen nie. Waar as jy ‘n ou kry wat nogtans hierdie goed kan doen en hy het glad nie voorberei nie dan het hy dalk nie nodig gehad om voor te berei nie so dit pla my nie einlik dan as hy nie voorberei het nie.

Interiewer: Ek hoor wat mevrou sê.

Petra: As hy inelk geval die goed kan doen, weet. Ek dink dis deel van self-gerigtheid, is dat mens moet, jy weet mos of jy daai goed ken. As hierdie ding gaan oor omtrekke en oppervlaktes van vierhoeke, of van veelhoeke ek weet man ek verstaan daai goed lankal ek kan vir die juffrou ‘n les gee daaroor, weet.

Interiewer: Dis waar, ek het nie so daaraan gedink nie.

Petra: Ja, dan hoef jy nie voor te berei nie.

Interiewer: So, sal mevrou sê op hierdie stadium is daar enige iets wat dui op self-gerigtheid op hierdie stadium kom dit darem so voor in die klas en voor die klas en met interaksie met hulle?

Petra: Ek dink so.

Interiewer: Is dit?

Petra: Ek meen die vra, dit wat hulle aan die einde van die klas wanneer ek nou vra vir refleksie as ons bietjie praat oor goed dan moet ek sê ek het nog eintlik opgetel by hulle wat vir hulle werk wat hulle van hou sê hulle vir my en dis wat ek in daai goed geskryf het is dat hulle jy kan daai toetsie wat hulle skryf byvoorbeeld meen dit gaan nou uit en uit oor wat hulle voorberei het. Hulle sal sê dit help hulle om te sien wat hulle toe ken en wat hulle toe nie ken nie en dan kan hulle in daai groep met hulle groepmaats nou ook as hulle nie iets verstaan nie by daai een hoor so, maar ek weet hulle het spesifiek gesê en dit kom amper elke keer uit dat dit help hulle om te weet wat hulle toe weet want ek dink eintlik hulle is op daai stadium en omdat dit ‘n bietjie dit is nie noodwendig ‘n maklike module nie, maklik bedoel ek almal gaan nie honderd present vir daai module kry nie weet, glad nie en die hulle weet hoe lyk ‘n vierhoek en hulle weet hoe lyk ‘n vierkant en daai goed maar daar is min van daai ouens as ‘n mens nou tipe wil ek amper sê ‘n kort vraag, ‘n *monkey puzzle* tipp van vraag dalk sê, want ek het dit in nou die dag se toets gedoen. Byvoorbeeld sê klassifiseer die volgende vierhoeke weet spesifiek en as ek dan nou sou sê byvoorbeeld ongelyke hoeklyne sny mekaar loodreg weet as jy dan nou mooi dink kan dit net ‘n vlieër wees. Ongelyke hoeklyne en hulle halfeer

mekaar ook nie. Want nou, daai goed is vir hulle so hulle moet dis nogsteeds onthou, ek het ‘n baie groot storie met lees met begrip. Ek dink nie hulle verstaan wat hulle lees nie en hulle kies sommer iets daar. So die groot amper skok gaan vir hulle nog kom as hulle nog daai tipe kort vra goed ook antwoord want dit dink ek toets daai insig ook goed.

Interiewer: Defnitief, want hulle assosieer wiskunde mos nou maar net met getalle en ‘n prentjie van ‘n vlieër en om in woorde te beskryf wat daai is, is ‘n groot problem. Dan, nog twee goedjies. Die een is, is daar nie klagtes nie, maar kommenataar oor bronne wat net hoofsaaklik in Engels is, is daar enige iets soos dit?

Petra: Niemand het nog vir my iets gesê nie.

Interiewer: Okay so.

Petra: Ek dink onthou ek gee in Afrikaans klas, daar dis nie soos by afstand wat in Engels is nie. Hulle het, goed, hulle is oorwegend Afrikaans in die klas so dis vir my miskien die ander ding waar ek wil hê die ou wat dit dan nie verstaan het nie moet dan vir my aan die begin van die klas vra. Ek doen wel, al is die tolk daar, ek kry myself, ek sê baie keer die engelse woord in elk geval vir hulle. Net soos ek in die afstand in Engels klas gee en ek weet daar sit Afrikaanse kinders, ek noem vir hulle die Afrikaanse terme. Want omdat ek weet die tolke nie altyd die term gebruik wat ek sou gebruik het nie jy weet.

Interiewer: Ja, dit is so.

Petra: So, ek doen dit.

Interiewer: En dan, so mevrou se tydsgebruik voel dit vir mevrou asof mevrou se tydgebruik dieselfde is as gewoonweg of gewoontlik in ‘n meer tradisionele klas of is dit min of meer dieselfde? Hoe beïnvloed die flipped classroom mevrou se tyd?

Petra: Kyk die feit dat ons nou elke klas ‘n toetsie skryf voor, nou goed ek het assisstente, maar ek laat hulle nie merk nie, want ek merk graag as ek dit kan hanteer, want dan kan ek presies sien waar hulle reg of verkeerd skryf en ek is konsekwent reg deur. So, dis hoekom ek verkies, so ek sal sê daar vat dit dalk nogal bietjie ekstra tyd maar dis nie vir my ondoenbaar en ek merk die dag as ek dit kry die volgende dag jy weet. Dit kan bietjie meer tyd vat en dan juis omdat onthou hierdie het ek nou die *links* en alles het ek nou al verlede jaar opgesit en ek is eerlik en omdat ek so hierdie jaar min tyd voor daai tyd gehad het, en self nou nog, het ek nie spesiefiek nuwe goed gaan soek nie. So, ek is dankbaar soos vir die nuwe goed wat jy nou gee weet.

Interiewer: So, mevrou sê dit is die tyd, dis nie die flipped classroom wat mevrou se tyd vat nie dit is mevrou se werkslading oor die algemene.

Petra: Ja ja, dis hoekom ek nie by die flipped classroom nou ek het hom mos eintlik wil ek amper sê hierdie klas is verlede jaar al voorberei en hy het baie goed gewerk verlede jaar. As hy nie vir my goed gewerk het nie, dan sou ek spesiefiek meer goeters gedoen het. Wat ek wou doen en wat ek nou al gedink het ek volgende jaar gaan doen in elk geval weet is ek wou mos vir elke klas ‘n video gemaak het self oor daai ding al was dit ‘n elementêre iets, ek wou soos wat ek ‘n klas daaroor sou gee wou ek ‘n 10 minuut video maak en dit oplaai vir hulle ook elke week vir hulle. Want spesifiek Sams en Bergman, die *founders* van die flipped classroom, hulle sê ook mos eintlik is dit die beste dat die dosent of die onderwyser self dit doen jy weet. So, dit is my plan vir volgende jaar, maar ek het ook gedink kyk ek sal nou ons gaan nog hier by die vlakke en die kante en goeters van 3d ligame met Euler se reël en dinge ek het gedink ek gaan dalk daarvan dalk ‘n video of iets maak maar dit kom so oor ‘n week of drie weet dan sal ek dit opsit. Want hierdie eerstes was vir my ook ek dink dis dalk maklik genoeg en daar is genoeg goed op die internet gewees wat hulle kon kyk.

Interiewer: Daar is baie goed op die internet, ja. Dit is so. Hulle sê, Bergman en Sams sê, van die videotjie self maak, dit is waar. Ek dink nou sommer wat ‘n *nice* manier is wat ek dink mens dalk kan inkorporeer wat ook sommer tipe van monitor of berei hulle voor, is mens sê sommer in daai video eerste ding as jy in die klas kom wil ek hê jy moet dit of in die klas gaan ons dit. So, dan gaan mens dadelik agterkom as mens in die video sê, weet hulle wat gaan in die klas aangaan en dis ook ‘n manier om te kyk of hulle die video gekyk het. Maar in elk geval. Okay baie dankie vir mevrou se tyd.

Petra: Plesier.

Micro-cycle 6

Focus-group interview 3

Interviewer: Dankie julle. Welkom. Hmmm … die eerste vraag. Enige een van julle kan gaan. Ek het in die vorige fokusgroep het ek agtergekom dat, dit voel vir my, baie van julle sien nie die nut om voor te berei nie. Verskeie redes van vorige kennis en hmmm… dat die werk nie eintlik uitdagend is wat julle in die klas doen nie. So, julle het nog sover reggekom deur nie eintlik te veel voor te berei van julle nie. So, ek wil net by julle hoor… van julle… hoekom berei jy steeds voor of doen jy nog steeds nie?

Michelle: Hmmm, ek berei voor, soos omdat ons dit so lank terug op skool gedoen het. Soos dis so half graad agt, nege, werk. So, dan berei ek half net voor om te kyk… soos, hoe doen ek dit nou weer, of net om vining weer te recap, maar jy berei nie eintlik voor, voor nie. Veral as jy, soos, gedruk is met jou ander akademiese goed, dan gaan jy nie twee ure daaraan spandeer om weer te kyk as jy.

Interviewer: Okay. Michelle, dink jy jy sou meer voorberei het as daar uitdagende inhoud in die klas was wat jy geweet het, sjoe, ek moet my storie ken, want dit wat ons in die klas doen, daag my nogal uit, en dit wat in die toets is, of so.

Michelle: Ek sou ja, ek sou verseker, want, soos byvoorbeeld, iets wat ek heeltemal van vergeet het, voorwaar ons moes voorberei het, het ek baie meer moeite gedoen om voor te berei, want die klas is so van, as jy nie voorberei het of as jy nie weet watter, as jy nie weet watter werk behandel word nie, dan, dan's jy nie by in die klas nie. En dan, as jy nou 'n toets skryf wat ook al, dan…

Interviewer: En het dit 'n rol gespeel, die feit dat dit half 'reteach' word in die klas?

Michelle: Partykeer het die gehelp, want dan besef jy, okay, soos dis, dis eintlik so of jy snap dit dan beter of so iets, maar ander kere, dan sit jy net daar. En ja…

Interviewer: Okay. Een van julle?

Anet: Omdat dit partykeer voel asof daar nou nie nuwe goed is nie, dan berei jy maar voor om te weet wat aangaan in die klas, maar tog, as jy in die klas kom, verduidelik sy net dieselfde werk oor. So dan let jy ook nie rêrig te veel op in die klas nie. So, jy berei maar voor om te

weet wat gaan gebeur, en jy doen nou maar die takie wat daar is vir ingeval sy dit as deelname gaan vat. Maar dit is ook.

Interviewer: So, op die ou end is dit half jou punt wat jou dryf … wat as ‘n deelname kan wees dan…

Anet: Ja, omdat dit ‘n basiese vlak is. Omdat dit klaar soos ‘prior knowledge’ is…

Michelle: En soos in klas presence, is dit half net of ‘n mens met ‘n halwe oor luister as sy werk verduidelik wat jy klaar verstaan het. En dan dalk, as sy iets noem wat nie in die video was, of in die opdrag nie, dan sal ek dalk nou weer luister… o okay… nou weet ek ook. Want dan sal ek gewoonlik iewers sal ons dit moet gaan toepas, so…

Vera: En ek dink as sy nie die hmmm… die werkskaart opgesit het nie, het ek nie voorberei nie…

Interviewer: Is dit? So, so begin jy? Dis eintlik my volgende vraag. So, Vera, hoe begin jy jou voorbereidingstyd? As jy nou besef, ‘mathematics module’, ek moet voorberei daarvoor. Wanneer begin jy, en hoe gaan jy te werk? Wat is jou gedagteproses?

Vera: Want soos ek voel… sy doen basies die werkkaart in die klas. So, as sy nie die werkkaart opgesit het nie, het ek dit nie gedoen nie, want soos die werkkaart doen ons, merk ons in elk geval in die klas, so dan kan ek nou maar… Maar as sy dit nie opgesit het nie, sou ek nie voorberei het nie, want sy doen basies presies dieselfde werk in die klas. So dan… is dit net soos ‘n herhaling eintlik.

Interviewer: Okay. Okay, so, hoe gaan jy te werk met jou voorbereidingstyd, en wanneer vind dit plaas?

Vera: Wel… gewoonlik… dit hang af nou wanneer sy die email stuur. En partykeer is dit baie laat in die aand, of sy vergeet daarvan. Soos nou, soos toe, as die kinders haar nie gister gaan vra het wat ons moet leer nie, het sy nie eers geweet ons skryf toets nie. Sy’t vergeet daarvan. So, toe is dit soos, okay, toe het ook sy nie ‘n werkkaart opgesit nie. Ek dink sy moes eintlik. (ander stemme beaam). Veral met buite-oppervlakte-formule.

Rachelle: Sy wou, en sy het nie.

Vera: Want ek dink dit kan nogal moeilik gevra word op sekere dinge, want ek het na die voorbeelde in die handboek gaan kyk. Dis nogal ingewikkeld (stemme beaam). So, ek dink dit

sou nogal nice gewees het as sy kon ‘n werksopdrag opsit vir die eksamengewys ook…vir voorbereiding.

Anet: Want ek weet nie van toe julle op skool was nie… daai oppervlak-area was baie vining gedoen (ander stemme beaam). Daar was nie so baie detail daaraan spandeer nie. So, ek voel daar kon op ‘n stadium baie detail daarop spandeer word.

Interviewer: Met ander woorde…hierdie kan tog nog nuwe kennis (stemme beaam) op ‘n manier gewees het. Dit kan interessant gewees het. Dit kan jou gehelp het om dan te verhoed wat met julle gebeur het…is dat op skool was dit vining vir julle en as ‘n afgematte topic aangebied wat dan nou kan verhoed dat jy dalk kan teruggaan skool toe en dit dalk heeltemal anders doen, want dis eintlik so ‘n lekker topic. Okay, ek wil nog by een van julle, Rachelle, sal ek ook nogal wil hoor … ek sal jou gedagteproses wil hoor. Soos, wanneer begin jy voorberei, hoe werk jou voorbereidingsproses? Hoe werk jou gedagtes? Okay.

Rachelle: Okay, so wanneer sy nou die werkkaart opsit, want al die ander vorige werkkaarte wat sy opgesit het, sal ek, as hy uitkom, dan sal ek hom dadelik doen, of as ek tyd het, dan sal ek hom dadelik doen. Anderste, dalk die Dinsdag as ons die Woensdag klas het. Maar ander kere doen ek hom as hy uitkom, sodat ek mooi voorbereid is. En… dan sal ek ook kyk na die… die lys wat sy gegee het van wat ons moet half voorberei wat volg op die klasse. En as ek nou dink ek weet wat aangaan, dan sal ek net vining na die werk kyk, en nie dit soos voorberei soos ek wat eintlik moet nie, omdat ek al baie weet van dit.

Interviewer: Waar begin jy? In jou handboek? Soek jy ‘n video? Gaan jy na eFundi toe om te kyk? Hoe gaan jy te werk?

Rachelle: Ek kyk maar eers in my handboek. So, en as ek dan nie daar regkom nie, dan sal ek videos gaan soek op Youtube, maar dit het nog nie gebeur nie.

Interviewer: Is dit? (Rachelle: Verleë lag). Okay. Interessant. Wil een van julle dalk iets daar bylas?

Michelle: Ekke begin soos gewoonlik met die aktiwiteit wat sy dan nou gee. En dan werk ek van daar af. Ek antwoord dit wat ek kan, en dan as ek by ‘n vraag kom…. Okay, so ek begin by die werkkaart wat sy dan nou … as sy dit betyds op eFundi sit. Hmmm… dan sal ek daar begin, en dan antwoord ek wat ek kan, en dan as ek by ‘n vraag kom wat ek nie verstaan nie, sal ek of in die handboek gaan soek of dan nou … ek sal eerste na die handboek toe gaan, want gewoonlik is dit dan daarin. En dan sal ek videos kyk en dan sal ek op eFundi lees. So, ja, maar ek het nog nie rêrig videos gekyk nie. Ek het nog nie die verplig … nie verplig te wees

nie, maar daai … hmmm… een keer het sy daai e-pos gestuur met video-les op, en toe ek het die een gekyk. En het hom begin kyk, en toe besef ek maar ek verstaan die werk, en toe skip ek aan en toe…nog nie rêrig nuut nie, toe skip ek ... en toe het ek hom eintlik nie gekyk nie. So, ja…

Interviewer: Okay, hmmm…

Vera: Kan ek iets sê? Ek voel soos daai videos sal gaaf wees, nie dat ek sê ek weet wat daar aangaan nie, of dis hoe dit werk nie, maar dit wat daarop is, is nogal… dit het my baie gehelp. Soos baie van dit is ‘n kort opsomminkie gewees. Dis cool.

Interviewer: Waar kry jy dit?

Vera: Op eFundi. Soos ek het ‘n hele boek wat ek opsom… Soos my boek is rêrig nogal op datum en alles. Hmmm… so ek gaan soos voor die tyd soos wat ek op datum is met my boek soos by eksamen hoef ek nie weer na die video te kyk… ek kan net in my boek leer, en vining net recap soos wat het ons gedoen. Soos daar op eFundi het sy soos ‘n kort opsomminkie wat ek dink nogal oulik is.

Interviewer: Waar kry jy dit op eFundi?

Vera: Onder … ek dink dis onder…

Rachelle: Dis onder die leereenhede.

Vera: Ja, die leereenhede, is dit daar. En as daar nie ‘n kort opsomming is nie, gee sy vir jou die hoofstukke wat jy in die handboek moet gaan kyk. Soos nou sin was daar hoofstukke gewees. So dit het my baie gehelp. Toe gaan ek net dadelik na die hoofstukke toe in die handboek, en som van daaraf op. Ja…

Interviewer: Hmmm… het een van julle, dit klink vir my of julle sê dat daar was nie ‘n werkkaart nou, en dat julle nie eintlik seker was oor die toets nie. (groep beaam). Hmmm… as daar nou nie ‘n werkkaart opkom nie, dan het julle haar ge-e-pos of haar gevra om dit vir julle op te sit, of los julle dit maar net, en hoop vir die beste?

Michelle: Hmmm… soos ‘n paar van die kere wat die werkkaart opgekom het, hmmm… was dit half soos … aan die begin het sy dit vroeg opgesit, soos sê nou maar, die naweek…hmmm… die Vrydag of die Saterdag. Ons het op Woensdae hmmm… ‘mathematics module’. Dan het jy genoeg tyd gehad om dit dan in jou skedule in te werk. Dan, om te beplan, en dan, hoe verder die semester aangegaan het, hoe korter het die tyd geraak. Soos, toe raak

dit Sondae, toe raak dit Maandae, toe raak dit Dinsdae, en dan raak dit Dinsdae-aande laat. So ons het half gewoond geraak dit kom nog… die… die werkkaart kom nog. So, ja... en dit was bietjie sleg, want dan het jy minder tyd om voor te berei. So… want… ja… dis hoe ek voel.

Vera: Ja… dit is so. Dit het met die toets gewys.

Vera: Ons het al opgelet of hoe sy half dit doen… dat die werk wat ons die dag behandel, gaan sy ook in die toets vra. (groep praat gelyk) …

Vera: Die heel eerste toets…

Michelle: Toe het ons nie dit geweet nie. Ja, toe, toe vang dit ons…

Vera : Toe't ons, sy doen nou dit. So elke keer… nou weet ons … soos nou vandag se toets… soos wat nou gebeur het … die goed wat ons vandag moet doen, gaan sy oor vra. En soos die vorige keer het sy ook al gesê sy gaan vra, maar baie van die… al die werk. So, dis ook hoekom ons nou maar net aangeneem het sy gaan al die werk vra en vandag se werk.

Rachelle: Ja, almal was onseker gewees…

Vera: Oor wat ons moet leer. Toe sê ons nou maar net kom ons leer net alles, want dis nie so moeilik nie… dat ons net als kan deurgaan.

Interviewer: Maar dan dit wat sy toe nou voor die tyd doen, is toe net in die toets eintlik.

Vera: Ja.

Interviewer: Okay, hmmm… en dan. So dit klink vir my julle begin soos die aand voor die tyd dalk… soos op 'n Dinsdagaand dan nou. Maar as dit byvoorbeeld nogal 'n meer 'demanding' vak was, julle sou mos vroeër begin het? (groep beaam) As, sê nou maar julle het hmmm… op 'n Maandag en 'n Vrydag 'n vak gehad byvoorbeeld, en jy weet, sjoe, ek moet nogal 'n effort hier insit. Sal julle sê julle is selfgereguleerd om dit dan te spasieer en te besef: okay, nee, ek kan nie die aand voor die tyd vir hierdie vak nie? (groep beaam).

Michelle: Ek sal omtrent so 'n week voor die tyd wil begin beplan het om te kyk hoeveel werk moet ek voorberei, en soos, hmmm… jy weet, al sê nou maar die Maandag wat nou kom, het jy nou klas, die vorige Maandag het jy nou half alreeds die les en die goed gekry wat jy nou vir die volgende klas moet voorberei. Dan sal ek daai dag al gaan kyk, okay, watter van die werk verstaan ek al, watter van die werk verstaan ek min of meer, en wat is totaal en al nuut. En dan sal ek van daar af half vinnig recap oor die werk wat ek klaar verstaan, en dan so

stelselmatig tyd aan dit spandeer, sodat ek liewers te vroeg klaar is, as wat ek die aand voor die tyd daar sit.

Interviewer: En julle strategieë en hoe julle voorberei het, het nie verander oor die semester nie, want dit het vir julle gewerk. Julle het nie nodig gehad om te sê: sjoe, dit wat ek nou doen en hoe ek voorberei, werk nie vir my nie. So, ek moet dit gaan aanpas en ‘n plan maak of meer beplan… Dit het maar dieselfde gebly, want dit was voldoende? (groep beaam)

Interviewer: Dan, hmmm… julle sê die goeters… okay, jy het dit eintlik al klaar, Michelle, geantwoord toe jy half gesê het dat wanneer goed opgelaai word, wat nou mos hoofsaaklik die werkkaart is, maar die videos en goeters was toe van die begin af eintlik daar. So alles was redelik van die begin af daar. Sou julle dit verkies het dalk dat hmmm… weekliks die bronne wat jy moet gaan leer vir jou opgesit word… dat als nie van die begin af heeltemal daar is nie? Of wat sou julle verkies het? Dink jy dat daar elke week vir jou ge-*highlight* word: vir volgende week gaan kyk hierdie video en hierdie video… dan is jy reg. Of dink jy die wat dalk vooruit wil werk, dat dit nice is, as alles van die begin af daar is?

Rachelle: Of sy kan dalk net byvoorbeeld hmmm… nou daar waar jy die werk gekry het, wat sy nou in die leereenhede sit, wat sy nou verduidelik en die opsomminkies gee, daar by die video sit, sodat dit als ook, want in plaas van dit net ‘n lys van videos sit, dit wat jy moet hê… vir daai gedeelde… dat die videos daarby is.

Interviewer: Is al die videos net in lêers?

Vera: Soos onder daai hoofstuk sit en sê hier is die oefening in die handboek as jy wil gaan oefen.

Interviewer: Dis ‘n goeie voorstel. Ek hou daarvan.

Vera: En byvoorbeeld. Sy’t ‘n email gestuur en toe sê sy ons moet ‘n… ‘n Google forms invul. Toe is daar daai een som wat sy nooit die antwoord gegee het nie. (groep beaam) So, toe vra sy… toe is ek soos… ons het nooit … sy het nooit die antwoord … (Groep lag senuagtig, en praat saam)

Vera: Ek weer nou nog nie hoe om die som uit te werk nie.

Interviewer: En dit was ‘n goeie vraag!

Vera: Dit was rêrig.

Michelle: Dit was nogals vir my sleg, want ons het nooit … Sy het gesê ons gaan … ons moet daarna gaan kyk, en volgende week terugkom daarna. En ek het weer gaan probeer, maar ek kon nie…ek, ek is bietjie dom … ek kon nie daai doen nie.

Interviewer: Die antwoord is 16.

Michelle: Hoe op aarde, maar okay, hmmm… verstaan… ons het nooit teruggegaan na dit en gesê okay, jy weet, wat, wat, hoe het jy, hoe't julle plan gemaak, hoe het julle gedink? Okay, dis hoe jy eintlik moet dink. Kyk hierso… die gee vir jou die. Moenie net vir 'n mens die antwoord gee nie. (Groep beaam en soek eerder variante). Gee vir my eerder, soos kyk, hmmm … jy kon dit so gevind het of hierdie groep het oulik… hulle het dit so gevind… hulle het hierdie gebruik.

Interviewer: Julle sou daarvan gehou het as dit so was.

(Groep beaam en is beswaard oor situasie – nie tyd om uit te werk nie)

Michelle: Ja, ek sou wou weet hoe om dit uit te werk, maar nou sit jy half en soos mmm…ons kan nie. En… soos ons het in groepe ook al bymekaar gekom, en dan is dit soos … nee ons weet nie.

Vera: Dis soos vandag se avo-ding. (groep giggel en beaam). Maar dit was eintlik half. Sy gee 'n avo-som. Sy sê soos sy weet nie hoe om dit uit te werk nie. Toe kom ons kyk of een van ons dit uitwerk. Toe werk een van die meisies dit uit. Ek weet nie eens wie dit was. Toe… wat het gebeur? Toe sê sy sy dink net dis die bewoording of iets… ek kan nie eens onthou wat sy gesê het nie. Toe het sy eintlik soos aanvallend vir my voorgekom (groep beaam) dat sy soos verkeerd is. Ek weet nie. Ek het dit opgetel.

Interviewer: Okay, kon julle die som regkry?

Anet: Omdat ons toets geskryf het, het ons nie rêrig tyd daaraan spandeer nie.

Michelle: Ons het die blaai gekry om daarna te kyk, maar ons het nie rêrig aandag daaraan soos in. Ons het half gekyk, o, okay dis wat jy gaan moet doen, maar ons het dit nie fisies gedoen nie. Omdat tyd beperk was, omdat ons nog moet toets skryf ook.

Interviewer: Is daar was… was daar vir julle gesê wanneer julle dit voor moet klaar hê… moet julle dit vir die volgende klas hê, as jy moet gaan op eFundi?

Anet: Sy het in elk geval gesê volgende week sou die laaste klas gewees het, maar sy gaan net in klas wees as 'n informele les vir daai wat nou goed het wat hulle nie verstaan nie.

Michelle: So, daar gaan nie eintlik klas wees nie.

Interviewer: Okay. Dink julle enige iemand gaan na daai klas toe gaan?

Michelle: Ek dink daar sal kinders gaan wat soos met iets sukkel, of wat hmmm…. wat ‘n punt het wat nie reg ingelees is nie. Maar ek dink nie andersins nie.

Interviewer: Okay. En dan… het dit vir julle gevoel asof die klas verander het oor die semester? So, enige iets van die semester… hoe dit was in die klas, hoe jou bronne op eFundi was, eFundi se formaat? Enige iets van ‘mathematics module’…van die begin van die semester tot die einde van die semester? Is daar enige iets wat verander het? Is daar enige voorstelle wat julle gemaak het wat gehoor is, of nie?

Rachelle: Daar was een klas wat tussenin gegee was oor… ek dink dit was area gewees of so ietsie, wat sy wel ‘n video op eFundi gelaai het. Dit was die enigste, soos basies naaste aan die Flipped Classroom-konsep-idee het wat sy gelewer het. Verder was dit maar net: hier’s jou taak, gaan doen dit, kom klas toe, bespreek dit, skryf toets as nodig en gaan huis toe, dis dit.

Michelle: Wat ek… wat ek ook daarvan gehou het… van daai spesifieke les, is hmmm…ons het half ‘n notification gekry dat hierso is die “links” en dat jy moet voorberei vir volgende week in plaas van soos… ek dink dit is ‘n goeie ding dat die videos vooruit opgesit word vir die kinders wat vinniger beweeg… verstaan. Hmmm… maar dit vir my was lekkerder om te weet… okay, hier is eintlik die videos wat vir volgende week op toepassing is. Want, soos jy het nie half altyd die tyd om elke liewe link te gaan oopmaak en te kyk, okay, waar is ek nou, wat moet gebeur, jy weet… so aan nie.

Interviewer: Goeie voorstel.

Michelle: En ook, soos byvoorbeeld die kinders wat nie WiFi of beperkte WiFi by die huis het, kan dan vroegtydig kampus toe kom en dit hier aflaai, en dan dit by die huis gaan kyk of so.

Interviewer: Dis ‘n goeie voorstel, en ek stem, ek stem saam met jou. Dit maak vir my sin.

Michelle: En, en ook dit herinner jou om soos voor te berei… en te weet… o okay, jy weet.

Interviewer: Want om selfgerig… om van jou verwag te word om selfgerig te wees, beteken nie jy moet heeltyd voel jy’s in die donker en jy weet nie wat gaan aan nie, né? (groep beaam)

Rachelle: En nou dink ek die leereenhede op eFundi moet ook soos op datum gehou word, want op ‘n stadium, ek weet nie of hulle nou al is nie… Ja, behalwe vir dit… daai, aan die kant

is daar mos die studiegidse vir leerinhoud. So, op die videos kan daar onder en die materiaal wat daar onder moet kom. Maar ek het so twee weke terug gekyk, en toe was daar nie… daar was van hulle wat nog moes ingevul word… die leereenhede wat ons klaar gedoen het. So, ek weet nie of dit nou nog so is nie.

Interviewer: Okay, so die formaat, so die formaat van eFundi… julle het nou goeie voorstelle gemaak vir dit. En verder… nog iemand wat iets wil sê oor die klasse. Het julle gevoel dit het verander, het dit presies dieselfde gebly? Het julle voorstelle gemaak wat, julle voel, nie gehoor was nie. Het julle nie voorstelle gemaak nie? Het julle maar net aangegaan, omdat julle gevoel het, wel, ek hou by, so…?

Michelle: Ons het voorstelle in die klas gemaak dat ons moeiliker vrae kry om te … om voor te berei en te doen. Toe kry ons daai som met die blokkie met die sirkel en die es… daai ene. Hmmm… so dit was nogals vir my lekker gewees dat sy eintlik geluister het en gesê het okay, maar kom ek gaan soek vir julle ‘n challenge en dit. Hmmm… dit was lekker, want soos dit het ook gevoel asof daar nie net in klas gesit word en so weer eens hoor wat ons klaar weet nie. Toe kon ons bietjie, actually, jy weet, uitredeneer en dink en praat en hoe gaan ons te werk gaan en so aan.

Interviewer: Maar iets wat ek daar opgelet het, is dat … so iets word vir jou gegee, en dan vyf minute en dan boem. Dit voel vir my vrae soos daai, moet jy sit en al vat dit ‘n uur om dit klaar te maak. En ek dink dis die ding van die classroom wat mens graag wil sien moet gebeur in die klas. Jy wil graag in die klas sien: ek reteach niks, ek sê niks, ek is die fasiliteerder. Daar’s jou ‘n moeilike vraag… daar gaan julle. Kom wys vir my, kom ons leer bymekaar. Dit…okay…so…ja…

Michelle: Soos hier nader aan die einde het dit vir my meer begin voel soos sy het meer begin reageer op vrae. Sy het nie… aan die begin het sy half soos dan het ons die videos en goed. Jy het al voorberei, geweet wat aangaan, en wat dit is. En dan het sy gekom en dieselfde goed verduidelik wat jy nou klaar voorberei het. En hier nader aan die einde het sy meer begin gaan op, hmmm… jy weet, okay, jy het nou klaar voorberei, wat verstaan jy nie. So, as jy nie voorberei het nie, het jy daar gesit en huuumm, want gaan nou gebeur, en as jy voorberei het, het jy gesê okay, ek verstaan die nie, of kom ons werk aan die, of okay, ons verstaan alles. So ons kan nou moeilker gaan, soos moeiliker vrae begin hanteer of wat ook al.

Interviewer: Ek…wat dink julle van hierdie? Ek hou van die idee om een of twee spesifieke videos vir studente voor te stel. Dalk die week voor die tyd, dat jy self kan besluit daai dag wil ek ‘n video kyk en die ander dag… dat jy nie op een dag nou dertig minute se videos moet

kyk of wat ook al nie. En… maar dan ‘n spesifieke video… dat die lektor in die klas vir jou kan vra: wat van daai videos verstaan jy nie, dat almal op dieselfde bladsy is. Want nou is daar ‘n magdom, the sky is the limit, van die hoeveelheid videos wat jy oor area kan kry. So, jy kan nie daai goed pinpoint nie. Juffrou het, toe hulle daai som gdoen het van die volume van die maan, het ek dit, en dit, en dit nie verstaan nie. (instemming deur stemme) So… ek dink spesifieke videos wat jy moet weet waarnatoe hierdie gaan, dink ek kan dit ook nogal bietjie beter maak dalk.

Michelle: Ek dink ook so, en dan soos half om spesifieke videos voor te skryf, gaan beter wees, en dan half as die kind dit nie verstaan nie, en hy op sy eie ‘n video gaan soek, moet hy dan half die “link” klas toe bring, of so iets. Dat as dit dan dalk opkom in ‘n vraag, of hy sê okay, maar ek het dit ook nie verstaan nie… hierdie video het dit verduidelik wat hy gedink het, kan hy dit dan met die klas deel.

Interviewer: Definitief. Daai ruimte vir dit, né? Maar vir so ‘n ruimte, voel dit vir my, daar moet ‘n werdersydse tussen die dosent en die studente moet daar: ek sien julle wil leer, van die dosent se kant af, so ek wil die ekstra myl vir julle gaan, en van die studente se kant af : ek sien hierdie dosent gaan die ekstra myl vir my, en om mekaar dan daar in die middel te kry, en om rêrig te wil leer. Hmmm… so ek dink as julle dalk ‘n oulike video gekry het, sou julle dit vir dosent gesê het: jis, hierdie was ‘n oulike video in hierdie area. Dink julle, het julle al oorweeg om dit te doen of het julle dit al gedoen?

Michelle: Ek het dit nie gedoen nie, maar ek sou verseker. Soos ons het mekaar so gehelp met, met hmmm…Chemie in die eerste semester. Toe’t ons oulike videos gekry om die stappe van die goed te onthou, wat hulle, dis daai videos met die, dis super-irriterend, maar die tune is so catchy, jy onthou dit… daai videos. Toe het ons mekaar so gehelp het met so aangestuur het, en so aan. So ja… dit werk.

Interviewer: Hmmm… en het vir julle gevra of julle die videos en goeters op eFundi opgespoor het. Dit voel vir my van julle het darem redelik al van dit gesien as dit nodig was, maar ons het gesê dat dit dalk belangrik is waar ‘n mens dit gaan indeel onder die leereenhede… dat jy spesifiek kan weet, en dat jy dalk ‘n reminder kry in die vorm van ‘n notification van: vir volgende week is dit dan nou, met ander woorde, hierdie en hierdie, en dit maak vir my sin. Julle het ook al klaar goeie voorstelle gemaak vir eFundi. Is daar nog voorstelle vir eFundi? Hoe julle voel ‘n mens kan eFundi nog beter benut. Ek bedoek daar’s forums waar jy gesprekke kan hou op eFundi. Daar is ‘n plek waar jy vir die dosent obviously kan e-pos… al daai goed. Het julle nog dalk voorstelle vir eFundi?

Michelle: Ek dink dalk soos in plaas van, soos daai, die forums waar jy ‘n gesprek kan hou op eFundi waar van dan, sê nou maar, daai… daai som wat ons gekry het wat ons nie rêrig na terug toe gegaan het nie, half om daar te sê, hmmm… ‘n plek te kan hê, okay, wie verstaan nie hierso, of hmmm… wie’t ‘n idee waar om te begin, of… of die dosent kan dalk sê: okay, ek sien julle sukkel hiermee. Hierso is die eerste stap wat julle moet doen, of ‘n leidraad te gee, en dan half weer te probeer uitfigure van daar af, en dan te sê, okay ek het sover gekom. Waar trek julle? Ek haak vas hier, maar ook om dit half te beperk dat niemand half die antwoord of so iets gee voordat almal half nie tot daai punt gekom het nie. Dit sou lekker gewees het.

Vera: Dis ‘n baie cool idee. En nog ‘n ding. Soos ons het byvoorbeeld net leereenheid een en twee gedoen. Sy… die res. ek dink nog tot sewe is blykbaaar vir die derdejaars. So, hoekom split sy nie die modules nie, en sit net vir ons ons modules op? groep praat gelyk). Maar ek het begin stres, want ons het net so drie weke oor, en daar is… maar toe besef ek ons doen net een en twee…so om dit te split.

Interviewer: Okay, maak sin.

Michelle: Dit sou beter gewees het. Dan voel jy ook, jy, jy weet, jy leer nie iets ekstra nie, of …ja, dit wat daar is, is dit wat jy moet weet. So as jy als deurgewerk het, dan’s jy reg. Ja.

Interviewer: Okay, en dan, is daar een van julle… die twee videos wat ek gestuur het in my e-pos. Daar was een oor…Rachelle lag. Daar was een oor hmmm… Flipped Classroom… ek het ‘n korte probeer kry, maar wat ook goed is, en die metakognisie. Hmmm…Anet, het jy een van hulle gekyk?

Anet: Ongelukkig nie. Ek het nie gekyk nie.

Interviewer: Okay, het jy een van hulle gekyk?

Michelle: Ek het die een oor die Flipped Classroom gekyk. Ek het gedink dis baie oulik, en ek het beter verstaan. Dis nie dat ek nie verstaan het nie, maar ek het nou duidelik ‘n idee.

Interviewer: Verduidelik vir my die flipped classroom in jou eie woorde.

Michelle: Soos in ander woorde, hmmm… in plaas van om in die klas sukkel, en te verstaan wat aangaan, gaan berei jy voor op jou eie tyd met die Internet of met videos of met jy whatsapp jou vriende en sê ek verstaan nie hierdie nie, of, jy weet, so aan. En dan berei jy voor, sodat as jy in die klas kom, dan sê jy soos juffrou, okay, ek haak hier vas, die werk verstaan ek nie, hierdie werk verstaan ek. Hmmm… ons kan… dan kan jy half begin by half

‘n gemeenskaplike… dit hoef nie noodwendig ‘n gemeenskaplike punt te wees nie, maar dat jy weet op watter vlak van denke die kinders is… dat jy nie onnodig tyd spandeer aan werk wat hulle alreeds verstaan nie. So, ja…

Interviewer: En ek dink in daai video was ook die hierargie van die vlakke… kognitiewe vlakke… dink ek.

Michelle: Ek het die kognitiewe vlak-video het ek net aan die begin gekyk, toe … het ek nooit gaan klaar kyk nie.

Interviewer: So dit was nie in die Flipped Classroom se ene nie, né? (Nee) O, okay, askies, dan is dit in die ander een, okay. Rachelle, het jy een van die videos gekyk?

Rachelle: Ja.

Interviewer: Watse een?

Rachelle: Altwee (lag verleë).

Interviewer: En…?

Rachelle: Die tweede een was vir my bietjie soos…

Interviewer: Die metakognisie?

Rachelle: Ja… hy was vir my moeilik gewees, omdat soos Engels… ek’s nie goed met Engels nie, maar van die woorde was vir my ‘n bietjie te hoog. En omdat die video ook lank was, het dit my verveel. Maar die eerste een was ‘n goeie video, want ek het half beter ‘n idee gekry van die Flipped Classroom, en dat leerders ook… okay, dit het ek geweet, dat leerders ook op verskillende vlakke is. Maar daar’t ek nou net gesien dat … soos ‘n leerder is wat hmmm… goed is, en sy, sê nou maar sy weet al wat aangaan, so dit verveel haar, en dan’s daar weer leerder wat glad nie weet wat aangaan nie. En dan… met die Flipped Classroom, soos wat hulle dan gaan voorberei, is daar ook tegnologie wat hulle kan gebruik om mekaar te help, en dan so kan jy ook leer. So daar is vir my interessant, daar…

Interviewer: En daai kind wat verveeld is, kan nou ‘n uitdaging gebied word om jou te extend, né, of te verryk soos ons sê. Dat jy nie heel tyd sit en verveeld is in die klas, en vir die juffrou moet luister nie. Maar dat jy kan uitgedaag word, en dat die ander kan ondersteun word.

Michelle: Ja, ek dink dit het gehelp om dit actually fisies te sien, soos wat dit nou geteken het. Dit was interessant om te sien hoe hulle die, die, soos sê nou maar, die banke omgedraai het.

Em toe was dit nou die rekenaars en so aan. Dit was lekker om … dit nou lekker gemaak om…jy wil aanhou kyk, want jy wil nou half… wat gebeur nou volgende. Waar die kognisie ene… het ek nie klaar gekyk nie, want hy sit daar met die artikel, en dan haal hy …. Dan's ek soos…

Interviewer: Dis meer akademies.

Michelle: Ek kon dit ook gaan Google en lees. So…

Interviewer: Hmmm… hoekom lag jy, Rachelle? Is dit omdat jy vir Vera gesê het dit is vervelig, of wat is die storie? (Gelag)

Vera: Laat ek vertel wat het gebeur. Ons het mos netnou ietsie gaan drink. Toe vra sy vir my het ek al die videos gekyk… toe sê ek vir haar nee. Toe sê ek vir haar: okay, ons het hierdie… ek gaan haar nou presies sê hoekom het ek nie die videos gekyk nie. Toe sê ek sy moet ons vertel waaroor die videos gaan. So, dis eintlik hoekom sy lag… sy gee ons so 'n bietjie weg.

Interviewer: Okay. Nou maar Vera, so, jy het nie gaan kyk nie. Kan ek vir julle vra die rede dat julle nie iets ekstra gaan kyk nie. Is dit omdat julle voel: ek hou nie daarvan nie, ek gaan eerder op Youtube dan iets gaan kyk wat my interesseer, soos wat daar dan ook al is, of dit 'n movie is, en of is dit 'n topic oor Global Warming, of wat ook al. Iets wat jou interesseer? Is dit net… was dit net soos: aag ek het nie gedink dis nodig nie, of wat?

Vera: Ek het 'n baie slegte maand gehad. Soos letterlik alles het half skeef geloop. So, ek het net nie daarby uitgekom nie. Maar ek wou rêrig, soos ek wou rêrig ook dit gekyk het …

Interviewer: Okay. So dit is nie 'n data issue…? of so iets nie?

Vera: Nee, glad nie. Eintlik … ja. (groep lag)

Rachelle: Ek is weer soos vas met tyd gewees. Ek het soos… ek het letterlik gesit. Die videos was besig om te upload, en alles. En toe, ja, raak ek distracted, so…toe begin die vaak. Toe doen myne, sommer my nuwe een sommer updates, toe's my data… sal 'n ander dag, ek belowe. So dis rêrig net half als… maar ek belowe. (lag verleë)

Interviewer: Nee, nee, ek vra, want ek wil weet. Ek wil weet, want onthou die hele studie gaan ook oor die gebruik van videos, en hoe om mense te kry om dit te kyk. So, dis net vir my interessant om te hoor wat julle sê. Hmmm… klastyd se gedagteproses…klastyd se gedagteproses. Wat gaan in jou kop aan vandat jy in die klas instap totdat jy min of meer daar uitgaan. *Highlite* asseblief. Moet nou nie vir my elke gedagte sê nie. Dit gaan 'n… (groep lag

effens) Ja, enige iemand wat dit wil ‘n probeer gee? Of jy uitgedaag voel, of jy voel jy leer, of het jy al ooit gedink: jis, dis hoe hierdie klas dalk beter kan wees, of jis, ek hou nie hiervan nie, of jis, ek hou baie hiervan in die klas, of hmmm… net daai… wat dan nou daai metakognisie-deel van my…

Michelle: Hmmm… as ek in die klas inkom, dan is dit soos half die eerste ding dan probeer ek onthou van dit wat ek voorberei het. Hmmm… soos waarmee het ek gesukkel, jy weet. Hmmm… om half dan nou vrae te rig, of, of beter die werk te verstaan, of dalk om…ja…so… en dan as ek nie vrae het nie, dan sit jy maar eintlik en wag dat iemand anders ‘n vraag vra. En as dit nie gebeur nie, hmmm… dan is dit ‘n bietjie awkward. Maar (verleë lag) ja, soos eerstens dink ek waarmee het ek gesukkel, of waarmee… oor twyfel ek. Wat ek dan nou weer wil vra, en dan as dit nie gebeur nie, dan luister ek maar wat ander mense vra wat ek nie aan gedink het nie, of hulle verder gedink het, en dan… daarna sit ek net en knik…

Interviewer: Voel jy, jis, ek sien uit om te hoor wat gaan ons vandag doen?

Michelle: Nee.

Interviewer: Nie?

Michelle: Om eerlik te wees, nee. Ja, dit voel asof jy… jy weet klaar wat in die klas gaan gebeur. So dis nie half van … wat gaan ons vandag doen nie. Dis so half van… okay, ons doen dit vandag.

Interviewer: Okay, en julle gaan maar vir die deelname deels ook. (groep beaam) Okay, nog iemand wat hulle gedagteproses…

Vera: Ek gaan rêrig eerlik wees. Soos, my groepie hou van chat.

Interviewer: Okay, sit julle daar voor.

Vera: Ja (groep lag lekker) daai ene. Ek sou nie sê ek’s die hoof een daarvan nie, maar blykbaar is ek. Elk geval… hmmm… soos ek dink omdat die klas partykeer… soos as sy, sê nou maar, die werkskaart weer gaan verduidelik of ietsie of sy soos vra… dan raak ons verveeld. En dan begin ons, sê nou maar, oor ander goed praat. En dan is dit maat heeltyd wat gebeur.

Rachelle: Ja, ‘n mens raak eintlik net opgewonde om te sien watse moeilike vrae gaan sy vra. (Groep praat gelyk) Sy vrae die ander vrae. Verder is dit net herhaling.

Vera: Soos ek wil antwoorde hê van dit. Ek wil hê, soos in Mr X se klas, ons behandel dit. Soos jy gee jou opinie, en ek sou kon sê ek stem nie saam nie. Hoekom doen jy dit.

Interviewer: ‘n Mens wil voel ‘n mens leer iets nuuts, né?

Michelle: Soos, soos as jy in die klas kom … ek like dit om voor te berei, want dan weet jy half, jy weet, waarnatoe dit gaan, en als, maar soos as ek in die klas kom, wil ek ‘n challenge hê. Soos, okay, ons het nou die vrae beantwoord het van dit waarmee die mense gesukkel het, wat hulle nie verstaan nie – wat ook al. Kom ons pak nou ‘n challenge aan. Almal sit lekker klaar in groepe. Almal kry dieselfde som. Of jy werk individueel of in groep... almal verskil seker maar. Maar dan kan jy sê, o okay, hene julle ek haak vas. Ek het tot hier gekom. Ek het nie eens daaraan gedink nie. En dan van daar af kan ons verder gaan, en half so leer. Want as jy by die huis sit, dan kan ek ook die somme doen, maar ek gaan ook maar net so ver kom. So dis wat jy vir my in die klas kan wees… dat jy van mekaar kan leer. As jy vashaak, dan kan jy sê: juffrou, wat nou? Dan gee sy vir jou half ‘n leidraad en sê: onthou, die radius is die helfte van die sirkel (Groep lag) byvoorbeeld. Dis nou simpel, maar sy gee nie die antwoord weg nie, maar sy gee vir jou genoeg inligting dat jy… o ja!... jy weet… jaa.

Interviewer: So, dit sluit aan by wat ons by gaan kom van die rol van die dosent. So dit klink vir my die dosent is bietjie… daai rol van fasiliteerder en so. Maar wat julle ook netnou gesê het van daai som wat julle na gekyk het, daai een met die blokkie en die sirkel. So, het julle besef, sjoe, mens kan in hierdie area rêrig nogal lekker uitdagings kry. Al hierdie goed is nie eenvoudig nie. Dit kan regtig jou nogal stretch.

Rachelle: Maar soos dit byvoorbeeld soos met Mr X byvoorbeeld. As ons nou sit en ons sukkel met ‘n som en Vera sê okay, sy sukkel, sy kom tot daarsô toe, dan sê ek, okay, wat jy van daaraf doen, doen jy so. Dan nooi hy ons na die bord toe. Dan skryf ons almal verder tot waar ons gekom het, en dan as ‘n klas saam, bespreek ons, okay, hoe gaan ons verder ... Dis wat ek *like*…

Interviewer: Okay. Rachelle, wil jy nog iets bylas by jou gedagteprosesse in die klas? (Nee). Reg. Okay.

Vera: Kan ek nog iets vra? Sorry. Dis nou soos een van my vriendinne… sy het laas semester, ek dink sy was soos maar soos by een klas. Soos, dis vir haar, sy verstaan die werk, en sy het deurgekom. Sy het goeie punte. Ek dink sy het omtrent ‘n onderskeiding gekry. So dit sê wat die level van die klas is.

Interviewer: Ja, ek hoor wat jy sê. Hmmm… en ek wou hier vir julle gevra het of julle hierdie week die prep-werkkaart gekry het. Want ek wou vir julle gevra het, want ek het nie ‘n notification gekry wat gekom het nie. So, julle het dit ook nie gekry nie. Dit was nie daar nie. Maar julle sê julle het dit eintlik maar gou behandel voordat julle die toets geskryf het. (groep beaam) Okay, hmmm…hoe was die toets? Anet, kom ons begin sommer hier by jou.

Anet: Daar was eintlik… as jy in die klas redelik opgelet het, en jy weet min of meer waaroor die werk gaan, was dit actually nie moeilik nie. Wat wel baie mense verwar het, is hmmm… Ons het … sy het vir ons gesê ons het ‘n piramide, en een is ‘n prisma. Teken die een bo-op die ander waar hulle een vlak deel…die basisvlak deel. So dan het daai bewoording nie lekker deurgekom nie… moet jy hulle inmekaar teken nie, moet jy A teken en B teken… en so mors jy tyd. (Groep gee kommentaar) Maar daar is eers later, sy het die A en B omgeruil. Want ek het vir haar ‘n prentjie geteken… toe vra ek is dit so…toe sê sy ja. So jy moes basies soos ‘n huisie… (Groep praat deurmekaar) en toe later toe sê sy vir ons die een vlak was tien sentimeter en die ander vlak was vyf sentimeter en die loodregte hoogte was sewe sentimeter. So, nou met die prisma het dit mooi uitgewerk, maar met die piramide… is dit nou die middelste lengte of is dit nou die skuinslyn? So, eers toe baie mense kla… ek was al klaar met daai vraag, maar ek het dit net so aangeneem… so, toe sê sy vir ons, okay, nee die skuinsvlak is nou die sewe. Om dan by die volgende vraag, wat 2.2.2 is, sê sy vir ons, okay, nou vat dit asof daai middelpunt sewe was. So, dit het baie mense verwar.

Michelle: Dit was vir my maklik… ek het… nou nie maklik nie, maar ek het rêrig gevoel ek het goed gedoen, geweet wat ek moet doen en als. Tot daai vraag… ek het hom beantwoord soos ek moet, en toe kom sy met daai inligting, toe’s ek soos…

Interviewer: Stop gou. Was daar toe tyd om terug te gaan toe julle daai regstelling gemaak het? (Groep bevestig)

Interviewer: Okay…okay…

Anet: Dit was so in die middel van… helfte van die tyd.

Michelle: Ja, so in die helfte van die tyd. So, jy het nog genoeg tyd gehad. Soos ek het omtrent net begin met die som, maar toe’t ek nie rêrig meer spasie nie. So, maar toe… toe sy daai inligting gee, toe’s ek so half van wat gaan nou aan. Toe’t ek vir ‘n… soos vyf minute daar gesit net om te besef wat ek eintlik nou moet doen, want toe’s ek verlore, want… want sy sê iets, en dan probeer jy nog uitfigure wat sy nou net gesê het… en dan verduidelik sy half vir die kinders wat nie verstaan nie, en dan’s ek soos… wag net gou…(Michelle lag verleë).

Interviewer: En toe kon jy dit uitfigure?

Michelle: Ek het gedoen wat ek gedink het ek moet… (Michelle lag verleë). Ek weet nie, ek … ek weet nie want…

Rachelle: Ek het die formules ingeskryf… die hoogtes… dit het vir my sin gemaak, maar ek kon sien die ander was totaal en al verward, want… as ek na haar geluister het… hoe sy dit verduidelik het, (Iemand: dit was nie reg nie) dan sou ek ook baie verdwaald gewees het.

Interviewer: Hmmm… nog iets oor hoe was die toets? Nog iets wat iemand dalk…

Rachelle: Verder was daar ‘n tabel wat ons in die klas gedoen het ‘n paar weke terug… (Groep beaam) en presies dieselfde… en toe vandag se werk, en dis dit.

Michelle: Sy het die kolomme verander en net ander bygesit.

Interviewer: As julle ‘n vraag in die toets verwag het soos daai een met die vierkant en die sirkel, dink julle julle sou ‘n bietjie meer effort ingesit het, en dalk na julle dosent toe gegaan het.… hey, hoe doen mens dit nou? As julle so ‘n tipe vraag… dalk een so tipe vraag in julle toets verwag het? (groep beaam)

Vera: So word ons ander Wiskunde… daar’s altyd een moeilike vraag. Groep beaam) Hy sê vir ons… daar’s een wat jy nie gaan kan… miskien nie kan doen nie. Kinders wat werk rêrig goed verstaan, gaan dit kan doen.

Interviewer: Okay.

Anet: Ja, soos byvoorbeeld nou met hierdie eksamen wat nou kom, het hy gesê hy gee nie vir ons ‘n diagram nie. Hy gee vir ons ‘n statement… ‘n sin. Dan moet ons die diagram gaan teken, en dan van daar af moet ons die bewyse doen. So hy gee… hy sê vir jou jy gaan ‘n moeilike vraag kry. Soos dan byvoorbeeld met ‘module Y’ voel ek… aag ‘mathematics module’ is… dis maklike werk, so… soos byvoorbeeld ek het glad nie geleer vir ‘mathematics module’ vandag soos wat ek vir Wiskunde sou nie… glad nie. (groep lag) Ek… ek het glad nie geleer om eerlik te wees vir vandag se toets …

Vera: Wat van vrae soos formules…. ek het haar gevra… sy het gesê ons moet formules leer, en toe moes ons nie eens die simpel goed leer nie. Sy het glad nie dit eers vir ons gesê nie… so frustrerend…

Anet: So, dit kom basies voor dat ‘mathematics module’ vir my baie makliker is as ‘module Y’. So, ek sit nie so baie moeite in ‘mathematics module’ in soos wat ek gewoonlik sou nie, omdat dit op ‘n laer vlak is.

Michelle: Ek voel nou weer soos ‘mathematics module’ kan eintlik so lekker wees soos… die goed wat ons doen, is eenvoudig en is die basiese goed van Wiskunde, maar kan eintlik so challenging gevra word, (groep beaam) en ek dink ons moet net soos… ons moet net actually daai challenge kry. Soos, ja, doen die basiese met ons deeglik, sodat ons dit verstaan en als, en dis half wat jy self by die huis kan voorberei. So, as jy klaar weet wat gaan aan, dan hoef jy dalk nie so erg voor te berei soos iemand anders nie, want iets wat jy nou weer voel, is moeilik, is dalk vir iemand anders maklik. Maar dan… as jy in die klas kom, om daai challenge te kry om te weet… okay… hoor hier, ons moet rêrig dink, en dan as jy nog steeds nie verstaan… as jy sien… hoor hier, ek ken eintlik nie die goed so goed soos wat ek gedink het ek doen nie. Dan kan jy weer gaan voorberei of teruggaan na die videos toe of ander videos gaan soek. So, ek dink dit gaan baie meer help as wat jy half net… want vir my voel dit op die oomblik ons doen net die minimum.

Anet: Dit pla jou meer as wat dit jou challenge.

Michelle: Ja, so dit kan eintlik so challenging gevra word, en lekker wees, maar ons doen net die minimum.

Interviewer: En het hierdie vak julle enigsins gehelp hoe julle dalk eendag hierdie gaan aanbied as julle gaan Wiskunde gee?

Vera: Soos ek dink sy moet dit doen. Sy moet vir ons tips gee oor daai herleiding. Dit pla my nog steeds. Soos, moenie dit net vir my sê nie (lag met ongeduld). Dis waarvoor die videos is. Gee vir my ‘n oulike manier om vir ‘n kind te kan verduidelik, want ek sukkel even daarmee… so hoe moet ek ‘n kind help as ek self daarmee sukkel.

Michelle: Soos byvoorbeeld om dit huiswerk half te maak wat dan as deelname kan tel of wat ook al. Soos gaan dink in ‘n kreatiewe manier in twee minute hoe jy dit kan hoe jy dit kan voorberei of aanbied vir ‘n klas. Hoe hulle dit gaan onthou. En dan kom jy nou in die klas die volgende dag, en dan in julle groep besluit julle wie se idee is die beste ene, en dan elke groep se een in die klas sê dan net gou vinnig wat’s hulle idee. En dan leer jy so.

Paticipant 2: Ons kry nie regtig sulke goed nie. Dis minimaal.

Interviewer: Met ander woorde om meer didaktiek in te bring. (groep beaam) Hoe jy dit aanbied eendag.

Michelle: Dit sal lekker wees

Rachelle: Soos byvoorbeeld as dit jou klas was wat voor jou was, wat se leidrade of konneksies sal jy vir hulle gee…

Vera: Omdat dit basies goed is… om daai basis reg te kry. Want dit is alles waarmee kinders sukkel.

Anet: As jy dit ontleed, dan is dit eenvoudig, maar om tot by daai punt te kom waar jy dit so kan ontleed dat dit eenvoudig voorkom, is ook ‘n ander uitdaging.

Michelle: Of dis half om te sê, soos byvoorbeeld hmmm… ons doen nou volumes en oppervlakte en wat als. En dit gaan… op die ou einde… kan jy dit deurtrek na hierdie area toe ook in Wiskunde… sien jy hoe dit bymeaar uitkom… jy weet half daai konneksie te maak, om dit soos fisies vir jou te sê. Want baie keer dan dink jy, o okay, ek is eintlik nou besig met Algebra, om hierdie volume uit te figure… maar jy besef dit nie eintlik eers nie, of, of sodat jy daai konneksie vir jou kan gee… en dan raak Wiskunde se prentjie dan half ‘n geheel …eintlik ‘n prentjie hê, en nie soos boksies met …

Vera: Waar jy dit dan in die regte lewe kan gebruik. Ek dink kinders sukkel ook met dit. Hulle dink net Wiskunde is Wiskunde, maar waar kom dit in die lewe…

Michelle: En dit gaan kinders ook soos motiveer soos: ek moet eintlik hierdie goed leer, want ek gaan dit gebruik… dis eintlik nie net Wiskunde nie. Dis eintlik, dis eintlik in die lewe…

Interviewer: Ja, want dis eintlik wat Wiskunde doen. Dit ontwikkel jou brein. Gaan jy dalk ooit daai direk in jou lewe gebruik? Ons weet nie… dalk…dalk nie, maar dit leer jou dink op ‘n sekere manier wat jy op plekke toepas wat jy dalk nie eens nou weet: hey, dis Wiskunde wat my brein so ontwikkel het nie. Maar in elk geval. Wat sien jy jou rol, as jou verantwoordelikheid in die Flipped Classroom? As ons bietjie meer kyk na die einde van die semester. Hoe sal jy sê wat moes jy doen, wat het… wat was jou rol in die Flipped Classroom? As jy nou dink aan ‘mathematics module’ ook net oor die Flipped Classroom in die algemeen? Wat dink jy is jou verantwoordelikheid?

Michelle: Jou verantwoordelikheid is om voor te berei vir klas… om seker te maak jy weet wat jy verstaan en wat jy nie verstaan nie, want as jy dit nie doen nie, dan kan jou dosent jou ook nie help nie, want dan… as jy dit nie doen nie, moet sy eintlik vir jou hele klas aanbied, en daar is nie tyd vir dit nie.

Interviewer: En as jy nou by die huis voorberei het, en jy kom agter vet, ek het nie ‘n clue wat hier aangaan nie, wat sou jy dan gedoen het?

Michelle: Ek sou vir haar gesê het ek het nie ‘n clue wat daar aangaan nie.

Interviewer: Sou jy haar ge-e-pos het?

Michelle: Nee, ek sou gewag het tot in klas.

Rachelle: Ja, want daar’s mos’n tyd wat sy vrae vra. As niemand iets vra nie, dan gaan sy net aan.

Michelle: Dan sou ek soos gesê het: hoor hier, ek verstaan glad nie die videos wat ons moes kyk nie. Hmmm… ek het net verstaan dat hulle dit in vervang, maar dis dit. (Michelle lag verleë)

Interviewer: So, jy sou nie voor klas dit met haar opgeneem het... noodwendig nie.

Michelle: Nee…

Rachelle: Tensy dit rêrig soos nou was.

Michelle: Tensy dit, tensy dit… sê nou maar…jy skryf… jy skryf nou in die volgende klas skryf jy toets oor hierdie werk, en… hmmm…soos nou het ons klas gehad, en dan toets geskryf. Sê nou maar dit sou nie gebeur het, waar jy net soos vinnig, okay, een of twee goedjies wat jy net oor wil seker maak… dan is dit okay. Dan sal ek wag tot in klas. Maar as dit soos als is wat ek nie verstaan nie, dan sal ek voor die tyd na haar toe gegaan het en sê: hoor hier mevrou, dis… dis nou panic times.

Vera: Dan moet jy kan sê: hoor hier, ek het my deel gedoen. Ja… my navorsing… dit en dit, maar ek verstaan nog steeds nie dit nie.

Michelle: Maar ek dink ook om eerlik te wees sou ek eers na ‘n vriend toe gegaan het.

Interviewer: Hmmm… wat heeltemal reg is. Maak nie saak wat jou bron van kennis is nie. Solank jy net seker maak jy kry dit. Want op die ou ent… jy moet verantwoordelikheid neem van wat jy weet, né? Rachelle, wat dink jy?

Rachelle: (Verleë lag) Sorry, wat is die vraag? (Almal lag)

Interviewer: Jou verantwoordelikheid? Wat dink jy gaan ‘n Flipped Classroom laat werk of watter modules werk nie van die studente se kant af nie. Jou verantwoordelikheid?

Rachelle: Ek stem saam met haar dat jy die verantwoordeliheid het om self voor die tyd te gaan, en voor te berei en seker te maak dat jy verstaan wat die onderwerp als behels, en dat jy die basiese kennis kan kry, en ook dalk dieper ingaan om seker te maak dat jy wel verstaan as jy in ‘n situasie kom wat jy nou ‘n moeiliker som moet doen, en dalk iemand moet help daarmee. Maar verder stem ek saam met haar.

Interviewer: Okay. En dan, hmmm… jy het bietjie… ons het netnou al gepraat oor die rol van die dosent, soos, hmmm… om vir julle uitdagings te gee, en hmmm… jy het gepraat van dan in die klas… fasilitering. Kan julle dink aan nog iets wat julle dink ‘n belangrike rol is van die dosent om hierdie Flipped Classroom baie suksesvol te kan laat uitrol?

Anet: Beskikbaarheid van bronne. Addisionele bronne.

Interviewer: Okay.

Michelle: Ek dink nou weer soos die dosent moet ook voorberei van sy of haar kant af. Byvoorbeeld, ook die videos kyk wat ons moet kyk, en soos ook dieselfde werk voorberei wat ons moet voorberei, dan sal…

Interviewer: Askies tog dat ek vra. Met ander woorde een video sal dalk beter wees wat jy weet almal het dit gekyk. Die dosent het dit gekyk…julle het dit gekyk. Okay, julle almal stem saam. Okay.

Michelle: Ja, want soos dan as ek sê: okay mevrou… die som oor die koppie wat op sy bal staan… die volume, en dan die deursnee (iemand lag saggies) en wat ook al gevra word… ek het nie ‘n idee hoe om te begin nie. Ek het, soos, hulle het my nou vir my gewys hoe om daar te begin, maar hoe gaan ek moet dink om dit te kon aflei of wat ook al.

Anet: En dan dink ek ook om al jou kinders uit te daag, soos daai wat op ‘n laer vlak is, daai wat op ‘n medium vlak is, en daai wat op ‘n hoër vlak is. Dat almal op die ou einde van die dag nie daar sit soos kiepie en verveeld is die hele dag nie. So, jy gaan natuurlik die eerste paar somme gaan jy vining dit doen as die res as jy op hoër vlak is. Maar dan ook gaan jy uitgedaag wees, en jy sal bereid wees om daai ekstra bietjie te doen teen die einde van die dag.

Michelle: Ek sou sê wat sal help dink ek daar is… in plaas van om soos twee of drie somme op die bord te skryf, en dit dan nou te doen… soos gee vir elkeen sy eie blaai. So, sê nou maar tien somme wat jy voorberei het. So, as jy in die klas deur al die tien somme kom, is dit fantasties. Dan’s jou werk klaar vir volgende week of wat ook al die beplanning is. Maar as jy nie, dan kan jy half op jou eie gaan en sê okay, maar kom ek gaan kyk daarna of gaan kyk waarmee jy gesukkel het of waar jy vasgehaak het waar iemand anders jou gehelp het. Dan

kan jy beter onthou as wat jy… die som staan op die bord en jy skryf dit op ‘n blaai. So, dan kan jy nie altyd onthou wat die inligting was wat vir jou gegee was en so nie. En dan ook die kinders wat vinniger werk, kan soos aangaan. Waar die kinders wat stadiger werk nog steeds teen hul eie pas kan werk en nie gedruk voel nie.

Vera: En soos ek dink sy moet verskillende vlakke van vrae op die werkskaart sit… dat ons dit merk in die klas, en soos letterlik fisies die antwoorde gee… hoe sal mens dit doen, en dan dalk nog ekstra moeiliker somme en maklike somme doen. Soos vir hom gee, okay, doen hom gou… dan merk ons hom. Dat ons so ook kan oefen. Soos sy gee nou net maklike goed. En dan is ons soos… maar dis vervelig. Soos actually challenging goed gee, maar ook dan te sê: kom ons merk dit, en kom ons… dat ek dit saam met julle doen.

Interviewer: Okay, so dit op te volg as daar dan ‘n challenge is.

Michelle: Ja, want ek dink om op te volg, gaan nogals baie help, want op die oomblik voel dit net half vir my as jy nie self die antwoord uitgefigure het nie, dan…

Interviewer: En hoop dis reg.

Michelle: Ja, dan hoop jy nou maar net dis reg, en kom nie in die eksamen nie.

Interviewer: Kan julle dink aan nog iets. Die rol van die dosent… julle kan ‘n oomblik vat, bietjie dink as daar nog iets is. Wat kon ek beter gemaak het van die dosent se kant af.

Michelle: Kommunikasie…

Interviewer: Kommunikasie?

Michelle: Ja.

Interviewer: Brei uit.

Michelle: Soos in hmmm… om… hoe wil ek sê, soos byvoorbeeld om te sê: okay, die toets waaroor gaan is volumes, en dit en dit en dit gaan, maar die werk is beperk… sê nou maar in sirkels of in prismas, want om net te sê volumes, en jy gaan kyk enige video op Youtube, dan kan jy…

Interviewer: Stop gou daar. So dit kom terug na dalk moet daar spesifieke videos wees wat ons weet almal gekyk het.

Michelle: Ja, want, byvoorbeeld as ek net gaan Youtube “volumes”, dan gaan ek op baie verskillende goeters uitkom as iemand anders. So, ja…

M: En dalk soos goed op eFundi te sit soos ‘n group create en sê hier’s feedback van daai moeilike som. Ja, as sy dit kan doen…. As daar dan nie tyd is in die klas om dit te kan doen nie, darem net terugkom om te sê: hoor hier, het julle die moeilike som se terugvoer gesien, verstaan julle dit, is daar iets waarmee julle sukkel?

Michelle: Of, soos ek het die memorandum op eFundi nou gesit. As jy nog steeds nie verstaan nie, kom sien my dan in ekstra ure as, as daar dan nou nie tyd in die klas is of so nie, maar om dit net te los…

Interviewer: Sou julle dit gedoen het? (Stemme beaam)

Michelle: Ja, as ek geweet het ek gaan terugvoer kry, (stemme beaam) dan sou ek meer moeite in die ekstra somme ingesit het.

Interviewer: Okay.

Vera: Maar ons moet die vak meer interessant maak, en moeiliker… dat jy dit wil bywoon, en wil ekstra vrae vra. Soos nou wil ons nie…

Interviewer: Dat jy voel jy leer iets nuuts (Stemme beaam). Julle het gepraat van ‘n avo-som netnou (Lekker lag). So… (Lekker lag) hoekom lag julle?

Michelle: Want dit… dis snaaks.

Interviewer: Okay, het julle hom probeer? Het julle hom reggekry?

(Almal praat gelyk)

Vera: Ons het niks van daai som gedoen nie. Sy’t gesê daai meisie doen dit. Toe praat die meisie. Niemand kon haar hoor nie, soos ek kon haar nie hoor nie, en toe begin hulle twee so ‘n bietjie stry, en toe sê ek net soos okay…

Michelle: O, wat ek ook nog wou gesê het met die kommunikasie is, sê nou maar, as sy ‘n som verduidelik aan een leerder, en sy kom agter, hmmm… maar hoor hier, iemand anders het nou net ook vir my gevra of so iets, verduidelik dit dan aan die hele klas in plaas van om net te sê: o julle, onthou nou net so en so en so. Verduidelik dit dan aan die hele klas. Laat almal dan daardie twee minute luister… al is daar kinders wat dit reeds verstaan… hmmm…

want nou vra sy iets, maar ek het dit ook gedink, maar het dit nie eintlik gevra nie… tipe van ding. So…of nou vra vyf mense dieselfde vrae, en…

Vera: Ja, soos daai som… sy soos: ek kon dit nie regkry nie. So, hoekom kon jy eerstens ‘n som vir ons gee as jy hom nie eers self kon regkry nie. Dis net vir my… sy moes hom self gedoen het om te sien okay, hier is ‘n goeie vraag, ek weet darem al wat die antwoord is. So as die kind hom doen, dat ek kan weet, okay, dis reg.

Anet: Ek dink die miskonmmunikasie was van die prentjie en die woorde het nie oreengestem nie.

Vera: So, dan moes sy die woorde gaan verander het, laat dit wel sin maak.

Michelle: Soos byvoorbeeld, hulle het gesê jy sit die pit van die avokado in die water. En dan suig die water, dan moet jy die volume van die pit uitwerk. Hmmm… maar dit was eintlik die hele avokado, want hulle gee nie vir jou genoeg inligting net om die pit se berekeninge te kan doen nie.

Vera: Ja, hulle gee die advokado se afmeting.

Rachelle: Hulle gee die avokado se afmeting, maar hulle sê ook nie soos die pit is ‘n derde van die lengte of so iets nie. Hulle gee net …

Vera: Soos ek dink net sy moes voor sy die ding vir ons geprint het, self die bewoording dan verander het, laat dit was…of sy het dan die somme gedoen… sy dan gesê sy kon dit nie regkry nie.

Michelle: Of dan nou net uitgeprint en gesê het die pit moet eintlik avokado wees, en dan sou jy dit kan regkry, of so iets.

Interviewer: Ja, die regstelling maak.

Vera: Sy moes die call gemaak het.

Interviewer: Ja, en dan miskien sê wanneer dit moet klaar wees, want sê nou maar net julle het nog volgende week klas gehad, sou julle dit gaan… doen het?

Michelle: Ja, ek sou dit gaan doen het. (Ander beaam ook)

Interviewer: Is dit nog steeds… is dit ‘n maklike vraag?

Vera: Daai goed lyk vir my nogal ingewikkeld. Soos ek het net so vinnig, so nie presies gelees nie… want die prentjies lyk nogal ingewikkeld, en ek doen nie baie goed met soos…

Interviewer: Maar as julle no nie rêrig gesit het nie, hoe weet jy dat al die inligting wat jy nodig het, is nie dalk daar nie? As jy nog nie rêrig….

(Stemme gelyk)

Michelle: Ek het dit actually… ek het dit actually deurgelees. Ek het dit nog nie gaan self doen nie, want ek het nog klas gehad tot nou toe. So, hmmm… ek het dit deurgelees en toe, ek het gedink soos, okay, ek dink ek weet min of meer wat om te doen, maar ek weet nie lekker wat is die formules en so aan nie. So, ek dink dis hoekom ek ook in die toets gesukkel het, want ek het half… ek verstaan wat in die werk aangaan, maar ek het nog nie al die inligting om … soos inligting, bedoelende formules of hoe om dit stap vir stap te doen… of so nie. So ek dink dis… raak nogal uitdagend.

Anet: Ja, want ons het ook al gevra vir ‘n formuleblad, of so, of ons in die eksamen gaan kry. En toe ons nou die toets en goed kry, was daar die formule van die piramides wat ek weet ek nie byvoorbeeld geleer het nie. So, toe vra ons vir haar gaan sy vir ons moeiliker formules gee op ‘n formuleblad, toe sê sy ja. So as dit op eksamen van toepassing is, hoekom is dit nie op toetse en goed nie.

Interviewer: Okay. Het julle vir haar gevra?

Vera: Nee, want toe’t sygesê sy sal dit gee, maar toe vra ‘n kind haar… ek’s nie seker wie dit was nie, toe sê hy net dan moet sy dit vir ons email… dat ons die ander kan weet.

Interviewer: Weet watse formules, want dalk verwag jy jy kry almal, en dan kry jy niks nie. Hmmm… okay, nog iets by die dosent se rol? Is julle redelik gelukkig nou tot… enige laaste aanmerkings. Enige iets wat julle nou aan kan dink? Vat gou ‘n oomblik.

Anet: Ek onthou ons het in die begin voorstelle vir haar gegee, soos waar sy kan verbeter en so. En dit was ook net dit… sy het die vir twee of drie weke gevolg, en toe daarna, toe gaan dit… toe begin dit weer teruggaan.

Michelle: Sodra sy besig geraak het, dan het sy teruggeval, en …

Interviewer: Okay. So julle voel… terug na die vraag toe wat julle netnou gesê het van verandering… julle voel aan die begin was daar ‘n bietjie verandering, maar toe’t dit weer geval na wat dit was.

Michelle: Nie met alles nie, maar met hier en daar se goedjies, ja. Soos byvoorbeeld, hmmm… ons… sy het nie weer die klasse begin aanbied wat ons voorberei het nie. Sy het nou gewerk vanaf die vrae wat ons gestel het… van wat ons nie hmmm… geweet het nie. En dit het dit half vir my beter gemaak, want die klas het half gevoel, jy weet, okay, ons beweeg vinniger, ons kan aangaan na dit wat ons nie verstaan nie. Hmmm… so dit, dit het beter geraak, maar soos goed soos om die goed betyds op eFundi te sit, het slegter geraak.

Interviewer: Okay. Ek verstaan. En dan, as julle nou… julle praat met mense in die klas… obviouslys almal wat nou nie hier is nie. Is almal redelik op dieselfde bladsy as julle? Voel julle almal is by met die kursus? Daar is nou niemand in die klas wat gaan druip nie… wat julle van weet nie.

Michelle: Daar's nie mense wat ek van weet nie, nee. Daar's eintlik mense wat wegbly, want hulle voel… (Michelle lag verleë)

Interviewer: O, okay. Nog enige laaste gedagtes. Okay. Dankie julle.

Micro-cycle 6

Focus-group interview 4

Interviewer: Okay, dankie dat julle hier is Angela… Jade. Hmmm… eerstens kan julle vir my vertel… gister het julle toets geskryf. Hoe was die toets?

Jade: Dit was okay. Dit was weereens… dit was soos… ons het… die dosent het nooit gespesifiseer waaroor ons skryf …

Interviewer: Stop gou daar. Het jy haar toe gevra toe jy onseker was? Het jy dalk vir haar ‘n e-pos gestuur of iets?

Jade: Ek wou, en toe’t sy… toe het my vriendin my gevra wat ons oor skryf. Toe sê ek ek neem aan omtrent alles… van laas keer tot waar ons laas geskryf het… van daar af. Ek neem aan ons moet van daar af begin leer. En toe sê sy, okay, sy is nie seker nie, maar sy gaan die dosent sien… en dan… en toe besef die dosent, o julle… ‘n dag voor die toets… ek het vergeet om die vraestel op te laai… wat ons moet leer.

Interviewer: Het julle dalk iets gehad wat julle kon help voorberei?

Jade: Hmmm… ja, maar net die goed op eFundi. Sy gee maar net vir ons links van Maths is Fun, en sê watter paragrawe ons in die handboek moet bestudeer.

Angela: Wat vir my verwarrend in die toets was, was … sy het van die hmmm… op die sketse het sy… of die bewoording het sy op die sketse verander… op die prentjie wat… hoeveel eenhede was, of dit was loodregte lyne of dit was iets anders.

Jade: Ja, daar was ‘n fout op die vraestel. Dit was bietjie verwarrend gewees.

Interviewer: Okay.

Jade: Maar toe sê sy hmmm… jy weet mos om die wydte, om die buite-oppervlakte van ‘n piramide uit te werk, moet jy die skuinshoogte hê, en nie loodregte hoogte nie. En toe sê sy… toe’t sy vergeet om te bewoord dat… die … want jy het ‘n reghoekige prisma en ‘n reghoekige piramide bo-opmekaar gesit om ‘n huisie te maak. Toe sê… toe sê sy net die loodregte hoogte is sewe van altwee figure… toe sê sy, nee, die prisma se loodregte hoogte is sewe, maar die piramide se skuinshoogte is sewe, want ander sou ons …

Interviewer: O, okay. So julle het nie genoeg inligting gehad om dalk Pythagoras te gebruik nie.

Jade: Ja, ja, ons het, maar sy wou net nie hê ons moes nie. Ons het… frankly… het ons nie geweet ons moes nie. Ons het gedink ons moet die loodregte hoogte gebruik.

Interviewer: O, so dit was die bewoording, en nie… ek hoor jou.

Angela: Ja, dis die bewoording. Ons het eintlik geweet wat die vraag vra, maar die bewoording was nie reg nie. Toe is dit ‘n deurmekaarspul.

Interviewer: Okay. En hoor hier, Jade, was jy goed voorbereid vir die toets sal jy sê?

Jade: Ek was redelik voorberei. Ek was net onseker oor my hmmm… al my formules… my volume en buite-oppervlakte en dit het my so ‘n bietjie deurmekaar gemaak, maar verder was ek voorbereid vir die toets.

Interviewer: Okay. Hmmm… en in die vorige fokusgroep het dit uitgekom dat… van die mense gesê het hulle berei nie eintlik voor nie, want hulle gaan klas toe, en dit word anyway in die klas gedoen of wat ook al. En toe wil ek net by julle hmmm... gehoor het: Berei julle nog steeds voor? Hoekom berei jy nog steeds voor as as jy weet goed gaan eintlik in die klas weer vir jou geteach word?

Jade: Dis half makliker om dit self uit te pluis en te ontdek, want baie keer kan mense soos hmmm… dosente het dalk op ‘n ander manier van dit te verduidelik. So dis maar net makliker om dit vir jouself uit te figure as wat dit is nou ‘n nuwe persoon se verduideliking daarvan te probeer verstaan, en sin maak. Ja, verstaan, en baie keer voel ek sy gaan te in diepte, soos dan mense vra onnodige vrae wat basiese kennis is wat jy al in graad 9 moes weet het.

Interviewer: So, daai mense het nie gaan voorberei nie.

Jade: Nee… ja, dan’s dit bietjie irriterend as die mense wat nie voorberei het het… dan vra hulle nou ‘n stupid vraag in die klas, en dan weet… dan is die hele klas… uhhh… jy kan freaken hoor hoe sug almal, want hierdie… dit was letterlik… dit het net so op die web site gestaan.

Interviewer: Okay.

Angela: Maar selfvoorbereiding wat my baie help, is as sy daai… daai vooraf groepopdrag doen, want dan sien ek wat eintlik van my vereis word… en hmmm… dit is vir my asof ek in die handboek uit die hoofstuk uit gaan werk… Dis net vir my baie meer volledig, en ek hou

van bietjie meer orde, en dat ek sien wat daar aangaan. Want… klas as ons nie aan alles raak nie. Ons raak net aan party goed.

Jade: En spring rond.

Angela: Ja, en dan maak dit my deurmekaar. So vir my om voor te berei en eintlik te weet wat daar aangaan, maak vir my maar ‘n groot verskil.

Interviewer: So, jy sê as die werkkaarte kom, dan weet jy eintlik al wat word van jou verwag. So, voor die werkkaart was jy half onseker, okay.

Angela: Ja, nee, absoluut. En dan wat vir my baie lekker is, waarvan ek hou…dis net standaardvrae wat sy daar vra… maar dan doen ons klaswerk in die klas wat sy moeiliker vrae vra… wat die vir my … **baie** beter maak.

Interviewer: Okay, so julle sal sê daar is ‘n verskil in die standaard vir die vrae in die werkkaart en die vrae in die klas.

Angela: Ja, en ek hou baie daarvan, want ek haat dit as mense jou net werk vra, en dan is dit so maklik, en dan in die eksamen vra hulle jou vas. Ek hou nie daarvan nie. So, vra vir my moeilike vra dat ek dit voor die tyd probeer uitfigure en sien hoe jy dit kan doen … die standaard wat gestel is.

Jade: Dit… dit ook… dit was ook ‘n probleem… met verlede semester se module ook. Ek voel ons het die elementêr… die mees elementêre goed gedoen. En dan kom ons in die eksamen, en dan is sê jy net: wat gaan hier aan.

Angela: Ja, absoluut.

Jade: En dan pluk mense soos vlieë, en ja…

Interviewer: So julle voel nou dat die standard wat julle in die klas doen… die toets is baie dieselfde, (beide sê ja), maar is dit nog steeds vir julle uitdagend genoeg? Dink julle nie dit kan meer uitdagend wees nie? Voel jy jy het bietjie iets ekstra geleer as wat jy op skool geweet het, of is dit maar dieselfde?

Angela: Is maar dieselfde, rêrig… vir my. Daar’s vir my so hier en daar iets wat jy nie soos in detail sou ingegaan het nie… wat jy ook maar bietjie uitfigure, en so. Maar, omdat ons dit in groepe doen, is dit nie **so** uitdagend nie.

Jade: Ja, want daar ‘s baie opinies om jou te help, en soos hierdie persoon… jy verstaan dalk nie, maar iemand by jou tafel doen.

Angela: Ja, en iemand anders sien iets raak wat jy nie raaksien nie.

Interviewer: So, julle voel die groepwerk is definitief goed, (beide beaam) en dit help julle? (beaam).

Interviewer: Okay. Dan… Jade, hoe begin jou voorbereidingstyd? En wanneer begin jy voorberei?

Jade: Verleë lag.

Interviewer: Vat my deur dit.

Jade: Okay, afgesien net die aand voor die tyd, hmmm… dan sal ek gaan kyk wat sy op eFundi gesit het vir ons. Ek gaan kyk nie baie by die leer… ek self gaan kyk nie baie by die leereenhede wat daar aangaan nie. Ek vat daai toetsie wat sy vir ons vra, en dan sal ek net gaan kyk by watse hoofstuk in die boek is dit. En dan gaan ek na daai hoofstuk in die boek toe, en ek som die hoofstuk vir my op, en ek scan deur so paar somme, en kyk of kan ek dit handle by… in die handboek se werk. En ek kyk wat sy vir ons gevra het daarso, en dan gaaan doen ek dit net, en dis my voorbereiding.

Interviewer: As jy ‘n vak gedoen het. Okay ‘mathematics module’ is nou… jy het al hierdie kennis, né? So, as jy nou ‘n vak gedoen het wat heeltemal nuwe goed was, sou jy nog steeds die aand voor die tyd voorberei het?

Jade: Ja, ek is ‘n baie nippertjie-mens oor die algemeen oor als. So, Biologie wat ook vir my baie nuwe werk is en goed, doen ek ook die aand voor die tyd… meeste van die tyd… of ‘n dag voor die tyd. Ja, ek een week hierdie werk wat sy opgesit het, het ek daai week voor die tyd gedoen, maar teen die tyd wat ek dan klas het, het ek als vergeet. So… ja…

Interviewer: Okay, en kyk jy enige videos?

Jade: Vir Wiskunde, nee, nie rêrig nie. Ek sal by Biologie… maar by Wiskunde, veral ‘mathematics module’ is darem nog eenvoudig genoeg dat ek nie ‘n video hoef te kyk nie. Ja, en omdat die werk dalk verduidelik word nogal in die klas ook, waar by Biologie ons juffrou dit nie verduidelik nie. So jy moet dit self gaan uitfigure, en dan help ‘n video my, want ek kan nie net gaan lees nie.

Interviewer: Okay. Hmmm… ek wonder nou met die goed wat vir julle opgelaai word, want jy maak baie staat op daai werkkaart voor die tyd… om dit solank te gaan kyk. So… so julle dink dis nie eintlik nodig dat dit vroeër opgelaai hoef te gewees het nie, want julle berei anyway die aand voor die tyd, of dink julle dit moes vroeër vir die wat sou wou?

Angela: Nee, ek dink absoluut dit moet voor die tyd… lank voor die tyd opgelaai word, want daar is kinders wat hulle beplanning vooruit doen en goed…

Jade: En wat moeilker… wat ook ander challenges het

Angela: Ja, of soos ander mense het op ‘n Dinsdag baie werk, en Dinsdagaand het hy ‘n aksie by die koshuis byvoorbeeld. Waar ek op ‘n Dinsdagaand meeste van die tyd niks aan het nie, so ek kan Dinsdagaand my werk doen. So, ek dink dit moet absoluut voor die tyd opgelaai word.

Interviewer: Okay, ek hoor wat jy sê vir die beplanning, né?

Jade: Dit sal maklik wees, as sy soos voor die tyd by elke … hmmm… soos die begin van die jaar by elke afdeling al klaar die groepsopdrag daar in het, of die oefening daar in het. Dan’s dit minder moeite. Dan hoef jy nie elke week… oe hene, ek het vergeet om dit op te laai… ja…

Interviewer: Okay, ek wil jou vra oor dit. So, jy dink dis ‘n goeie idee as al die bronne vir die hele module reeds aan die begin op is?

Jade: Ja

Interviewer: Okay, so… maar dink jy dan vir elke week moet daar ‘n reminder wees, byvoorbeeld soos ‘n announcement op eFundi wat sê: Onthou, vir volgende week… ons trek nou hier…Dan doen ons dit…dis hierie en hierie. (Beide: Ja,ja, dit sal baie help…) So, die met ander woorde, wat wil vooruit werk, maar ook, dat jy spesifiek weet wat gaan aan, so vir volgende week… hierie. In plaas van ‘n lys met ‘n klomp goed wat jy moet gaan soek vir die goed wat op toepassing is van jou, né?

Angela: Ek dink, soos baie keer sal die juffrou sê: Ja, die kinders wat nie kom nie, dan… hmmm… sal hulle sê: ek gaan hierdie goed net in die klas sê, nie op eFundi sit nie… hmmm… laat julle weet wat aangaan, maar dat die wat nie klas toe kom nie, dat hulle nie weet nie. Dit gaan reflekteer op hulle punte, en as hulle ‘mathematics module’ verstaan, wat is… dan’s dit nie vir my die einde van die wêreld as hulle nie klas toe kom nie. As hulle kom vir hulle toetse en so… Waar vir my dit baie tot die voordeel vir die dosent ook is, as sy elke week ‘n reminder

op eFundi sit dat almal dit sien… want dan gaan dit wees: o ja, ek moet dit nou weer doen… laat ek dit gaan doen, waar baie mense net sal vergeet.

Jade: Ek het al baie keer vergeet… dan stel ek soos reminders op my foon. Ek wil voorberei, ek wil voorberei, en dan iets val altyd voor. En dan vergeet ek. En dan skrik ek die oggend wakker wat ek klas het, dan is dit van: o hene, jy moet dalk voorberei vir klas.

Interviewer: Hmmm… ons het laas keer, met die vorige fokusgroep, het dit uitgekom dat baie van die mense het nie gesien daar's ekstra bronne op eFundi nie. Hulle het nie die links gesien van videos en allerhande goed nie. Ek wil net weet of het julle dit nou al opgespoor? Het julle gesien daar is bronne op eFundi, of nog nie eintlik nie?

Jade: Daar is bronne, maar nie videos sover… ek het nog nie die videos gekry nie.

Angela: Ek weet nie van videos nie. Ek het ook een keer gesien daar's bronne op. Ek het dit gesien.

Interviewer: Het jy op van dit gekliek?

Jade: Ja, dit was soos games… daarso's… met die… wat het ons gedoen, ek dink met die tessolasies of so iets… daar was speletjies wat jy kon doen… jou kon help

Angela: Ja… dit…dis nogal… die bronne wat daar is, is heel eenvoudige bronne. Dis baie basiese werk. Dis nie goed wat bietjie jou challenge nie. Soos ek sal dit baie meer baat vind daarby as hulle moeilike goed daar opsit… al berei ek dit nie nou voor vir klas nie, sal dit vir my lekker wees om dit te doen vir eksamen… vir oefening.

Jade: Ja, want ek kyk… al het ek deur die bronne gegaan, voel ek nog steeds, okay, maar wat soek hulle van my, en dan moet ek in elk geval self gaan soek of self videos gaan opspoor. Soos met die hmmm… met die binnehoek van 'n figuur… dat ons dan… die sentrale binnehoek wat ons so lanklaas… wat ons nie geweet het ons moet dit leer nie. Ons het ook nie geweet hoe om dit te kry nie, en dit was nie op die inligting aangeheg nie. So, toe moes ons maar self dit gaan soek het en probeer uitpuzzle, en baie van die bronne is verkeerd.

Interviewer: So, ek wil vir julle vra oor dit. So daar's 'n bietjie verwarring rondom presies wat jy moet weet. So, dink julle dit sal help as die dosent vir jou 'n video maak, en dit vir jou oplaai, en vir jou sê wat ons in… hierdie deel gaan wees, x, y en z. Dan weet jy presies wat jy moet weet, en dan doen mens 'n ietsie. So, as jy dan in die klas kom, whenever dan nou, die volgende dag of die week daarna, dan kan 'n mens vra: okay, het julle my video gekyk? Wat verstaan julle nie? Dat daai een kan sê daai voorbeeld oor die maan… ek het dit nie verstaan

nie. Anders… the sky is the limit. Dis so wyd oor wat mense kon gaan kyk het. En jy weet nie eintlik… daar's soveel strooi ook op die Internet, nê?

Angela: Presies. En letterlik dit sê as jy op eFundi… as jy op eFundi ingaan, dan's dit die hoofopskrifte… wat jy moet doen, en dan onder dit sê dit: okay, gaan kyk na… gaan kyk na buitehoeke… gaan kyk na volume van figure, gaan kyk na dit. Maar nie spesifiek hmmm… dit was die een ding wat my gepla het… was net… ons moes… ja, ons moes gaan kyk na die… as ons nie in Wiskunde geweet het van hoe om… wat die formule is van buitehoeke van enige veelhoek, of hoe om die binnehoek hmmm… van 'n reëlmatige veelhoek gekry het nie, dan sou ons dit nie kon doen nie… dink ek.

Angela: Maar… dit was so, maar ons het toe… daai keer het sy vir ons daai groepsopdrag opgesit. En toe daarna kon ek dit doen. Ek het ook vir die een weet ek… ek kan nie meer onthou watse een nie, het ek 'n verkeerde formule gehad. En toe ons dit in die klas behandel het, toe weet ek wat daar aangaan.

Interviewer: Ja, okay. So, dit klink vir my of jy 'n voorstel maak vir eFundi. Dat dit spesifiek gaan… vir jou gaan uitlê…

Jade: Ja, module-uitkomste sal great wees.

Jade: En ook, verstaan dit… ons het nie… op hierdie stadium het ons nie dit, en dit freak my so 'n bietjie uit vir eksamen, want ek is 'n persoon wat hou daarvan om te leer… spesifiek… soos …sê… jy moet die buitehoek van 'n figuur… jy moet die binnehoek… jy moet die sentrale binnehoek kan uitwerk van reëlmatig of onreëlmatig. Nou staan daar… nou's dit buitehoeke van figure… okay, reëlmatig of onreëlmatig? Watter figure alles? Tot hoeveel hoeke moet ons kan gaan?

Interviewer: Okay.So, oor my vraag van die video van die dosent spesifiek wat dan sê wat jy moet doen vir die volgende ding. Ja of nee?

Angela: Ek dink dit kan nogal werk. (Jade: Ja)

Jade: Ja, dit hoef nie noodwendig ook 'n video te wees nie. Dit kan letterlik… soos 'n opsomming… 'n puntgewyste…

Angela: Of 'n video nie langer as twee minute nie.

Jade: Ja, want dan… mense sien soos … aag nee…

Interviewer: Maar sê nou maar jy het geweet van die begin af. Luister… vir hierdie module gaan ek elke liewe week ‘n video kry. En al die belangrike inligting wat ek nodig het om te weet, **is** in hierdie video… sekerlik gaan jy hom tog kyk, al is hy nou biejtie langer as twee minute… tien minute, of hoe?

Angela: Tien minute is baie lank, maar ja…

Interviewer: Maar as jy weet daai tien minute word nooit gemors nie. As jy weet die video is tien minute, maar daar is als wat ek moet in weet, ek weet presies wat word van my verwag.

Angela: Ja, nee dit sal werk.

Jade: Ja.

Interviewer: Dan, julle het nou al klaar voorstelle gegee vir eFundi, soos wat dit uitgekom het. Het julle nog voorstelle vir eFundi, want eFundi is eintlik so ‘n fantastiese tool om te gebruik, en dit kan so lekker gebruik word. Het julle nog voorstelle hoe ‘n mens dit beter kan gebruik… of die uitleg of wat ook al… vir ‘mathematics module’ spesifiek?

Jade: Ek het gedink of… gewonder of die dosent ook track kan hou met ons vordering en alles… is in plaas van die groepsopdraggies, kan sy vir ons ‘n weeklikse toetsie aan die einde… soos aan die einde van ’n leereenheid… laat ons soos ‘n eFundi-toets doen, verstaan.

Angela: Ja, al tel hy soos een van jou deelname.

Jade: Ja, hy hoef nie eers deelname te tel nie. Die groepsopdragte wat ons doen, tel nie rêrig veel nie.

Interviewer: En dis ‘n manier om te kyk of mense voorberei.

Jade: Presies, want dan sien sy hoeveel submit het.

Angela: Ja, dit gaan vir haar ‘n voordeel wees… en vir ons… want ook daai toetsie gaan ons dalk ‘n vraag of twee oor hê.

Jade: En dit laat… en dit forseer ons om actually die werk te leer, of voor te berei voordat ons klas toe gaan. Verstaan, as jy vir die… as jy vir die studente sê: dit…hierdie toetsies… dis jou deelname. Presensie tel so persentasie. Hierdie toetsies… dit is jou deelname. Take it or leave it. Skryf dit. Skryf dit nie… dan gaan jy nie eksamen skryf nie.

Interviewer: Okay, hmmm… en dan… my e-pos… het julle dalk een van die videos gekyk van Flipped Classroom of metakognisie?

Interviewer: Okay. (studente lag verleë) En dan… okay die klastoetse… ek wil eintlik dit by julle weet. Hmmm… hoe het die klas verander oor die semester? En ek praat van hoe dit aangebied word… nie van die inhoud nie. Ek praat van hoe dit aangebied, en die… en die inhoud eintlik… askies. Hmmm… het dit begin op ‘n sekere manier en toe bietjie verander of iets, of het dit maar heeltyd half dieselfde gebly?

Angela: Maar die heel tyd dieselfde gebly. Is vir my baie vervelig.

Jade: Ja. (Jade lag ongemaklik)

Angela: Ongelooflik, en as ek klas toe gaan… omdat ek moet klas toe gaan… nie omdat ek wil klas toe gaan nie.

Interviewer: Ja, okay. So jy voel nie jy was ooit uitgedaag in die klas nie. Julle het tog gesê netnou dat die werk in die klas so raps moeiliker was?

Angela: Dit was so een of twee somme, maar…

Interviewer: Nog steeds nie uitdagend nie?

Angela: Dit was nie… vir twee somme om ‘n hele uur en ‘n kwart daar te sit, voel ek nie dis die moeite werd nie.

Interviewer: Okay.

Angela: Ja. Ek… ja…

Interviewer: Sou dit vir julle die moeite werd gewees het as julle daai som wat julle moes doen daai dag, wat so gelyk het. Onthou julle daai een? Sê nou maar jy’t nou gesê, okay, jy kan daai som oplos… jy kan gaan as jy hom opgelos het. Jy kan vir my verduidelik hoe het jy hom gedoen. Sou dit vir jou die moeite werd gewees het?

Angela: Ja, as ek vyf challenging somme gekry het… sy vra aan die begin is daar iets wat julle nie verstaan nie, en dan praat ons vinnig daaroor wat ons nie verstaan nie. Jy’t vyf somme. As jy dit klaar gedoen het, jou antwoorde is reg, dan kan jy gaan. Dan kan sy even daai somme maak… twee is groepsomme wat julle moet doen, en drie is die individuele somme. Dit sal ook my dan nie pla nie.

Jade: Ja, want wat gebeur ook baie keer in die groepe… mense het persoonlike lewens. Party gaan ‘n halfdag hê, en dan gaan hulle nie wil deelneem nie, verstaan. Dan het jy omtrent drie uit ‘n groep van vyf wat dalk werk en aandag gee. En die res is net van: aaag, hoekom moet ek hier wees… hierie is useless?

Interviewer: Maar op die ou end van die dag gaan dit oor jou, en jou leer né? Hmmm… en ek vra dit nou sommer, want sê nou maar daar was ‘n moeilike som… sê nou maar soos hierdie… hierdie som is moeilik. Maar dis ‘n goeie uitdaging. As jy iets soortgelyk in die toekoms sien, dan… dan gaan dit jou opgewonde maak… dan dink jy, jis , ek het al eenkeer so iets opgelos. So, sê nou maar jy het net met hierdie som daar vir ‘n uur gesit, sou julle dit gedoen het? Sou jy vir ‘n uur gesit het totdat jy hierdie ding oplos?

Jade: Ja, ek dink nie dit sou ons ‘n uur gevat het om dit op te los nie, maar…

Interviewer: Dit het iemand in my klas drie ure gevat om hom op te los, maar toe het hy hom gekry. So, jy sou maar net opgegee het?

Jade: Ek weet nie.

Angela: Ek sou opgegee het tot hulle vir my net so… dan sou ek gehou het… ek, persoonlik sou daarvan gehou het as die juffrou vir my ‘n soortgelyke som verduidelik op die bord, maar hy is nog steeds klein bietjie makliker. Jy gaan nog steeds die diepte van hierdie som moet insien.

Interviewer: Ja. Okay.

Angela: Dan gaan ek bietjie meer hoop hê, en dit gaan nog steeds challenging wees, maar ek gaan darem ‘n idee hê waarnatoe ek gaan.

Interviewer: Of miskien, soos rondloop en sien wat jy doen, en jy kan vrae vra en sê: maar het jy daaraaan gedink dat daai hoek dalk 90 grade is, onthou jy jou sirkelmeetkunde in graad 11? So, om te fasiliteer.

Angela: Of sy loop rond en sê: jy’s op die regte pad, of nee, jy is op die verkeeerde metode. Of wat, wat, wat…

Jade: En toe’t sy gesê sy sal daai som met ons behandel, en toe… was nooit vir ons die antwoord gegee nie.

Interviewer: Het julle ooit vir haar gaan vra?

Jade: Ja, ons het op ‘n stadium… ek en my vriendin Lynette, en toe sê sy net: ja, ek sal in die volgende klas vir julle verduidelik.

Interviewer: En toe nie)

Jade: Toe nie.

Interviewer: O, okay. Net gou kyk… by die vraag kom. Skies ek het nou myself hier deurmekaar gemaak.

Angela: Ja, ek … dit voel vir my die dosent spesifiek… is partykeer so bietjie… ek dink as dit by Wiskunde kom, is baie kinders so… hulle is so agtermekaar-kinders. En sy’s ook agtermekaar, maar deur die weer. So, dan sal ek voorstel dat sy ‘n spesifieke lysie maak van hierdie kinders het hierdie die vorige keer vir my gevra… skryf net vinnig neer in die klas. Volgende keer as jy in die klas kom, weet jy hierdie een, twee, drie moet ek gou-gou, vinnig behandel, en dan kan ek aangaan met my normale roetine van die klas.

Jade: En dis baie kinders, en dit begin… dissipline begin soos ‘n groot probleem word, want die kinders… die studente wil nie daar wees nie.

Angela: Want dis vervelig.

Jade: Want dis vervelig, en dan raas en skree die dosent op die res van ons wat wel stil is en wel werk… en dan is sy net… dan… want hulle raas. Dan is ek soos, okay, en dan is dit net ‘n onaangename atmosfeer vir die res van almal.

Interviewer: Okay. En dan het hierdie… hmmm… het hierdie module julle dalk ‘n bietjie gehelp met julle didaktiek? So, as jy nou gaan Wiskunde gee eendag, hoe jy dit dalk sal aanbied vir jou studente, want julle sit nou in ‘n klas waar hierdie vir julle verskriklik vervelig is. Hoe gaan jy seker maak dit gebeur nie met jou eendag as jy vir jou studente gaan leer nie?

Angela: Ek het baie al oor hierdie gedink. Soos, op skool leer hulle absoluut niks vir jou van selfstudie nie. Skool is nie selfstudie nie. Jy gaan doen net jou huiswerk van die werk wat die juffrou vandag vir jou in die klas verduidelik het. En sy het vir jou drie somme gegee wat presies dieselfde omtrent lyk wat jy nou moet gaan doen. Waar hierdie…

Interviewer: So sê jy dis nie eintlik goed nie.

Jade: Inoefening is goed.

Angela: Ja, inoefening is goed, maar….

Jade: Totale lack of self study.

Angela: Die kinders op Universiteit… jy't 'n keuse gemaak: ek wil kom swôt. Meeste kinders het bietjie ruggraat wat kom swôt. So hy het hierdie keuse gemaak. Hy weet as hy dit mors, dan's dit… Kinders gaan skool, omdat dit hulle moet skoolgaan. So, as jy nou vir hulle gaan sê: hoor hier, julle moet hierdie werkies vanaand deurgaan. Ons doen dit more in die klas. Die twee pliggies in die klas gaan dit doen. Die kinders gaan nie… so ek sien nie baie hoe hierie gaan werk in 'n klas nie. Ek sal eerder die werk wat ek in die week behandel het, sê nou maar as jy vir graad 10 tot 12 gee, en jy gaan gee vir hulle ekstra somme om te doen, en elke week met ekstra klas, dan implementeer jy dit so. Watse werk het julle nie verstaan nie… kom ons praat daaroor… kom ek verduidelik dan daai werk meer in detail vir julle. Kom ons gaan weer oor daai werk. So sal ek dit gebruik, maar in klas weet ek nie so mooi… ek het nog nie gedink hoe ek dit dan sal gebruik nie.

Interviewer: Ja, maar dit sou nogals nice gewees het as 'mathematics module' vir jou soos wat jy dink: whaoo, ek gaan dit eendag so vir my kinders aanbied, want hierdie was cool. Ek verstaan nou actually hoekom die volume van 'n kegel 'n derde van 'n silinder is, nadat ek gesien het hoe Archimedes dit bewys het.

Jade: Ja, 'mathematics module' het rêrig ons net gewys… het ons oë oopgemaak daarvoor… dat… hey, die goed wat ons teoreties leer, is actually in die regte lewe toepasbaar. So in daai opsig kan dit help.

Interviewer: Stop gou. So op skool het jy nooit daai konneksie gemaak nie.

Jade: Nee. Nooit. Niemand, ja… onderwysers… jy kom deur die teorie, want daar's nie tyd in die sillabus vir regte lewe. Jy leer wat jy leer, jy vra nie vrae daaroor nie. Jy gaan aan.

Interviewer: Ek's lus om te huil as jy dit sê, maar in elk geval, okay. Daar's twee vrae wat ek nog vir julle wil vra, maar ek wil net gou terugkom, want dis baie interessant wat jy nou sê van op skool, en universiteit, en die verskil. Maar is dit nie nou juis 'n probleem nie? Hoekom doen ons hoërskool op een manier, waar jy geen verantwoordelikheid neem vir jou werk nie, en jy blameer die juffrou as jy nie goed doen nie. En nou kom jy op universiteit, en nou is alles heeltemal anders. Moet ons nie dan verander hoe dit gedoen word op skool nie, en nou sê julle maar iemand gaan nie voor die tyd verantwoordelikheid vat nie, maar as jy druip op hoërskool, want jy bring nie jou kant nie. Seker op 'n stadium gaan jy darem besef hmmm… dis my verantwoordelikheid om hierdie deur te kom. Ek weet my juffrou reteach nie als in die klas nie. As sy van my verwag het om voor te berei, en ek is nie voorberei nie, is ek agter… klaar. Gaan daar nie op 'n stadium 'n mindshift kom nie? Ek wonder sommer.

Jade: Ek dink dit moet dan al in vroeë stadium van ontwikkeling… dit moet al in graad 3…4…5. Daai, dit moet daai 'crucial'… tussen, tussen die ouderdom van van 7 en 14 moet dit al klaar implementeer word. Teen die ouderdom van 14 … dan het jy hulle half verloor. Dan's hulle set in hulle ways. Teen die ouderdom van 14 moet 'n kind sy leerstappe gee, en alles al uitgesorteer hê om hoërskool te kan aantakel, en om universiteit aan te takel.

Angela: Ja, teen daai tyd al weet dit is sy verantwoordelikheid om selfstudie te doen.

Interviewer: Hmmm… ja.

Jade: Dan is mense van nee, die kinders is te klein. Hulle gaan dit nie kan doen nie.

Angela: Ek dink op 'n manier sal dalk wees om dit in die skool bietjie toe te pas… vir 'n begin. Nou is dalk… ek dink nou net vinnig… maar as jy dalk sê met graad 10-leerders… ons doen môre vorms, en ons doen buite-oppervlakte, warra, warra, warra. Hierso is julle werk wat julle moet deurgaan… hier's drie bladsye, en hier's vyf somme wat julle moet doen. Dan, more, as hulle in die klas kom, dan skryf hulle vinnig 'n toetsie van vyf minute, en jy kan sien wie't voorberei, en jy laat daai punte tel. Jy moet die punte laat tel.

Jade: Dis… dis wat ek wou sê… jy gaan hulle moet dreig met: dit tel punte.

Angela: Ja, dan kan die … dan kan jy ook sommer vinnig in die klas ook, voor jy die les begin, identifiseer waar lê die probleem al klaar… wat die kinders rêrig nie verstaan nie, en watse werk hulle nie meer wil doen nie, want dis vir hulle vervelig. Hulle het hierdie klaar… So, dalk is dit 'n manier van dit begin eksperimenteer. Dalk nie so baie van hulle vereis nie, maar tog van hulle vereis om voorbereeiding te doen.

Interviewer: Hulle nog steeds lei. Nie hulle in die donker te laat nie, maar te lei om self reg… En ook wat jy gesê het, okay, soos byvoorbeeld in Wiskunde op hoërskool het jy 'n paar somme… so, jy't drie somme in die klas gedoen, en dan doen jy soortgelyke somme by die huis… (Stem beaam) drie van byvoorbeeld. So, dit leer jou nie dalk om baie selfgerig te wees nie, en dit leer jou ook nie eintlik om vir jouself te dink nie.

Angela: Ek het myself… Wiskunde vir myself… lekker… maar ek hou baie… ek hou baie van Wiskunde, maar om vir myself goed te doen in Wiskunde, het ek elke Saterdag 'n ou vraestel uitgewerk en dit is wat my gechallenge het, en ook ons het elke week by ons juffrou 'n Wiskundeklas gehad, en… 'n ekstra klas gehad, en in ekstra klas het ons moeilike probleme gehanteer. Ons het nie net die vervelige werk gedoen nie. Ons het moeilike probleme gekry.

Jade: En ja, in die ekstra klas doen jy goed wat actually in die eksamen gaan kom. En dit is vir my hartseer, want baie kinders kan nie ekstra klas toe kom as gevolg van vervoerreëlings, of buitemuurse akwitwiteite… nie almal kan altyd by ekstra klas wees nie. Wat dit vir my hartseer maak dat ons nie die moeilike eksamengoed in die klas behandel nie, maar net by die ekstra klas. Dit voel vir my jy sluit ander uit.

Angela: Maar dit is ook… alles hang af van die grootte skool wat jy is. Want as jy ‘n klein skool is, gaan redelik almal kan hmmm… ekstra klas toe kom. Maar ook, as jy ‘n klein skool is, kan jy dalk daai drie moeiliker somme doen in die klas, want jy’t baie minder kinders. Jy kan almal… sê nou maar hierdie een sukkel met daai som, kan ek hom individueel gaan help. Soos ek het gedink in my klas sal ek eendag toepas. Ek gaan altyd ekstra moeilike somme hê vir die werk… Waar, as die kinders wat hierdie werk nie verstaan nie… die kinders, sê nou maar, tussen dertig en vyftig present kry, laat ek hulle help met die eenvoudige werk, maar vir Fransie wat goed doen, druk ek daai papiertjie in haar hand, en sy sal gedrewe wees, want sy wil 90% hê of 100%... daai een wat goed doen. So, sy sal daai ekstra somme so waardeer wat ek vir haar gee wat moeilik is, maar kan ek met hierdie een aangaan. Maar daai een wat op daai vlak wil wees, soos hierdie een wil dalk net deurkom.

Interviewer: Maar as ons dit nou terugbring na ‘mathematics module’, en wat ons nou sê die hele idee met die Flipped Classroom. Die hele Flipped Classroom is om julle te kry om vir julleself te dink, want jy moet gaan voorberei by die huis, maar as jy klas toe kom, moet daar uitdagings wees wat maak dat jy actually na die volgende vlak toe gaan van die werk.

Jade: En dis wat ek voel gaan help as die kinders self die… hmmm… sommige van die teorie kan voorberei. Dan is daar tyd in die klas vir hierdie moeilike vrae, en vir kinders om actually vrae te vra. Daar’s nie rêrig tyd as jy al die… as jy wil die hele periode gaan chalk and talk, dan gaan daar nie tyd wees vir die moeilke vrae om gevra te word nie. Dan gaan jy sê: kom sien my na skool, of so… Wat my ma altyd gesê het, is ‘n goeie voorbeeld van hoe ‘n swak Wiskunde-onderwyser of hoe ‘n swak onderwyser is… onderwysers is soos kom sien my tussen klasse. Waar… wat… hulle verstaan nie… kinders wissel ook. Hulle het ook ‘n skedule en goed… (E: Hulle wil ook badkamer toe gaan) Verstaan, en dan sê die onderwyser: kom sien my tussen klasse as jy vrae het. Hier’s die werk… daar’s die huiswerk… gaan voort.

Angela: Of kom vra my pouse.

Jade: Nee, ek wil nie.

Interviewer: Maar okay, watse tyd dink julle is dan gepas?

Angela: Ekke… wat vir my lekker was, wat ek by my laerskool geleer het. Ek weet nie rêrig of ek dit sal… of ek dit so sal toepas nie. Ek het daarvan gehou. Ons het ‘n ekstra Wiskundeklas gehad. Jy het geweet… van graad 10 af tot matriek. Jy het op ‘n Maandagaand as jy in Matriek is twee ure Wiskundeklas. Jy reël jou goed om dit… jy weet dit. Waar… by my graad 7-juffrou het so… ons skool het half twee uitgekom… of twintig voor twee. Tot twee uur is sy in haar klas. Daar’s geen ekstra klas nie, maar as jy die somme gedoen het, en jy het ekstra vrae… ek is tot twee uur hier. En die kinders wat by die koshuis moet gaan eet, reël maar. En as jy rêrig wil, sal jy pouse kom. Daar is daai kinders wat rêrig wil kom. Hulle sal kom. Die wat nie rêrig wil kom nie, gaan nie kom nie.

Interviewer: Hmmm… Okay, so dan nou by die Flipped Classroom. Jy is veronderstel om die beginsel van die Flipped Classroom… gaan kyk ‘n video by die huis wat vir jou die kennisgoed gee. Daai goed wat ‘n onderwyser net vir jou kan sê wat jy self kan lees. Maar waar die onderwyser daar vir jou moet wees om jou te help vir die moeiliker goed… so dan moet die Flipped Classroom kom, doen die moeiliker in die klas. Wat dink julle is jou rol as student om so ‘n Flipped Classroom baie suksesvol te laat hardloop, en ook, wat dink julle is die rol van die dosent om so ‘n Flipped Classroom suksesvol te laat rol?

Jade: Die student moet natuurlik gaan… jy moet jou voorbereiding gaan doen. Jy moet jou inhoud ken, jy moet die basiese goed kan ken om dit toe te kan pas op die moeiliker goed. En die dosent se rol is om te reël as fasiliteeerder vir hierdie moeiliker probleme, vir die mense wat die probleme ervaar het met sommige van die basiese goed, en dit gou-gou te recap… nie onnodig uit te brei, en van onderwerp te verander, en oor ander dinge te begin praat nie… maar kort bondig… beantwoord die vraag. En dan gaan jy aan na die moeiliker probleme toe wat in die eksamen kan voorkom. Omdat die kennis redelik baie van ons hoërskoolwerk hmmm… bevat, so, jy moes dit al geleer het. So, dit is rêrig hersiening van hoërskool.

Angela: Hmmm… ja, ek sou ook sê hmmm… as die videos, sê nou maar, die oulike video’tjie nou opgelaai word, laat die student dit gaan… kyk. En dan, sê nou maar, vrae doen… of die vrae self of opdraggie wat daar is om te doen. En dan in die klas te sorg dat sy so voorberei is… ek weet nie… dalk soos in die voorbereiding dalk een of twee somme insit wat rêrig moeilik is. Laat, as ons in die klas kom, laat dit nie net hierdie dom, eenvoudige goedjies is nie. Laat die kinders wat bietjie op ‘n hoër vlak is… want dis altyd so in ‘n klas… daar’s die wat op ‘n laer vlak is, en die wat op ‘n hoër vlak is. Laat die kinders wat op ‘n hoër vlak is rêrig ‘n challenge gevoel het deur daai een of twee somme. Al kon daai wat op ‘n laer vlak is, dit gladnie doen nie. Maar laat daai wat op ‘n hoër vlak is, ook wil klas toe kom, en ook wil hoor: wat gaan nou by hierdie som aan, want ek kry hom nie uitgefigure nie. Ek wil hom uitgefigure kry. So, laat hy ook voel, want die kinders wat op ‘n hoër vlak is, voel net so aaaggg, wat moet

ek by die klas gaan doen. Ek verstaan al hierdie werk. Nou moet ek nog gaan sit vir drie sommer om te doen. Laat hulle van die begin af, ook gechallenge word.

Interviewer: So, die dosent is ‘n fasiliteerder, en ook obviously die content writer. Daar moet goeie content… is obviously die dosent se verantwoordelikheid. Wat van eFundi? Dis ook die dosent se verantwoordelikheid?

Jade: Ja

Angela: Absoluut

Interviewer: Okay. En die student dan verantwoordelikheid neem vir sy eie werk? Hy kan nie net terugdraai, en as al daai goed in plek is van die dosent se kant af … dan hmmm… het jy dan mos geen verskonings nie.

Angela: Ja, nee… dan kan… dan’s dit… dan kan… soos die kind kan nie kom kla oor deelnamepunte of iets nie. Daar is klas… geleentheid in die klas… as jy die werk nie verstaan het nie… en ek het spesifiek in elke video gesê wat is die leeruitkomstes, wat ek van julle verwag. So, wat verstaan jy rêrig nie?

Jade: Ja, op hierdie stadium is dit, voel, die vrae wat in die klas gevra word, is nie goed wat hulle rêrig nie verstaan nie. Dis goed, want hulle het nie gaan voorberei nie.

Interviewer: Ja, ja. So, dit mors almal se tyd. So, die dosent se rol ook om iets in plek te stel… om te gaan toets… berei hulle voor. Soos jy netnou genoem het… van dalk ‘n toetsie op eFundi.

Angela: Ja, dit kan baie goed werk.

Interviewer: En ook om te gaan… en om dalk te gaan vassstel wat verstaan hulle nie. So, sit gou na die video ‘n refleksie op. Wat het jy nie verstaan nie… dan voor die dosent klas toe kom, dan weet hy klaar: daai persoon het vir my laat weet hy verstaan nie dit nie. So, ek gaan nou met hom sit, en daaroor werk. Gaan julle solank aan, of iets soos dit.

Angela: Of vraag drie was moeilik of maklik. Dis eintlik iets eenvoudig, maar net 25% het hierdie vraag reggekry nie. Ek moet daaraan… vinnig… al behandel ek dit vir drie sekondes, maar dit moet behandel word. Dit kan baie… veral vir die Flipped Classroo, dink ek, dis ‘n baie oulike idee.

Jade: Want dit… onthou jy ons EDXX-dosent, Ms M? Sy’t altyd…sy’t elke week het ons ‘n eFundi-toets gehad oor die werk wat ons daai week geleer het. En dit het so baie gehelp. Jy’t

jou werk geken! Teen die einde van… teen die einde van die tyd wat dit opgekom het vir eksamen… (Angela: het jy presies geweet wat daar aangaan) Presies.

Interviewer: Jy't nie gewonder wat is nou …

Jade: En jy het geweet wat aangaan. Jy't nie rêrig vrae gehad oor wat om te leer, en hoe presies moet ek hierdie aanpak, want jy't die toetsies gehad. Jy't die toetse gehad om jou weekliks te toets of jy jou inhoud ken… of jy werklik aandag gegee het in die klas. Moet jy dalk weer na hierdie slide gaan kyk. Gaan kyk na hierdie in die handbook.

Interviewer: Ja, ja. So julle het nooit… askies nou laastens, ek dink sommer nou daaraan, en dan's ons klaar as julle nie nog comments het nie. Hmmm… so daar… jy't nooit gevoel as jy 'n som kry of wat ook al: sjoe… hierdie lyk nogals vir my rof. Ek sal dalk 'n bietjie moet gaan oplees. Ek sal dalk 'n bietjie moet Google… oe… ek ken dalk nie hierdie so goed soos wat ek gedink het nie. Dit was vir my altyd net half eentonig… okay… ek het al so iets gesien… okay, ek weet eintlik dadelik wat om te doen. Daar was nooit dat jy gevoel het jy moet jou strategie om te leer, en om 'n probleem oplos, aan te pas nie?

Angela: Ek sou sê: vir my … as ek nie… ja… as ek sien, okay, maar ek ken nou nie hierdie formules nie, dan's ek soos okay, maar ek gaan dit leer vir die eksamen, ek sal…

Interviewer: So jy praat van formules? Nie noodwendig… sjoe… hoe benader ek hierdie som nie?

Angela: Nee, soos daar sal soos letterlik die werk… leerwerk… sal ek nie op datum presies wees nie. Maar ek sal weet ek gebruik hierdie formule vir dit, maar ek kan nie die formule onthou nie. Maar dis… dit was vervelig… baie. Daai som is die enigeste som dink ek…

Interviewer: Die een met die sirkel en die vierkant.

Angela: Ja, wat nogal challenging was. Verder was…

Interviewer: En tog het julle hom nooit gaan oplos nie. Hoekom nie? Hoekom het julle nooit met hom gaan sit by die huis en hom klaargemaak nie? Is julle nie so geïnteresseerd in dit nie of voel jy… aaggg… of wat sal julle sê?

Angela: Ek weet nie… sy het aan die begin van die klas vir ons gesê… sy gaan ons nie vasvra in die toets nie…sy gaan ons nie probeer vasvra nie. Dan's ek soos sy gaan nie die weer vra nie, want hier probeer sy ons vasvra.

Interviewer: So, as jy weet daai gaan nie in die toets wees nie, gaan jy nie bother nie, né? So, dit gaan meer oor die punt… om net om hierdie vak agter die rug te kry, as wat jy nou dink jy gaan iets nuuts leer… noodwendig?

Angela: Ja… nee. Ja.

Interviewer: Okay. Enige iets nog.

Angela: Dis nie… soos… dis…met hierdie vak… omdat dit so ‘n makliker vak is, dink ek kort dit baie meer motivering om dit lekker te maak, en goed. Want almal sê net soos: uuuhh, kyk hierdie ekstra vak, en dit vat tyd in my dag, en ek’s nie lus vir dit nie. Dis nie… ek belowe… dis nie net ek wat so voel en dink nie. Dis rêrig, almal dink so en dan moet ek nog voorberei vir die klas, en ek sit net daar in die klas. Ek het klaar voorberei. Ek weet wat daar aangaan. Nou gaan sit ek in die klas. Vir wat moet ek in die klas gaan sit?

Interviewer: Ja, ja.

Angela: Waar, as jy dalk aan die begin van die klas daai lekker moeilike som, en almal probeer hom uitfigure in die klas en so… wat dan ‘n lekker challenge is vir die klas… dink ek dit sal…

Interviewer: En dan is dit lekker, want mens kan vir mekaar wys. Kyk, wat het ons gedoen. Kyk, wat het ons gedoen. ‘n Mens kan dalk op verskillende maniere en bymekaar leer wat jou ook gaan help as jy eendag ‘n onderwyser is, en iets moet gaan aanwend.

Angela: Ja, en dan… ja, ‘n bietjie tydgebonde daar insit. Nie net as sy na die tyd wil reflekteer oor die som, laat sy nie net… sê… okay… as julle klaar is… sê, dan merk ons dit nie. Sê: jy’t 15 minute. Figure die ding uit. Julle moet dit uitgefigure kry. Laat dit nie so langdradige storie is nie, want dan begin die kinders gesels voor hulle die som doen. En hulle praat nou eers almal oor die naweek voordat hulle die som doen. En dan doen ons die som. Dan kan ons nie eintlik klaar kry nie, en moet ons maar huistoe gaan.

Interviewer: So, dit was ook nie eintlik ‘n akademiese kultuur van hier leer ons… hier werk ons nie?

Angela: Nope. Dit was my lekkerste geselsklas.

Interviewer: Is daar nog enige aanmerkings… enige iets wat julle wou sê of bydra?

Angela: Nee, ek dink net as dit ‘n bietjie meer… baie meer gestruktureerd, ja… en ‘n challenge… ‘n bietjie meer challenging wees, sal lekker wees.

Jade: En…en die dosent sal self sê: ek weet nie hoe om eFundi te gebruik nie. So, jammer julle. Ek is ook nog besig om dit uit te figure. Sê ek maar, maar jy's die dosent hier. Ons… ons hang af van eFundi om ons inligting te kry of voor te berei, sodat ons hierdie module kan slaag. So, nou sê jy vir ons die enigste manier hoe ons gaan… hoe ons kan slaag, weet jy nie hoe om te gebruik nie. Dan is jy net….

Angela: Ja, ek voel ook absoluut… as dit… dit was ook vir my: soos wat de hel, wat…

Jade: Wat soek jy hier… wat doen jy hier?

Angela: Doen dan 'n kursus as jy moet. Skryf dan nou maar vir jou in 'n boekie al die stappe wat jy moet doen. Maar moenie elke keer as jy daar kom, ek gaan volgende jaar, aan die einde van die jaar, dit op eFundi reg hê nie. Nee. Kry dit reg. Dis wat jy moet doen. Jy moet net eFundi doen, en net daai bietjie werk wat nie eens vir ons moeilik is nie… hoe maklik is dit vir jou … voorberei vir die klas. So, jy kan net die eFundi regkry. Want dis soos 'n manier van kommunikasie, en daarom, as dit nie reg is …

Jade: Dan's dit soos: hoe moet ek hierdie doen? Verstaan?

Angela: Dit maak jou… net sulke klein goedjies, soos daai tyd jy sit en gesels, en nie produktief werk nie, en eFundi wat sy nie regkry nie, en die goed wat nie challenging is nie. Al daai goedjies dra by tot "ek's nie lus vir dit nie".

Interviewer: Lae motivering. (Al twee: Ja) Ek verstaan. Okay.

Angela: So, as jy weet jy kom in die klas, dis werkgedrewe, ons gaan nou werk, ek gaan iets leer… al vat dit nie die hele tyd nie, maar vandag het dit my gechallenge, ons het die werk geleer, en ek het dit reggekry, dan …

Jade: Dit voel asof… dan praat sy oor ander goed net om die tyd verby te kry, en dan is ons almal in elk geval so verveeld …

Angela: Dis rêrige 'n vervelige klas. (Jade: Uhhh, my genade) Ek's eerlik, dis super vervelig. Ek hoop nie sy luister nie. (Jade lag verleë)

Interviewer: Is daar nog ietsie?

Angela: Dis net… dit… daai klein goedjies sal al baie verbeter as dit… daai toetsie voor die tyd en die video. Dink dit gaan al 'n baie groot verskil maak.

Interviewer: Okay. In die Flipped Classroom en om dit beter te maak. En dalk ‘n bietjie meer motivering. Net dat ‘n mens darem nie voel dis ‘n mors van tyd nie. Okay, dankie julle.

Angela: Ja, of ook daai, sorry, daai hmmm… Kahoot.

Interviewer: O ja, iemand anders het dit ook voorgestel.

Angela: Dis baie lekker. Dis fine as almal sien wat aangaan. Dis soos rêrig baie fun.

Jade: Ja, en hierdie is maklik genoeg om dit te kan doen op Kahoot. Verstaan. Hierdie is makliker genoeg… die inhoud om dit te kan doen.

Angela: Jy kan vinnig die som in jou kop doen en…

Jade: Ja.

Angela: Ja, dis maklik genoeg… jy kan rêrig sulke goed implementeer.

Interviewer: Okay. Dankie julle.

Reflection interview

Petra – current lecturer semi-structured interview

Interviewer: Ek wonder sommer mevrou Dreyer hulle het nou ‘n paar toetse geskyf en mevrou weet hoe lyk hulle punte. Hoe lyk hulle punte oot die algemeen vir hierdie groep?

Petra: Kyk daar is altyd en spesifiek in hier die groep ok weer ouens wat rerig goed doen en natuurlik ouens wat nie so goed doen nie. Ek het nou nog glad nie gemiddledes en dinge uitgewerk nie, maar ek sou dink uhm ek wil dit nou probeer vergelyk maar ek het nou net verlede jaar se groep waarmee ek dit kan vergelyk mos. Ek wil dink hulle het ‘n bietjie swakker gedoen, ja. Maar vir my was die groep mos dalk moet ek meer na die eksamen na toe kyk. Want verlede jaar se groep was ek mos so beindruk mee omdat hulle almal geslaag het. Drie het nie geslaag nie en toe met die tweede geleentheid wel. So ek sal kyk met die eksamen maar ek dink die deelname was vir my ook mos bietjie minder as verlede jaar, maar daar is ook wel kinders wat weer goed gedoen het. Ek is nou jammer ek kan nie vir jou se van ‘n gemiddeld nie.

Interviewer: Nee dis reg. Kon mevrou ‘n patroon optel in die tipe goeters wat hulle verkeerd gedoen het? Is daar sekere afdelings waarmee hulle gesukkel het of is dit maar net half ‘n mengel.

Petra: Ja, ek dink dis maar ‘n mengsel. Ek dink uh dit voel vir my partykeer juis of hulle juis ‘real life’ goed of hulle dit amper beter insien. Weet? En ek dink so as ek nou volgende jaar nou weer vir die volgendes dan sal ek eintlik meer ‘real life’ goed wil insit ook. Dit voel vir my asof hulle daarmee.

Interviewer: In die toetse?

Petra: In die toetse ja.

Interviewer: En dan voel mevrou se verwagting van die klas van die begin af en nou sal mevrou sê mevrou se verwagting is oortref of nie?

Petra: Nee, my verwagtinge is nie oortref nie. Ek dink omdat ek verlede jaar so opgewonde was oor daai klas my verwagtinge half oortref en ek het rerig gedink hierdie jaar gaan dit weer so wees. Maar miskien is dit dalk juis miskien is dit dieselfde as verlede jaar maar omdat ek verlede jaar nie verwag het dat dit goed gaan wees nie jy weet, ek het dit ervaar. Ek dalk moet eke k is nie negatief oor die klas nie glad nie jy weet glad nie. En ek is ook glad nie

negatief oor die flip idee nie ek gaan verseker dit net so aangaan volgende jaar. Uh so eintlik moet ek sê kom ek se my verwagtinge is dalk net dis nie oortref nie maar ook nie onderskat nie dis omtrent so net dieselfde. Want ek dink nogsteeds die flip het vir hulle gewerk. En ook aan die hand van wat hulle vir my terugvoer gegee het.

Interviewer: En dan as mevrou volgende jaar daarmee aangaan wat sal mevrou dieselfde hou en wat sal mevrou anders doen vir die flip?

Petra: Twee goed spesiefiek. Ek sal, onthou dis ‘n tweede semester module ne, so dis nou eerstejaars wat in kom aan die begin van die jaar. Hulle doen al in die eerste semester hierdie Module 111, dis bietjie ‘n meer ingewikkelde module as hierdie 121. So hulle dink, so hulle tref dit nogal hard daai module waar hulle in kom en uhm soos wat ek nou met die twee jare gedoen het ook. Ek gaan sien graag die klas voordat ek met die module begin. So aan die einde van die erste semester vra ek daai dosent of ek net so 10 min met hulle kan gesels dat ek net vir hulle kan vertel hoe ons gaan werk die twede semester. En dat ek dan vir hulle mos se ek gee reeds vir hulle ‘n taak op Efundi, want hulle gaan proef mos direk na die vakansie as hulle terug kom moet hulle al vir my iets ingee. Nou ek gaan daai ding ook nog baie mooi deur dink, want hierdie module is nie baie moeilik nie dis mos maar oor die vorme en dis baie verstaanbaar en baie van die goed weet hulle of wil ek sê dink hulle weet hulle. En dit voel vir hulle asof dit bietjie maklike goed is maar omdat dit makliker is as die eerste semester se ding, of meer bekend is. So ek sal vir hulle wil ek wil amper sê meer uitdagende goed in daai eerste ding gee. Ek wil hulle eintlik ‘n groter ‘challenge’ gee, in daai eerste taak wat hulle gaan doen, dat dit nie vir hulle te maklik voel nie. Ek wil ‘n paar goetertjies daar in sit wat hulle kan trigger en dan die ander ding wat ek wil anders doen en dit het meer uitgekom in wat hulle vir my gese het is en dis ek het nou hierdie jaar weer vir al daai klasse wat ons gehad het net die links op efundi gehad en vir hulle ook gesê hulle moet nou self nog verder goed gaan soek. Dit het ek nie vreeslik hierdie jaar by hulle ervaar dat van hulle vir my kom sê jis kyk hierdie oulike link wat ons ook gekry het maar verlede jaar het ek, maar hulle het gevra ook dat ek moet self vir hulle videos opsit en ek het nogal gedink dit gaan ek defnitief doen. Ek het ook in die literatuur ook gelees dat uhm dis baie goed in ‘n flipped classroom dat ‘n mens ook kort afdelingkies gee nou ek is nou 2 jaar deur hierdie module daar is vir my eintlik dis lekker afgebaken wil ek amper sê in 10 klasse. Lekker eerste net veelhoeke of wat okal. Nee dis tipe driehoeke en dan die vierhoeke en dan vir elke konsep wil ek amper sê is daar, kan mens ‘n lekker klas oor doen en ek het gedink ek wil 15 min klasse dan maximin. 10 na 15 min klassies videotjies maak en dit vir hulle opsit sodat hulle met elke klas dit dan kry hulle dit dan eers om te kyk.

Interviewer: Het hulle ook gesê dat hulle sal daarvan hou.

Petra: Hulle het gesê ja, hulle het pertinent vir my gesê elke keer, hulle dink ek moet videos van die klasse opsit wat ek dan nou in die klas verduidelik want onthou ek verduidelik eintlik nie in die klas nie behalwe as hulle vir my vra. Vra op wat hulle gekyk het. En dan seker maar die tipiese onderwyser wat ek dan is dan sê ek okay kom ek gee nou vir julle klas hieroor. Dan brei ek dalk bietjie meer uit as wat hulle dalk selfs gevra het en dis hoekom ek gedink ek dat ek eintlik, want ek weet mos nou wat wil ek eintlik vir hulle laat leer in daai ding dat die links en alles eintlik bonus en ekstra is, hulle moet daarna gaan kyk maar ek gee vir hulle ‘n basiese klas oor dit wat ek voel wat hulle nodig het in daai klas. En dan rerig ‘challenging’ goed doen, want dit het ek deur jou agtergekom onthou jy, jy het dit eintlik agter gekom hulle wil uhm meer komplekse dinge doen in die klas.

Interviewer: Nog iets vir dieselfde of anders of is dit nou min of meer dit?

Petra: Ek dink dis min of meer wat ek vir hulle sal.

Interviewer: En dan, dink mevrou hierdie klas is waardevol vir hulle en dink mevrou dit is ‘n waardevolle klas. So vir hulle en vir mevrou. As mevrou nou dink in lig van wie hulle is waarnatoe hulle opad is. Is hierdie klas waardevol?

Petra: Absoluut. Dis weer vir my een van daai deeltjies van wiskunde wat almal eintlik altyd voel ag ons weet hoe werk ‘n driehoek ons weet hoe lyk ‘n vierhoek en daai goeters. Maar gaan doen bietjie rerig of vra vrae daaroor of merk hierdie toetse van hulle en sien hoe verkeerd skryf hulle dit en die waardevolheid wat ek sal dink veral vir hulle ook is het ek spesifiek gesien in die begin dan kon hulle net so 5 uit 10 of 3 uit 10 kry vir die ding. Dan sê ek weet jy as ek nou vir julle hier is nou ‘n saamgestelde figuur en ek vra nou oppervlaktes en dinge dan kan jy nie vir my hier ‘n klomp somme doen of wat okal nie. Jy moet vir my skryf jy los mos nou hierdie probleem vir my op. Jy moet vir my skryf kom ons sê dan nou maar as jy nou besig is met die dak se oppervlakte uit te werk of iets dan moet jy vir my kan skryf jy weet die dak is nou of pyramide of buite-oppervlakte of wat die problem dan okal is, maar dan moet jy kan sê wat jy doen. As jy net vir my daar skryf kom ons sê nou dis ‘n buite oppervlake van iets wat jy uitwerk. As jy nou op die ou einde mooi jou goodies skryf en en jy skryf op die ou end dis 140. 140 wat? Ek moet weet is dit vierkant ‘n meter is dit dit en ek meen dat jy daar kry en dis wat vir my altyd wys hulle baie keer dink hulle hulle weet meer as wat hulle weet. Want dit voel vir my so half of ‘n ou onthou hulle het wiskunde in matriek gehad. Hulle doen wiskunde hoofvak. Hulle gaan wiskundeonderwysrers wees. Dan dink ek op eertsejaarsvlak behoort jy al reeds te weet maak nie saak watter oppervlake jy uitwerk nie, oppervlakte is

vierkant ‘n meter. Jy kan nie by ‘n oppervlakte vir my kom skryf dis meter of dis soveel kubieke meter nie. Dis daai ek voel mos daar is basiese goeters dis amper dis amper soos ek weet ons wil nie van ‘n toolboksie praat nie, maar ek glo daar is ’n toolboksie wat jy reeds moet weet. Dit moet jy weet, of ‘n laaikassie. So, en ek dink dis hoekom dit waardevol vir hulle is, want as hulle dit nie daaruit geleer het, want hulle het verseker al beter gegaan, want al is dit net omdat hulle weet nou ek het dit verwag so ek hoop hulle doen dit later so en ek dink hulle moet dit ook van hulle student verwag.

Interviewer: Presies, want hulle is veronderstel om hierdie al reg te kan doen van hoërskool af doen want dit is ‘n herhaling so mens hoop dat hulle wel hulle studente eendag dan nou van hoërskool af al beter sal onderrig. Dink mevrou die module in daai opsig dat dit hulle beter in staat gaan stel om hierdie inhoud beter aan te bied as ondewysers.

Petra: Ek hoop so, defnitief. Want soos ek sê want hulle dink hulle weet dit maar ek dink nie hulle weet so baie as wat hulle dink hulle weet nie.

Interviewer: So, interessant. Soos kan mevrou aan enige uhm metakognisie wat na vore gekom het soos uhm metakognisie so the ability to know what you know and the ability to know what you don’t know. Ja, so is daar enige iets wat mevrou daar kan sê?

Petra: Weet jy elke keer as ek vir hulle aan die einde van die periode mos hierdie vraeslysie gevra het sou hulle altyd gesê het iets van uhm jy sal dit sien op die papiere ook altyd sal hulle iets gesê het van dit hulle hou van die flip idee want dit help hulle om te agter te kom wat hulle nie weet nie. Hulle het dit spesiefiek genoem. En dit is vir my metakognisie. So hulle kom agter wat hulle toe nie weet nie. En dat hulle dit dan nou op ‘n ander manier of weet dan nou weer gaan kyk of iets.

Interviewer: En dan is dit moeilik om agter die kap van die byl te kom by van hulle wat dan nou rerig swak doen in hulle toetse is dit omdat hulle rerig net nie gaan werk nie of hulle gee nie om nie of is hulle metakognisie swak dat hulle nie kon agterkom wat hulle nie eintlik weet nie.

Petra: Ja, ek dink dis ‘n moeilke vraag. My persoonlike gevoel is daar is baie student wat ek amper wil sê wat ek dink nie hulle kant bring nie ek dink dis ‘n metakognisie probleem nie. Ek dink rerig waar. Dis seker ‘n aanpassing van skool na universiteit toe niemand hou jou dop nie, en dit lyk eintlik ‘n maklike ding ag ons sal in die eksamen leer weer? Ek dink rerig nogal daar is vir my nogal ‘n…

Interviewer: Lae motivering?

Petra: Lae motivering dalk selfs ja.

Interviewer: En dan Efundi. Het dit mevrou goed gewerk en het mevrou gevoel mevrou raak beter met Efundi en hoe kan mens Efundi beter gebruik dalk selfs.

Petra: Okay. Ek beplan om Efundi baie beter te gebruik. En ek moet eerlik sê ek het bietjie verbeter, maar selfs eers weer na die einde toe en jy weet dit self toe ek agterkom ek het vandag weer vir iemand vertel van Efundi is nie die mees gebruikersvriendlike stelsel lyk vir my hier rond nie, want ek sien dit met die ADT waar ek dis NGOS waar ek mos program koordineerdes is soveel studente kry nie hulle goed opgelaai nie toe kom ek agter maar dis presies die fout wat ek gemaak het want ek sit dit op announcement dan tik ek die hele dingetjie mooi en die mense is soos jy wat ook lid weet of member daar was dan gaan ek af dan moet ek kies gaan jy nou vir watter groepe dit moet wees dan moet ek kies moet julle genotify word en dan kom ek agter dan sê dit continue dan druk ek continue dan dink ek mos nou is ons klaar dan gaan hy weer na boontoe dan is dit net dieselfde ding weer en dan het ek altyd gedink ek is klaar en dan gaan ek uit en dan kom dit nie by hulle uit nie en al die tyd moet ek net weer deur die ding gaan ek hoef niks weer te doen nie ek gaan net weer deur die hele ding en dan staan dan heel onder weer want dit was nog nie of my skerm nie, want na continue spring hy eers weer boontoe, maar dan staan daar ‘n post announcement. Nou sien ek het dit nooit geweet nie. Ek weet dit nou. So nou die laaste klomp goed het ek elke keer seker gemaak ek is tot daar. So ek weet ek gaan verseker beter wees met Efundi en dis hoekom ek ook hierdie videotjies wat ek maak op efundi vir hulle sit. En jy weet ek gee mos vir die afstand ook. Vir die afstand gaan ek al daai videotjies reg aan die begin al gee dat hulle op hulle tyd kan werk want ek gaan twee maal met hulle in ‘n semester praat volgende jaar. So dan voel ek hulle kan ook meer kry wat ek hier gee, maar so Efundi defnitief dink ek kan ‘n mens baie beter gebruik en ek gaan dit verseker beter gebruik en ek weet ek weet nou meer en ek gaan sorg dat ek nog meer weet. En uhm vir hulle weet ek nie of hulle efundi spesifiek beter gaan gebruik nie want hulle ken al eintlik al Efundi teen die tyd wat hulle by my uitkom.

Interviewer: Is daar dalk nog enige funksies van Efundi wat mevrou bygeleer het wat mens dalk kan.

Petra: Ek het nie nou nie, maar ek het gehoor van verskeie funksies. Want ons gaan ook by Uni prep, waar ek is, ons gaan nou selfs daar ook doen en ek gaan daar vir hulle toetsies opsit. En wat ek wel bygeleer het is onthou hulle die afkampus gee vir my hulle take elektronies. En ek kan dalk nou selfs vir hierdie student ek dink ek moet dit dalk doen nou dat ek dink wanneer hulle vir my dalk daai taak wanneer hulle begin weet taak doen. Moet hulle

vir my elektronies ingee voor ek hulle self sien. En dan kan ek dit dan al vir hulle terug gee en ek kan dit dan elektronies merk ook. Ja, so ek het dit en ek weet ook by die Uni prep het hulle ook gesê hulle gaan vir ons ‘n opleiding reël vir dis ook een of ander dis ook soos ‘n toets ding wat hulle op Efundi kan skryf en dan merk Efundi sommer. Neem aan dan is dit soos ‘n ‘monkey puzzle’ tipe van ding. Maar ek het gedink ek sal gaan kyk wat ek daarmee ook kan doen.

Interviewer: En dan as mevrou nou hoor iemand in hierdie gang wil vir ‘n semester ook ‘n klas flip doen. Wat sal mevrou vir hulle aanbeveel?

Petra: In kort sal ek sê eerste ding is ek dink jy moet die student voor die tyd vertel wat jy gaan doen. Dis baie belangrik dink ek. Jy moenie daai dag as jy in die klas kom eintlik nie want dit nou in die begin van die jaar is, is dit nou anders. Maar jy moet vir hulle reg aan die begin moet jy vir hulle baie mooi vertel hoe dit gaan werk en wat jy van hulle verwag wat jy van hulle verwag om te doen. Dis vir my belangrik. En ek dink jy moet vir hulle so bietjie vertel dat dit werk jy het dit al gedoen en dit werk en okay kom ons kyk hoe werk dit met hulle en so maar jy moet hulle inkoop kry want as hulle nie inkoop nie gaan dit nie werk nie so jy met die student en ek dink ‘n mens moet deergans meer motiveer jy weet. Ek dink ek moet een of ander motiveringstrategie of ietsie ook met hulle in die ding kry. En so dit sal ek vir mense sê jy moet dit defnitief doen en dan moet jy, ek sal vir hulle ook aanraai dalk om van die begin af videos self te maak. Ek sal dit wat ek nou al gelees het oor flipped claasroom en dit wat ek weer nou nog gaan lees voor ek met iemand praat.

Interviewer: Videos self maak. Uhm enige nog iets daar vir ‘n dosent?

Petra: Ja, defnitief daai wat ons hierdie jaar gedoen het wat ek nie verlede jaar gedoen het nie was om reg aan die begin van as hulle inkom ‘n tipe van ‘n takie ons het dit nou klas taakies genoem. ‘n Klas taak te skryf, toetsie tipe van ding te skryf oor dit wat hulle voorberei het.

Interviewer: So dink mevrou dit het goed gewerk as mens dit dan eers vir hulle gee? Dink mevrou mevrou sal dit oorweeg om dit elektronies vroeër by hulle uit te kry dan kan mevrou in die klas alreeds sê ek het gesien julle sukkel met x,y en z in plaas van ‘damage control’ want dit kom nou eers uit.

Petra: Ja. Ek dink dis absoluut die antwoord maar dan sal jy ‘n ander ding implementer vir om klas by te woon. Maar in elk geval as jy hulle inkoop kry hulle moet eintlik bywoon, hulle moet daar wees, maar ek dink dis rerig iets wat ek sou sê probeer daai Efundi dingetjie want dis

hoe ek verstaan dit by BlackBoard, dis waar my seun hulle op kovsies, hulle het so hulle moet voor jy klas toe gaan moet jy daai toetsie klaar gedoen het.

Interviewer: En dan uhm is mevrou gekontak deur baie student soos per epos of met spreekure in die kantoor of so?

Petra: Ja. Uh nie baie nie, maar ek is wel.

Interviewer: Wat was hulle tipe, wat wou hulle weet?

Petra: Weet hulle sal ek dink hoekom hulle ook nie baie hier was nie, ek moet sê dis baie in die klas, want onthou die klas het oop die ou end ‘n werk klas geword. Ons het altyd in die klas gewerk aan die goed so hulle sou baie keer vra ek wil nie nie sê elemetere goed maar ek wil amper sê rerig basiese goed en dis hoekom ek nogsteeds voel ook hulle dink hulle weet baie meer hulle dink. Hulle dink as hulle vorms ken hulle kan hierdie goeters alles doen, maar dit is nie so nie. So hulle sou vir my meeste maar in die klas vra van dit wat hulle nou gaan kyk het op die links en dan wat hulle vir my hier sou om vra het baie keer is as hulle nou die toets terug gekry het weet in die klas en hulle wonder dan maar hoekom het hulle nie hierdie punte of dit nie. Hulle wil amper net kom seker maak hoekom kry hulle nie daai punte nie.

Interviewer: Okay, so dis weereens daai fokus op punte eerder as leer wat ons al voorheen oor gepraat het. So dit was min wat hulle met mevrou ontak gemaak het buite klastye oor inhoud wat hulle oor onseker is?

Petra: Ja, nee dit het hulle vir my in die klas meestal gevra.

Interviewer: Okay. En dan uhm watter ander tegnologie uhm ek probeer nou my eie vraag hier verstaan wat ek neergeskryf het. So mens het van Efundi gebruik gemaak en dan het mevrou van powerpoint gebruik gemaak. Is daar nog enige tegnologie wat mevrou nou al deur die loop van hierdie jaar uitgevind het of agtergekom het wat dalk goed kan werk om ‘n flipped classroom nog beter te maak.

Petra: Wel defnitief die internet. Ek meen al hierdie ‘links’ wat jy vir hulle opsit meen dis tegnologie wat jy gebruik en daar is die sky eintlik die limit. So daar kan hulle, ek het niks anders in die klas vreeslik nie. Ek sal baie graag wil amper meer ek wil sê praktiese goed in die klas ook doen. Ek het al gedink om in elk geval volgende jaar meer noem dit nou maar modelle omdat hierdie goed is vorms en vaste liggame en goed.

Interviewer: So fisies dit vir hulle te wys.

Petra: En selfs amper dat hulle dit bou in die klas.

Interviewer: Ja, dis is so.

Petra: Want dit dink ek kan ook vir hulle help wanneer hulle dit nou weer gee in klasse. Weet wanneer hulle skool hou.

Interviewer: Natuurlik. En vir die flipped classroom, om dit mens probeer meer aktiewe leer, groepwerk bevorder so laat hulle by mekaar kan leer en as jy uitgedaag word dat jy saam kan werk daaraan. Sal mevrou sê daar was goeie groepwerk? Het hulle goed saamgewerk en aktief saamgewerk?

Petra: Ek dink so. Kyk jy kry altyd ook in daai klas ouens wat iewers sit en nou eers weer iets anders moet doen of so, maar oor die algemeen sal ek sê hulle het vir my as ek dink al die tafels, groepe het vir my baie lekker saamgewerk. En die tye wanneer hulle nou werk daaraan en ek is daar rond en ek akn help dan uhm weet hulle vra my ook dan as ek daar is en hoekom is dit hier en ek kan agterkom hoe werk hulle in die groepe. Nee, ek dink dis defnitief ‘n lekker idee vir groepwerk.

Interviewer: En dan terug by metakognisie. Is daar enige iets nog wat mevrou kan aan dink wat mevrou bewus geraak het van of ‘n tekort aan metakognitiewe vaardighede of dalk waar jy kan dink sho hierdie kind of student het dit dalk.

Petra: Ek dink wat vir hulle op ‘n metakognisie vlak tipe van kan help is die feit dat hulle eintlik moet besef wat hulle nie nou in die klas verstaan of gehoor het of iets nie. Sê nou mar nie daar was nie of selfs net as hulle nie nou verstaan het nog nie en hulle het nie nou al het ons verduidleik of wat okal en hulle het nog nie gevoel jis ek is nou baas van hierdie ding nie. Dink ek behoort hulle nou agter te gekom het, oh maar ek kan nog weer op die links ook gaan kyk. Al het dit hulle net so bietjie aangewakker om te weet eintlik is daar so baie open resources beskikbaar. En ek dink dit is wat al die onderwysers en al die kinders ook moet agterkom. Daar is amper nie ‘n rede meer vir jou, of dit nou ‘n flip class of ‘n gewone klas was dat jy by die huis sit of as jy internet toegang het en jis en ek verstaan nou glad nie hoe hierdie ding werk nie dat jy nie iewers ander hulp kan kry nie. Jy hoef nie eers more in die klas te vra amper nie. So ek, dit is vir my metakognisie dat jy self agterkom ek kan nou ek moet net ietsie anders gaan kyk dan kan ek dit dalk agter kom. So ek sal dink op dit. En uhm, maar miskien sal ek nou eers in die eksamen agterkom. Jy weet, dat ‘n mens nou sien.

Interviewer: En in die klas partykeer goeie vrae uitgekom nie net die basiese wat mens dink hulle het nie voorberei of wat mens dink jis jy moet hierdie weet. Het daar goeie vrae uitgekom,

ek weet nie, ek kan nie nou aan ‘n voorbeeld dink nie, maar ‘n goeie vraag wat aandui sjoe jy het rerig in diepte hier ingegaan of enige goeie vraag dalk net soos sjoe hierdie vraag wat ons nou gekry het, ek dink dit kan nogal op twee verskillende maniere opgelos word of iets soos dit wat bietjie ‘n hoë kognitiewe vlak aandui.

Petra: Ek dink, weet jy waar het hulle nogal wat ek agtergekom het wat hulle party ouens het rerig nie, ons moes mooi kyk tot almal nou verstaan eintlik is toe ons nou, wat noem jy dit, piramide goed gedoen het hierdie vaste liggame. Nou gaan dit oor die volumes daar of die buite-oppervlake of wat ons in daai geval gedoen het. Nou daar is mos ‘n skynshoogte en dan is daar ‘n vertikale hoogte van hierdie ding. Nou daai goed is vir hulle verwarrend. Jy weet, so hulle sou daar oor vra maar hoekom is dit nou hierdie hoogte en nie daai hoogte nie en ek dink nogal as jy die prentjie sien jy, want jy moet daai prentjie verstaan eers dan gaan jy agterkom wat is die skynshoogte en hoekom is die skynshoogte so en hierdie regte hoogte en waarvan praat ek nou eintlik as ek van iets praat, wat ek nou moet uitwerk. As jy oppervlaktes moet uitwerk dan is dit eintlik hierdie driehoeke se oppervlaktes so dan is dit daai skynshoogte wat die hoogte van daai driehoek is, want dan teken hulle baie mooi hierdie hoogte in, want dit is dan daai driehoek se hoogte. Maar dan sê ek dis nie hierdie driehoek, ek dink rerig dis jy moet verstaan jy is besig met die buite-oppervlakte, dis ‘n vlak eintlik wat jy ‘n oppervlakte kry, weet dis nie nou die hoogte van die piramide nie. Ek onthou daai dag het hulle nogal, daar was baie wat baie deurmekaar daarmee geraak het.

Interviewer: En het van hulle maats dalk ook ingeklim om te probeer verduidelik?

Petra: Ja, want hulle verduidelik eers aan die tafel vir mekaar en as ek dan verby is.

Interviewer: En hoe het dit gegaan, het dit geklink asof hulle goed verstaan? Kon hulle dit goed vir mekaar oordra?

Petra: Ek kan nou nie baie goed onthou nie, maar ek dink ja. Ek dink nou ek sien so een tafel daar voor my spesifiek ek weet hulle het altyd baie goed maar dit kan ook nou weer wees want daar het iemand baie skerp gesit spesifiek met daai interessant som van jou was daar so meisietjie gewees. Sy is baie oulik met die goed en sy sal baie goed aan haar tafel ook verduidelik het altyd. Ek het dit defnitief agtergekom. Ek sal sê so twee en daar was nog ‘n tafel sulke meisies, hulle het vir my goed saamgewerk.

Interviewer: Uh en dan as mevrou nou moet dit opsom soos die flipped classroom mens het nou ‘n ruk daarmee gewerk, mens het bietjie daaroor gelees, mens sien dit half gebeur. As mevrou dit vir iemand moet opsom, in ‘n paar sinne, wat is die flipped classroom?

Petra: Uhm ... okay kom ek sê sinne, ek probeer nie meer as 5 sinne sê nie. Eerste een is ek is steeds baie opgewonde oor die flipped class. Ek wil daarby las ek wil dit ook nog doen met ‘n moeliker module, wil ek dit doen. Maar die videotjies maak en alles. So, maar ek is opgewonde daaroor, ek gaan dit nog in my tyd nog ‘n klomp keer doen en probeer en aanbied. Goed nou vra jy wat is dit. Uhm…dis vir my hierdie manier van klas gee wat ek oortuig van is baie goed kan werk as student inkoop, want dis rerig ‘n skuif van nie verantwoordelikheid, almal het heeltyd ‘n verantwoordelikheid gehad maak nie saak wat die opset is nie, maar die skyf van die verantwoordelikheid is dat die dosent of die onderwyser moet sorg dat genoeg goed beskikbaar is en goeie goed beskikbaar is vir die student, want anders gaan hulle dit nie kyk nie en hulle gaan dit nie kyk en hulle gaan nie leer daaruit nie, maar die student moet ook bereid wees om tyd te spandeer voor die tyd. Want, dis so half ‘n agterste voor om, hulle is nie gewoont daaraan nie. So dis hoekom ek sê hulle moet inkoop, dis vir my, dis wat dit is. Maar ek dink dit kan baie goed werk. En dan dalk moet ek net ‘n derde sin bysê. Uhm…Met die tegnologie en die manier van klas gee vandag en ek wil sê die tipe student en ook die tipiese student wat ons het, dink ek dis ‘n verseker ‘n manier om te ‘investigate’ en in te belê vir die toekoms. En hierdie is nou kontak studente gewees, maar ek dink amper nog meer vir afstand ook en ek dink afstand het gekom om te bly. So ek sou dink dis, maar ‘bottom line’ is ek is steeds. Al het hierdie jaar vir my nie so oortref soos wat ek gedink het nie. Uhm…ek is opgewonde oor dit.

Interviewer: En dan laastens, dink mevrou dat hierdie benadering die potensiaal het om metakognisie te bevorder indien ja, hoe en waar en indien nee, nie meer as ‘n traditionele klas nie?

Petra: Ek dink dit het die potential, defnitief. Ek het so terwyl ons praat al gewonder, ek sou nou mens moet die studente voor die tyd inlig, want dis nuut vir hulle. Ons gaan so iets doen en vir hulle vertel ek wil hê julle moet inkoop anders gaan dit klaar nie werk nie en hulle op ‘n manier motiveer en alles. Miskien moet mens ook voor die tyd vir hulle sê, weet jy ons wil spesifiek kyk, want ons vermoed en literatuur wys en wat okay kan mens sê dat dit vir jou metakognisie en vir hulle mooi verduidelik wat dit is. Dit is eintlik veronderstel, as jy reg in hierdie ding ingaan is dit veronderstel om vir jou rerig met metakognitiewe vaardighede te laat help ontwikkel weet dat hulle, hulle moet ook lus wees om dit te kry en hulle moet weet amper wat hulle hier deur kan kry en dis hoekom ek dink en ek is oortuig dat dit kan. So dit sal vir my wees. Uhm…ja, so ek meen dis nie dat ek dink dit kan nie, maar daar gaan verseker altyd ook wees vir wie dit niks metakognitief gaan beteken nie, maar dit sou ook anders niks beteken as dit ‘n gewone klas ook was tien teen een nie. Iets ek ook net wil sê ons het gister by die kongres het ‘n Prof van Unisa het gesê en ek sê ek voel ook altyd so as ons net altyd so hoor

hoe verkeerd dit was hoe ons nog altyd hoe ons nog altyd skool gehou het en geleer het. Hier sit ons dan? Ons het tog redelik goed uit die sisteem uit gekom. So, ek wil sê alles is nie altyd of alles van wat was, is nie verkeerd nie. Uhm, maar ons moet die tegnologie en die goed nou anders gebruik en ek is die heel eerste ou wat sal sê kinders van vandag leer nie naastenby of mense van vandag. Ek leer nie eers meer nou soos wat ek geleer het toe ek 20 jaar terug geleer het nie. So mens moet dit in ag neem. Absoluut. Jy kan nie daar sonder gaan nier, maar juis, gebruik iets soos CD's. Dink ek.

Interviewer: Ek wonder nou wat mevrou sê van die Prof van Unisa. Ek wonder nou wie en hoe gaan ons dan nou bepaal wat moet bly van die verlede en wat nie meer nie. Dis interessant. Wat is, hoe bepaal ons, dit was goed ons kan aangaan met dit. Ek wonder of is dit om te kyk wat die behoefte is waarnatoe ons werk in die toekoms. Hoe was die behoefte van jou vaardighede anders dan, as wat die vaardighede wat nodig is nou. Ek wonder nou sommer half hardop, dis interessant vir my.

Petra: Mar onthou, kyk ek dink toe ons op skool was, sou hulle gesê het okay wat gaan ek word ek gaan 'n dokter word so ek gaan swaot medies en dis wat ek gaan wees vir die res van my lewe. Hulle hoef my nie eintlik vreeslike ander skills te leer nie solank ek weet hoe om 'n dokter te wees en dis wat ek gaan wees. Waar vandag sin word glad nie, moet glad nie so onderrig word nie. Hulle soos hulle sê wat, ek meen, voor hulle 38 is, het hulle 14 jobs gehad jy weet. Hulle moet eintlik ek wil amper sê lewens skills kry. Want hulle hoef baie minder te leer en dit binne hulle te hê, hulle moet weet hoe om inligting te kry en goed te kan doen dink ek. Ek dink sodra daar is 'n groot manier soos jy sê dis die behoefte waarheen ons gaan, ek dink daar is eersten die ander ding. En dan vir persoonlik sal ek dink dit hang af uhm wat, ek wil amper sê jou vak gebied is nie, maar selfs dit maar ons moet tog baie meer geïntegreerd werk dink ek. Maar ek dink tog jou vakgebied bepaal so half wat is daar van die verlede wat jy moet hou. En ek meen twee verskillende, ag ja, twee persone gaan verskillend dink ook. Soos ek weet spesifiek ek dink bietjie anders as heelwat van my kollegas in wiskunde hier. Ek sê nou van 'n toolbox, maar 'n toolbox bedoel ek nie dis nou net dit wat ons doen en net wat okal nie. Ek bedoel net, voor ek enigsens iets kan leer, is daar basiese goed wat ek eers moet ken. En daai basiese goed voel ek moet ek seker wees van. Ek moet 'confident' voel in hierdie goed. En as ons nou bietjie hoërskool wiskunde goed praat dan sal ek nou dink as ons nou dink graad 8, graad 9. Ek moet eksponetwette en faktorisering en gewone breuke optel en aftrek. Noem nou maar getalletjies van laerskool daai tipe van berekeninge en goed. Daai goed moet ek kèn. Ek moet dit so ken, ek moet seker wees as ek hierdie som doen dis hoe ek hom doen en dis hoekom ek hom so doen en dis wat ek doen. Dit moet ek weet. En ek moet dit nie leer soos 'n pappegaai nie ek moet dit eintlik verstaan

om dit te kan doen. Dan dink ek, dan het jy ‘n kragtige klomp tools waarmee jy kan werk. Dis wat vir my belangrik is, jy weet, ek voel as ‘n ou by my kom en hy sukkel in standard 7 met wiskunde, dan sê ek vir hom ek het ‘n klomp goed wat ek jou eers wil van onder af leer want jy ken nie daai goed nie. En het het dit al hoeveel keer gesien as daai ou daai goed eers ken, dis asof hy hierdie goed net aangaan mee dan. Die mense sukkel omdat hulle nie ‘n paar basiese goed, wat hulle nie van weet nie. Ek meen praat bietjie op die straat met iemand net sommer. Vra vir iemand net snaaks iets dan, ek wil nou vir jou eintlik ‘n voorbeeld gee van iemand wat vanoogend vir my sê iemand wat ‘n doktersgraad het hier, uh, wiskunde is glad nie die vakgebied nie, maar dit gaan nou oor vakansiegeld of goeters dit kos R 5000 vir die staanplek en wat okal en hulle deel dit nou deur 3 en toe sê hulle dis R 1600 vir elkeen, maar is dit R 1600 as dit nou ‘n derde is van R 5000. Wel ek sê toe dis amper, want 16 maal 3 is 48 so dis R 4800 dan is dit jy weet. Uh, nou ek kan nou nie dink eintlik waarin jy ‘n PhD gedoen het nie, maak nie vir my saak waarin jy dit gedoen het nie. Dan moet jy darem weet wat is ‘n derde van iets.

Interviewer: Dis soos ‘n life skill.

Petra: Dis soos ‘n life skill. Presies. En dis hoe ek oor wiskunde voel oor daai ‘real life’ goed wat ons ek meen jy kan nerens gaan, jy kan niks doen dan het jy iets in wiskunde gedoen. Maar jy click nie eers jy doen dit in wiskunde nie. En mense wat nie kan ‘n register invul op skool nie. Dis ‘n life skill.

Interviewer: Dit is so. En ek dink nou ook om jou te leer om te dink. Ek het ‘n interessante boek vir my uitgeneem wat ek gelees het, ek weet nie of mevrou al bietjie navorsing gedoen het oor ons almal praat nou van metakognisie, maar daai strategieë of tools, mevrou wat praat van toolbox, daai tipe goed wat jy het om metakognisie te bevorder. Die strategieë in jou klas om metakognisie by jou student te bevorder. Ek weet nie of mevrou al bietjie daaroor gelees het nie?

Petra: Nee, ek sal bietjie lees.

Interviewer: Want dis baie interessant. Ons wil hê hulle moet metakognisie toon, maar ons kweek of soos ons sê foster nie daai dinge wat hulle al bevind het metakognisie wel bevorder, doen ons nie. So voel vir my as ons hulle leer, laat hulle in die steek.

Petra: Ja.

Interviewer: Maar in elk geval, is daar nog enige iets laaste gedagtes van mevrou se kant af.

389 Petra: Nee wat.

390 Interviewer: Okay van my kant of ook nie.

391 Petra: Is dit.

392 Interviewer: Ja, dankie mevrou.

APPENDIX G

Lecturer journal

My expectation for the flipped classroom this semester:

That students develop better SDL skills. That students engage and trust so much in this type of teaching and learning approach that they believe in it. And so that they will try it to some extent in their own class.

15 Augustus 2018

1. *During today's face to face session my students engaged in the following ways:*

They wrote the class test (unannounced) on the investigation they had to do prior to class. They were participating in the discussions about triangles and quads. Questions were asked on example orthocentre.

2. *The following student actions/comments/behaviours made me excited about the flipped classroom:*

They seemed as if they were enjoying the class. They asked questions on stuff they had to investigate prior to class.

3. *The following student actions/comments/behaviours may be an indication that I may need to change some of my flipped classroom strategies:*

-

4. *The following student actions/comments/behaviours during face-to-face session reflected students' attitude (positive/negative) towards video's viewed in their ow time:*

They said that the class was easy because of the stuff they've watched prior to class.

5. *The following comments of students may be evidence that the students find the video's helpful:*

-

6. *The following student actions/comments/behaviours may be evidence that the flipped classroom strategies support self-directed learning/metacognition.*

-

7. *The following aspect of eFundi support/hampers effective flipped classroom/metacognition/self-directed learning:*

-

General remarks:

Their comments when I asked them about their expectations for the class. They want to learn new things. They want to know or pick up they already know and what they do not know yet. They want to have fun in class. They want to experience and learn from and about the flipped classroom idea.

22 Augustus 2018

1. *During today's face to face session my students engaged in the following ways:*

The students were a bit loud today. They do say however, that they discuss the class work with their groups. Therefor they engage in some way when I was explaining. Oh a student asked about a problem they had to solve for the prior activity – then others also asked and commented about it.

2. *The following student actions/comments/behaviours made me excited about the flipped classroom:*

During the reflection time at the end I asked them again to give suggestions – what's good ad what not. Their comments:

It's good and works for him because he can get behind what he knows and what not. He also learns from peers at his table.

She feels I should not spend too much time explaining. Rather give more challenging class activities.

She feels I must post an activity worksheet o eFundi so that they can do it prior to class.

She suggests that I give level 4 activities in class.

3. *The following student actions/comments/behaviours may be an indication that I may need to change some of my flipped classroom strategies:*

Exactly what I wrote at 2. I will in future post activities on eFundi and will compile challenging activities for in class. I will however have to keep on evaluating whether they all feel that way – I doubt.

4. *The following student actions/comments/behaviours during face-to-face session reflected students' attitude (positive/negative) towards video's viewed in their ow time:*

Also, from what I wrote in 2.

5. *The following comments of students may be evidence that the student's find the video's helpful:*

When they suggest that I must not explain too much in class.

6. *The following student actions/comments/behaviours may be evidence that the flipped classroom strategies support self-directed learning/metacognition.*

Their suggestions that they actually get to class prepared and that they do learn from watching videos and content related activities prior to class.

7. *The following aspect of eFundi support/hampers effective flipped classroom/metacognition/self-directed learning:*

EFundi supports flipped classroom because I can now post more activities prior to class. I am not so comfortable with eFundi and it takes time to prepare (compile) and post these activity worksheets.

General remarks:

So far so good. This class and I still have to 'gel' together.

29 August 2018

1. *During today's face to face session my students engaged in the following ways:*

They did the class assignment on quads and the properties of quads. They said that they found this assignment easier because of the preparation they did before class.

2. *The following student actions/comments/behaviours made me excited about the flipped classroom:*

They commented afterwards that they like and enjoy the atmosphere in class. I take it that is because they feel more prepared in class – at least part of this should take credit.

3. *The following student actions/comments/behaviours may be an indication that I may need to change some of my flipped classroom strategies:*

They also commented about the worksheet that I put on eFundi – that helped them. The activities in class were then more challenging. I am going to stick to this.

4. *The following student actions/comments/behaviours during face-to-face session reflected students' attitude (positive/negative) towards video's viewed in their own time:*

They seem to really watch the videos.

5. *The following comments of students may be evidence that the student's find the video's helpful:*

The fact that the class assignment was easier for them.

6. *The following student actions/comments/behaviours may be evidence that the flipped classroom strategies support self-directed learning/metacognition.*

I am feeling that we are starting to find one another. Class engagement is becoming better and more meaningful. I must still get them to be more disciplined after worksheet is completed – to wait for everyone else.

7. *The following aspect of eFundi support/hampers effective flipped classroom/metacognition/self-directed learning:*

I can upload and assignment on basis related stuff on eFundi prior to class.

General remarks:

So far so good. And it is getting better – we are getting to understand and respect each other's expectations for 'in-class' and for 'prior to class'.

Researcher journal

In these entries, I account for the logistics of the study, decisions being made and why, as well as personal reflections. Field notes, memo's, observations, reflections.

Journal entries from my notebook as well as transcriptions from voice-recordings on my phone are included in this document.

As a mathematics teacher I am aware that there is a huge gap between classroom practice and what the research says. I like the concept of a flipped classroom as it seems as if it can possibly bridge research and practice, considering it is well-implemented. But that isn't different to a traditional approach. Teaching for learning is no easy task and whatever the approach, it takes careful consideration and planning. Not even to mention to execute the plan!

I am going to try and keep my journal in a chronological order for the data collection to make it easier to make notes per interview. Then I will make general notes and comments as certain themes arises and I will then and include the date as far as possible.

Data collection couldn't start as planned (August 2017) as ethical approval didn't come through in time. I wanted to collect data the first semester of the 2018. This didn't realise as the module was only taught in the second semester. Therefore, data collection only started in August 2018.

Summary of all interview dates for data collection:

Previous Lecturer interview	24 April 2018	08:30
Current lecturer interview 1	26 April 2018	14:00
Focus-group interview 1	5 September 2018	16:15
Focus-group interview 2	6 September 2018	16:15
Current lecturer interview 2	10 September 2018	14:30
Focus-group interview 3	17 October 2018	16:15
Focus-group interview 4	18 October 2018	16:15
Current lecturer interview 3	6 November 2018	14:30

Participant recruitment:

15 August 2018

Independent person to do student recruitment went overseas for a conference and had to find someone else! Mr x did the recruitment so well, I wanted to participate! Students responded well and asked some questions. Twenty-five students provided their details. They filled their names and details in and agreed that I can email them with further details.

24 April 2018 (micro-cycle 1)

Interviews with the previous lecturer of the module.

What came as a surprise to me is that the dynamics of the student populations for this course changed

Focus is not didactics. Some students were resistant if they are not taught concepts in class by the lecturer, in person. They don't take responsibility for learning.

* It is clear that students need to become better at managing their time. How can they be supported in this regard? Which strategies needs to be in place?

Time consuming to make videos. Lay-out of the classroom does not support group learning, physical space. They don't make use of extra sources on the internet. Suggested reflective prompts on eFundi to foster MC.

Also suggested progressive learning, you must complete something before you can move on, online helps with this. She suggested first getting skilled at implementing a FC with a small group before doing it with a large group. *How do you access student thinking in a big group?

She does not like the idea of student finding the video sources and called it dangerous. She found sources on YouTube low-budget and you must make sure the content is good. She suggested that a way to foster MC might be to let students search for video content and evaluate if it is good or bad – critical evaluation. Will also support them in their teaching practice.

CATEGORIES	**CODES CREATED**	**Inductive (I)**

		Deductive (D)
SDL	CODE: SDL	D
	CODE: Group work	D
Technology	CODE: LMS	D
Metacognition	CODE: MC assessing	D
	CODE: MC regulation	D
	CODE: MC teaching	D
	CODE: Scaffolding	I
FC implementation	CODE: FC principles	I
	CODE: FC knowledge	D
	CODE: FC challenges	D
	CODE: student profile	D
	CODE: student motivation	I
	CODE: lecturer knowledge, skills and beliefs	I
	CODE: student knowledge, skills and beliefs	I

What tools are available to make online communication with students less time-consuming and practical?

<u>26 April 2018 (micro-cycle 2)</u>

First Interview with the current lecturer. Present were myself, the lecturer and my supervisor. Took place at 14:00 at a coffee shop. At the start of the meeting I recapped the aims of the study.

The signed recruitment letters with participants explained the research as well as their role in it clearly. I highlighted the purpose of the research.

Shared with the lecturer that for MC we will look out for: do they take responsibility for their learning; can they drive (monitor their own learning); do they know where they struggle; if they struggle, what to do they do about it, in other words which strategies do they apply to ultimately improve their understanding and their learning.

<table>
<tr><th>THEMES</th><th colspan="2">Codes created during data analysis</th><th>Inductive (I)

Deductive (D)</th></tr>
<tr><td rowspan="3">FC determinants</td><td rowspan="2">CODE: motivation</td><td>CODE: Lecturer motivation</td><td rowspan="2">I</td></tr>
<tr><td>CODE: Student motivation</td></tr>
<tr><td colspan="2">CODE: knowledge, skills and beliefs</td><td>I/D</td></tr>
<tr><td colspan="2">CODE: Cognitive levels</td><td>D/I</td></tr>
<tr><td rowspan="4">21st century skills</td><td colspan="2">CODE: SDL</td><td>D</td></tr>
<tr><td colspan="2">CODE: LMS</td><td>D/I</td></tr>
<tr><td rowspan="2">CODE: MC</td><td>CODE: MC teaching</td><td rowspan="2">I/D</td></tr>
<tr><td>CODE: MC assessing</td></tr>
<tr><td rowspan="4">FC Design</td><td colspan="2">CODE: FC principles</td><td>D</td></tr>
<tr><td colspan="2">CODE: FC strategies</td><td>D</td></tr>
<tr><td colspan="2">CODE: FC benefits</td><td>D/I</td></tr>
<tr><td colspan="2">CODE: FC challenges</td><td>D/I</td></tr>
</table>

	CODE: FC lecturer role	D/I

CODE motivation

1. What was her motivation to implement FC:

Motivation was she heard that my supervisor had a student that needed someone to implement the FCA the year before. I couldn't implement it that first year due to ethical clearance, so she implemented it on her own that year which shows she was also motivated to do it. She also mentioned that she wouldn't have done it if my supervisor didn't ask, she said she would have gone and given lecturer traditionally. She had a positive experience.

Sustainable. She noted that attendance was good. Students brought extra links for the lecturer to put on the LMS for the others. Students were able to distinguish what they thought were good or bad.

*Idea for a strategy, ask students to evaluate sources and explain why they think its good or bad (METACOGNITION). She added that the group activity was their attendance mark.

*Emphasis on marks maybe and not learning?

CODE: metacognition

She noted that buying into this new approach is a MC skill.

*Therefore, you have to have MC skills to adjust to the approach better.

CODE: MC teaching

The environment lends itself to group work interaction. Provided opportunity for student to explain to each other. She suggested to make use of groups to mark the group activity in class.

*This is a good suggestion that support active learning and exploring different strategies. However, question levels must be right, and like Lit says, sum must have different routes to get to the answer. She didn't have any further suggestions; but said that she will think about it but emphasised that whatever she incorporated must be sustainable.

CODE: MC assessing

For in-class her role is to move around and support students during group activities

*How can this improve MC? Not sure. Taking responsibility for learning? When they plan ahead if they know they have a busy week the next week? Cognitive load issue then maybe?

*Seems easier to come up with strategies to teach for MC gains but to assess and see if it is indeed working needs some more attention. Quantitative methods? Further studies?

Code FC strategies

The same:

1. Explaining the approach to students (10min end of previous semester class).

After holiday, practical teaching.

*A lot of time went by between when she explained it to them and when the class started, almost 3 months. She motivated them by stating that from experience, the approach works well.

*Also, I should have asked how she explained it to them.

What is important to tell them whilst explain the FC to students? Their role, your role?

Code FC benefits (deductive)

When you miss lessons, circumstance, you can catch it up online.

* you still miss out on interaction.

The environment lends itself to group work interaction. Provided opportunity for student to explain to each other.

*link with Lit.

Code FC challenges (deductive)

She notes not preparing for class

*she noted that she will bring this into the design:

At the start of lesson, a quiz to check for prep as a solution for this problem of not prepping.

Won't be able to ask question

She says maybe that's is new to students.

Access to internet, not knowing LMS and where to find things.

* Solutions: show them the LMS, show then the lay-out.

CODE FC lecturer role (deductive)

Presenting the content (videos)

To get them actively involved, active learning. For in-class as well as out-of-class component.

For in-class her role is to move around and support students during group activities

She noted that she never looked at those grouped assignment after marking it with them in class.

*feedback

Code FC design (inductive)

She said she read a little about it and then formed her own opinion of how she wanted to implement it. She implemented it the first year without a lot of reading up. She felt it worked for her the way she did it. Did it work for students?

After the first implementation, she read up a bit more about the FC and noted that she want to do some things exactly the same and other things differently.

For her the main thing about the FC is that the student comes to class prepared.

*how can lecturers make sure that they do or support them in acquiring this skill of taking responsibility?!

*is the in-class quiz enough to to check for that? What will you do if they didn't prepare?

Different strategies:

Make her own videos for the 10 lectures. 10-15minue lessons.

Want to add all videos at the beginning of the course

*she had to study the LMS the year before for the FCA implementation. Seems like she didn't really use the platform before.

*She mentioned that she thinks it will be good for MC of student, so that the ones who want to work ahead can go ahead. SDL? That they don't have to wait for her.

*How can this improve MC? Not sure. Taking responsibility for learning? When they plan ahead if they know they have a busy week the next week? Cognitive load issue then maybe?

At the start of lesson, a quiz to check for prep.

*suggested that they do this on LMS even before class. She said it's a good idea but noted that she thinks it is a possibility on the LMS but she doesn't know it that well.

*I emailed two articles with design principles: Rotellar and Kim

Strategies that came out:

Gave opportunity to clarify content at the beginning of the class. Good for MC.

Group activities during class for most of the lesson. And then they mark that at the end of the lesson.

*what if they weren't done

She added that the group activity was their attendance mark.

Where did they use MC skills and/or which aspects can support MC:

She noted if they didn't understand before class and if they know they didn't understand and now know what to ask, that is MC. And that the engagement in class can support them.

*This is a principle that can support MC because there is lecturer support when normally they might have been home alone trying to figure it out and then losing motivation.

She then noted that she realised that students didn't understand the work as she was moving around during class.

*Therefore, benefit of active learning to gain access to student thinking.

The lecturer found that does help her to listen and see what strategies they are using. And she says that in-class does provide this opportunity compared to a traditional class.

CODE knowledge, skills and beliefs (inductive)

She mentioned that one video can be in Afrikaans and one in English and that it will be good for everyone if they do that. How does she know that?

Not a difficult module, 2D and 3D shaped.

She noted the success of the FCA based on the pass rate.

Question, how else did they benefit from the FCA:

She found that they were prepared for class.

Attention was good. She noted that, that is maybe not because of the FCA or maybe it was.

She understood the principle of the FC to not re-teach content.

Group activities during class for most of the lesson. And then they mark that at the end of the lesson.

*what if they weren't done. Problem solving takes longer for some students. If class time runs out, use LMS for solutions? Ask students to share solutions? Provide memo? Provide hints?

She noted that she never looked at those grouped assignment after marking it with them in class.

*feedback strategy revise?

She added that the group activity was their attendance mark.

*emphasis on marks maybe and not learning?

She mentioned that she has forgotten how the LMS works by now and that she'll have to learn it again.

*sounds like she doesn't use the LMS for other classes that are not flipped?

*Time consuming to learn it

She didn't find the approach to be time consuming. What took time was links and learning LMS

*she did not make her own videos. Seems as if the I the main element that makes the approach time consuming.

She noted that she wants to make the videos exactly the way in which she would have done it in class.

*Traditional flip?

She is considering the FCA for her other classes as well because it works for her.

*Does it work for students?

How did she know when they have learnt what she wanted them to learn?

She saw it with tests only and especially exams and the fact that they passed.

*It's too late then to support students in their learning of the module. Strategy revise on this aspect?

She then noted that she realised that students didn't understand the work as she was moving around during class.

*Therefore, benefit of active learning to gain access to student thinking.

The lecturer found that does help her to listen and see what strategies they are using. And she says that in-class does provide this opportunity compared to a traditional class.

She notes the benefit of the FC that students have support in class where they would have done that alone at home. Important aspect of FCA that she understands.

She notes that in class activities that they normally would have done at home. And typically, are test and exam questions. Real-life questions, module lends itself to that.

Student were very positive and involved in this module with the first implementation.

*She might have had the expectation that it would be the same for the next implementation.

Question: did she find that students were self-directed and to give examples:

Yes, when they were excited about the extra sources that they found. SDL, Links with Knowles definition from concept clarification. As well as when student do to her office to ask questions.

*FC might give students insight into the power of the internet for learning.

She mentioned that maybe student were so positive because the course was not an abstract module

*course content. She didn't use to be keen on group work in mathematics. She is seeing the value of group work in the FCA. *Her openness to do something new

CODE Cognitive levels (deductive)

A third of the students didn't have math in high school

She notes that because the course is elementary, student might skip videos and just do the quiz.

CODE: SDL

Question: did she find that students were self-directed and to give examples:

Yes, when they were excited about the extra sources that they found. SDL, did something extra. Links with Knowles definition from concept clarification. As well as when student do to her office to ask questions.

*FC might give students insight into the power of the internet for learning.

*She mentioned that she thinks it will be good for MC of student, so that the ones who want to work ahead can go ahead. SDL? That they don't have to wait for her

CODE: LMS

Access to internet, not knowing LMS and where to find things.

*she had to study the LMS the year before for the FCA implementation. Seems like she didn't really use the platform before.

At the start of lesson, a quiz to check for prep.

*suggested that they do this on LMS even before class. She said it's a good idea but noted that she thinks it is a possibility on the LMS but she doesn't know it that well.

She mentioned that she has forgotten how the LMS works by now and that she'll have to learn it again.

Did it have to do with the organisation and lay-out of the LMS.

GENERAL COMMENTS NOTED:

- She will use the links of previous year.
- She notes the benefit of the flexibility of the FC.
- She notes that student work well together in groups during class.
- She strongly feels that the design must be maintainable.
- There was no data collected on the FCA during the implementation the year before.
- They always asked questions in class.
- In a traditional class, she notes that she teaches the whole time since there is so much to transmit to them.

*The class was still traditional based on the fact that……maybe a term needs to be coined for a class that is between a traditional and non-traditional.

It is clear that students need to become better at managing their time to be successful in a flipped classroom. Regulating their learning requires metacognitive skills. How can they be supported in this regard? Which strategies need to be in place? She does not like the idea of students finding the video sources and called it dangerous. She found sources on YouTube low-budget, and you must first make sure the content is good. She suggested that it might be good to let students search for video content and evaluate if it is good or bad – critical evaluation. This is a good suggestion to foster metacognition. It can also support students in their teaching practice.

30 April

Assessing for metacognition employment seems much more challenging to implement than teaching strategies for metacognitive gains.

23 July

Emailed the lecturer for a meeting that week to hear how flipped classroom planning is going and to offer my help. She never responded to the email.

2 August

Finding the time to spend with the lecturer, she was away for evaluating practical teaching lesson for example. Schedules just kept clashing.

3 August

Started prepping for interviews, didn't realise it could get quite so technical and there is so much to consider. All aspects of research are time consuming!

The second semester started the 16th of July 2018. The students had their first class the 8th of August. They were all away for practical teaching at various schools and didn't have any classes. They were away for a long time! The flipped classroom was explained to them, the last day of the previous term, that was end of May! I hope they haven't forgotten?! (Chapter 5)

The lecturer was also away to evaluate student during practical teaching. This affected our time to get together before the implementation of the flipped classroom.

I am not sure why students that are becoming math teachers must do this subject if the main focus is not didactics

7 August

I am battling understanding my role in helping the lecturer plan. I feel like I am adding to her workload. I emailed (13 July) noting that I will forward material that might be helpful. She never replied, which is fine. But previously when I sent articles about the flipped classroom design, she also didn't reply or mention it. Is my approach wrong? In my head I am trying to help but maybe I am coming off differently?

8 Aug 2018

Next informal meeting couldn't realise, lecturer was not on campus, away with practical teaching.

11 August

Finding it difficult to arrange appointment with the lecturer and realising to connect our schedules is going to be a challenge.

5 September (micro-cycle 3)

Focus group 1

Nina, Vera, Zara, Lisa, Anet, Michelle, Rachel, Elise

THEMES	**Codes**	
FC determinants	CODE: motivation	CODE: Lecturer motivation
		CODE: Student motivation
	CODE: knowledge, skills and beliefs	
	CODE: Cognitive levels	
21st century skills	CODE: SDL	
	CODE: LMS	
	CODE: MC	CODE: MC teaching
		CODE: MC assessing
FC Design	CODE: FC principles	
	CODE: FC strategies	
	CODE: FC benefits	
	CODE: FC challenges	
	CODE: FC lecturer role	

Collected biographical information. No one has heard of MC.

During focus group interviews some students indicated that they didn't even know that there were videos on the LMS. I found that quite strange. looking at an entry from the lecturer journal on the 15th of August she wrote that students said they find the class work easy based on the videos that they watched prior to class. Obviously, this does not line up. It could mean that some students missed out on the session where the letter explained the flipped classroom approach to them, and they were not aware of the videos on the LMS. So, some students knew about the videos and some did not. or students knew about the videos some just watched, and some did not. Some only heard about it during participant recruitment.

Consider ways that all students have access to how this approach will work. Video? Signed acknowledgement? Knowledge, preparation, motivation, beliefs about their future student, LMS,

CODE: FC knowledge

AS we started discussing students realised that their math lecturer the previous semester implemented a FCA. Nina shook her head and said it wasn't, only one person had to prepare for the next lesson.

Therefore, they have had some form of exposure, but not the terminology.

No one in this group has read up about the flipped classroom after hearing about it.

Lisa: think it can work with high school learners, if the benefits are explained to students.

CODE: Cognitive level

Nina: no new concepts.

Michelle: Also exposed until exposed to definition. Told you what to prep for the next day, textbook readings or YouTube videos. No other aspect of the FCA was reported. Just asking student to read before class does not make it a flipped classroom. In this focus group, students find the FC to be an approach where you must come to class prepared. Which is in line with what the lecturer said, for her the main thing is to come to class prepared.

CODE: Technology

Michelle hesitated when said that she is good with technology. She mentioned that it is not a strength of hers. Can do the basics but struggles with new programs.

Elise: Also mentioned that she also lacks some technology skills.

Michelle: helpful when lecturers show the lay-out for LMS. It helps especially for first year, helpful.

Help each other in residence.

Lisa: SMART BOARDS.

Nina: she says please be patient I don't know how eFundi works. SO why will I go through the effort to go to eFundi if she doesn't know what is going on there.

It has a negative impact on students' out-of-class learning (RJ). The discussion about the lay-out of LMS, they found it difficult to navigate.

Michelle indicated that for one of her other subject that she watched videos she does pause the video to make notes and to rewind when she doesn't understand. Some students nodded.

Lisa says the lay-out is fine for noted that what bothers her on eFundi is that it is a lot of information that she needs to read and then the important information is at the bottom. She says no one will read it, the rest agreed they don't read it. Rachel suggested putting importation first.

*SDL of students, not taking responsibility, justifying it the whole time with the math content level. Michelle says that other subject you receive announcement, but not for the Mathematics module. So, you miss new and important information being posted. That's how they miss important info.

*Important, in one of the interviews with the lecturer, she realised that her announcements didn't go through. (lecturer knowledge)

*LMS lay-out: other lecturers highlight important info.

<u>CODE: Math content</u>

Vera: educator influences your results, many students don't like it because of how it is taught. She beliefs that everybody can do math, with good teaching.

Michelle: Teachers determine your experience. It's not like I didn't study or paid attention in class.

Nina: won't work for new or difficult content. She still battles with some mathematics concepts that are new to her after watching videos on it. In-class component misunderstood by students.

CODE: Student belief

Vera: Good experience. Varsity students and will do it, but at school, if you don't like it, why will you prepare at home? (belief). They don't even do homework so why will they prepare for class?

Rachel: FCA can work. If students are motivated it might work. She realises that motivation might play a role in her students one day.

Michelle says student won't prepare but say they did.

Michelle: Sport comment. Priorities.

CODE: Student knowledge

Students discussed their practical teaching and wanting to implement some things they learnt during the first semester. And how they were put of by the teachers at the school saying it won't work. They had their first experience of the resistance of traditional ways of teaching in high school and they were told there isn't time for that. There isn't time for new things. Just emphasises the pressure of schools to deliver results.

CODE: Student motivation

When asked if they think that the fact that it is a video will motivate students to use it to prepare. Lisa shakes her head in disagreement and noted that kids will use excuses like data.

Lack of students taking responsibility for their learning.

Student showed clear frustration with the subject and said that they are bored. Content overlaps with another module and that they are on a higher level than the content.

Nina added that she is not motivated to work in class because she is just repetition of what she already knows.

- When someone asked a question, it became a lecturer. Seems to be challenging for the lecturer to use the class time if she is not teaching. Mind-shift of being used to teach the whole lesson.RJ

CODE: FC challenge

Student also noted the challenge of access.

CODE: FC strategies

Checking for student prep. Reflection prompts on the LMS. Some students mentioned this will help.

Michelle: lecturer knows where to pitch in class.

Anet: suggestion for video making, questions built into video to show for class preparation.

Kahoot at beginning of lesson, student enjoy that. Provide the lecturer with stats to active their knowledge (as Lo principle).

CODE: FC OOC

Lisa: everybody does it differently.

Student would prefer their own lecturer to make videos. Michelle's reason for feeling this way is because she wants to know the right way so that she will get all the marks in tests (beliefs). But further acknowledges that it won't necessarily help you reach higher levels of thinking that might occur if you watch different approaches. She feels you are being taught how to think.

*And that's what she prefers?!

Nina suggestion: lecturer video, and then supply more sources for further information.

Worksheet on LMS for preparation. Different folders on eFundi where some of the content located. Student just look at the topic to prepare and then the worksheet.

Worksheet in class are the same. No one felt that the work in class was challenging.

Lisa said that they have asked the lecturer to make it more challenging. The student further indicated that they think the content can be asked in a more challenging way.

Group work in class doing worksheet.

CODE: SDL

Nina: when lecturer uses terminology that she doesn't know, she goes to google and types in it.

*The group seems to see the value of using the internet for learning purposes, other than the experience of Sarah in micro-cycle 1. She found that learners are shocked when she suggests using the internet to find for example the area of a circle (refer back).

*All student nodded in agreement.

Most student indicated that they haven't watched videos yet.

CODE: FC in class

Michelle indicated that she doesn't see the necessity of going to class. Re-taught. No videos are prescribed videos.

Two students indicated that they have seem videos on the LMS. The rest didn't know that there were videos.

6 September (micro-cycle 3)

Focus group 2

Hannah, Jade, Ann and Henda

<table>
<tr><th>THEMES</th><th colspan="2">Codes</th></tr>
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<tr><td>CODE: MC</td><td>CODE: MC teaching</td></tr>
</table>

		CODE: MC assessing
FC Design	CODE: FC principles	
	CODE: FC strategies	
	CODE: FC benefits	
	CODE: FC challenges	
	CODE: FC lecturer role	

This group seem to have had a better idea of the FC. One participant read up about the approach after participant recruitment. A participant mentioned that even though she prepared for class, there were definitions in class that she didn't know. Clear objectives? A solution might be specific sources. Or how did she prepare? A participant noted that didactics should be more emphasised in this module. She enjoyed the parts where she would want to use it with her students one day. Se have the example of showing why sum of angles in triangle is 180 degrees.

Another participant feels that specific sources needs to be demarcated.

One student had the strategy to prepare for class: first do the worksheet provided then google what she does not know. Students felt that class time and connecting with peers was valuable.

CODE: FC benefits

Hannah learning from one another's mistakes and access each other's strategies.

- This is potentially a way to foster MC

Ann: The benefit of the FCA of peer support and comparing solutions and ways of doing problems when asked how she sees the FCA.

CODE: FC strategies

Hannah: prefers clear instructions and would like specifically recommended videos. She says that she will look for others if she doesn't like it. Hannah seems very aware of how she learns best.

CODE: LMS

They were not aware if there were videos. They added that they weren't told in class explicitly to watch videos.

Module plan op LMS.

CODE: Technology

Hannah mentioned that she finds working with eFundi easy, but she was hesitant about her technology skills in general. Educators can't assume that digital natives are technology savvy when they are not used to using it for learning. Henda had experience with smartboard teaching in high school. She noted the power of technology to make the work visual, she specifically mentioned maths. Sketching and demonstration. They all agreed that there was no explicit instruction to watch videos.

*Henda remarked that the FCA makes room for alternative perspectives when she notes that you don't just have the lecturer in class and that one perspective. She noted this benefit of the FCA and she seemed to be doing a lot of preparation.

CODE: Math content (determinant)

Jade: doesn't see the value of the module. Felt it should be integrated with first semester math module.

Hannah: frustrated with the content of the module.

CODE: FC student role

Henda notes that FCA won't be successful if students don't do their part.

You are the learner and the teacher according to Jade. Jade says that she learns better when she must figure it out for herself compared to when someone teaches the content.

*Henda mentioned self-study.

* a general idea I got from students in this focus group is that FCA is isolated and unguided. And they seemed okay with that. Maybe because of the basic content.

*They saw what they had to prepare, but not how to prepare. Scaffolding.

CODE: student knowledge, skills & beliefs

No students had previous experience with FCA.

Henda: “I need to learn because I need to pass.”

Jade: facilitator.

- Jade’s experience thus far in her academic career sounds like traditional, she mentions chalk and talk.

CODE: FC knowledge

Jade: FCA is more self-study and doing problems in class. Educator tells you what to prep.

She did explain the FCA, (Hannah). When prompted said you have to research the topic yourself what will be done in class. She will provide activities in class and they can ask questions.

CODE: student motivation

Weekly test was a good experience in previous class

*incentive to study, marks were the focus. They also did quiz in this module, but it was only for a participation mark, again the emphasis on assessing for learning. She studies because she wanted good marks.

CODE: SDL

Jade researcher the FCA and whilst researching she read that videos are mostly used for OOC.

Henda: applied more SD with more challenging content.

They found group work in class positive.

Jade read up about the FCA.

She did lack understanding and sees at as unguided self-study.

CODE: Metacognition

No one has heard of metacognition.

Hannah: *FCA experience found her own ways to understand the work. Visual learning.

*MC; diagnosing her own learning needs.

Benefit of the technology. Hannah showed insight into the student-centredness of the FCA.

Hannah: Textbook then google, watches videos on YouTube, Khan academy.

- The content didn't require her to apply further strategies.
- Ann strategy: worksheet provided as part of preparation. If I can do it, she looks it up in the textbook, she doesn't google.

General comments:

They do prep.

When asked how they prep if they didn't watch videos: per lesson, module plan, topic to cover.

This might also be influences by the basic content? They see what class will be about and recognise it and then prepare or not…so what the topic is determines if they prep or not.

There were some contradicting comments. They said they have gone to class without preparing and then also shared why must they go to class for an hour and a half if they've spent (their own) time in prepping. But they just said they have gone to class unprepared. SO it seems like they don't want to do anything for this subject, They seem confident that they can do it.

Ann and admitted that they go to class without prepping. Henda: I have prepped and then there were things that I didn't know example a definition. Also a few times didn't prep for class.

Asked them to reflect on thought process during the lesson. Didn't get much out of them when asked to reflect upon their thought process during class.

Didn't find the FCA to be more time consuming.

*No discussion together on in class work it seems.

When asked how they can learn better in an FCA:

Content level. New methods for didactics. Helpful in that way.

How self-directed: Henda: sees the topic and puts that into google math induction. She seems very self-directed and takes responsibility for her learning. They all agreed that she re-teaches in class.

Assignment before class, quiz as into class; then time to ask questions (PPT); another class activity and then they mark that one.

Hannah: not everything gets re-taught, but most of it.

- I realised that the one lacking the memo is the out of class assignment provided as prep.
- So do mark the class assignments together in class. What if some learners are done before the others?
- The same level of questioning repeated it seems, I am hearing them say.

When asked what was good on eFundi and some suggestions:

Videos will help. Jade: some links don't have content. (also found in FG 1). Henda: feels like class should be shorter. Wasting time if work is re-taught if other students are not SD.

*understanding about the FCA seems lacking when Ann says that she doesn't see why class must be that long. If you've done the work on your own at home.

Student said class will be worth it if they did challenges in class. Higher levels

Hannah: activity to test your knowledge, needs to include everything that you can expect.

*I don't think I understood her with this answer.

This group was frustrated with the content of the module.

<u>8 September</u>

Therefore, you must have metacognitive skills to adjust to the approach better. So, supporting students in developing metacognitive skills and assessing for metacognition, might be key in implementing a successful FCA.

<u>10 September (micro-cycle 5)</u>

Had the meeting with the lecturer today.

She said that they said that they buy into the approach. She said that they are not as actively involved as the previous group. Last year they were more excited and shared sources that they found with the lecturer.

Not sure why they are not as involved as the group the year before. She notices that they are very marks driven. They are interested in typical exam type question. They just want to pass. Her experience so far is that they don't want to understand/learn. She offered a reason that maybe it's because of the easy content and that they didn't expect to have such an easy module. She notes that it is still a valuable module. The lecturer notes that they attend class and the motivation might be the class test in the beginning of the lesson that counts toward their term mark, an attendance mark. Counts one mark.

*The lecturer did what the students asked in providing them with exam type worksheets. She listened to the need of the students. However, sometimes students don't know best. *They indicated in FG 2 hat they asked for more challenging questions. Check lecturer journal.

She said that they suggested a worksheet for prep instead of just links.

*design change. WS on LMS as preparation. After the first class.

*If you just have a topic that says area of a circle you will get millions of sources and where will you start?! Ad where do you stop (About 129 000 000 results (0,39 seconds)) when you search that on google.

*Scaffolding.

Student indicated that they see the topic to prepare and then they just google. Dangerous. As in agreement with Sarah.

They just want to know if the worksheet is typical for the exam. "Even though it is basic or easy, I want you to understand the basics, that's what you need to learn in this class"

<u>CODE: FC in-class</u>

Start class with class test on prep, easy. There are students who found it difficult to watch it beforehand.

*this implies that she wants it to be doable even if you didn't prepare.

Any questions for clarification

She notes that it is ideal that someone asks something.

*as teachers we want to teach!!!

Then they do a more challenging work in class. And give them 10-15 minutes in class. Then I walk around and answer questions. Then we mark that work. Then ask them for feedback about the class and FCA.

During the first interview she said that she will think about a way to monitor whether they prep or not, the class test in the beginning is not the best way, they could have prepped but not have understood something. Maybe for more challenging content, the quiz in the beginning is not enough for test prep.

During this interview when asked if she's thought of a way to check for preparation, she said no she finds the test in the beginning of class works.

*She is of the opinion that if they could do it without preparing, it doesn't bother her. Especially since the content is not new.

*From the lecturer point of view, this makes sense, if they can do the work, it's fine. From investigating the potential for the flipped classroom this has implications.

*also in this case the class test didn't really accurately check preparation.

The lecturer mentioned something that I found interesting. She noted that if students did not prepare for class it might be because of being self-directed. If students looked at the content and realised that they know the work, they used their metacognitive skills to identify the knowledge that they already have so she is of the opinion that if they did not prepare because they saw the content and know that they're familiar with it, she is saying that it might be that they used some metacognitive skills. I wonder if the students will then actually prepare if they saw some of the content and maybe didn't feel so confident about it?

What they like: in class test help them identify what they know and what they do not know.

*MC, declarative.

Good experience according to her, then in groups they help each other.

*See if her journal says this.

Time: marking of class tests, using sources of last year. She mentioned that she doesn't have a lot of work, she didn't find new sources from the previous year. It's not the FCA but workload taking all her time. This class was prepared the year before and it worked well the year before, if it didn't work well the year before, I would have done more. What I wanted to do, is make videos, 10min as I would normally make videos. She mentions that Bergman and Sam's say its best if the lecturer does it herself, She had the intention to do it but didn't have the time.

*Some design changes did not occur due to time constraints. The module was only once a week for 9 weeks.

We agreed to load some sources for them for the next class, Wednesday. I emailed the sources the same day. She replied and said that she loaded them onto Efundi. I replied in the email that I didn't receive a notification from Efundi that it was loaded. That concerned me as I was wondering if the students received the notification?!

The sources included a video om area an perimeter of compound shapes; problem-solving questions (appendix, under data insamel folder) for the in-class sessions and a reflection form (Google Form) to complete before class (named class prep reflection).

Addressing student need for more challenging work, accessing their thinking of out-of-class learning, and allocating one specific link to video on YouTube for them all to watch (15min30seconds). This was also sent as a notification so everything that they had to do for the next lesson was in one place, as suggested.

25 students filled in the reflection form. Info from reflection form:

They all said they watched it. Most students said the video was too long. Some commented that they like the visual drawings, the step-by-step instructions. One student skipped through the video to see if there is anything new. Prompted if they feel prepared for the lesson: one student said: I know exactly what is expected.

*One specific video.

Most students indicated that it refreshed their memories of prior knowledge. And that it is easy.

Students also rated their knowledge on the topic.

Also, I forwarded an email with area of a circle to the lecturer that explains where pi comes from as well as how the formulas were derived. She didn't respond. I am starting to realise

that I am not sure how to go about collaborating with the lecturer and I made assumptions about what it would look like, which I should not have done.

It could mean that some students missed out on the session where the lecturer explained the FCA and the use of videos to them, and they were not aware of the videos on the LMS. That can explain why some students knew about the videos and others did not.

There doesn't seem to be a clear understanding of what exactly needs to be completed during out-of-class learning. Students perceived preparing as optional if they can do the in-class work. There weren't clear instructions and expectations of out-of-class objectives.

The students all nodded and said that the format is important to draw their attention to know that it's important. What the students are saying again is that they need clear guidance perhaps.

There seemed to be a disconnect between the experience by students and the perceived student experiences by the lecturer regarding the cognitive level of the work.

I suggested that they do a quiz on the LMS even before class to check for student preparation and a trend in student answers. She said it's a good idea, and she thinks it is possible on the LMS, but she doesn't know it that well. This is an indication that her exposure and her experience with the LMS is limited and the features were not used to its full potential.

<u>12 September</u>

Even though the content is related to their field of work, which should hopefully lead to more motivation to master the content, the purpose was not didactics. Extrinsic motivation of marks and having to pass could be why some students come to class.

The flipped classroom seems to lose some of the strategies that can support MC if the class is traditional. Constructivist ideas are required for a successful FCA implementation, one that can support MC. It might be like trying to make two paradigm shifts at the same time which is a tall order! The first shift of a traditional to a more constructivist class and then this new approach. It is not easy for a lecturer to have to do this. See if there are sources that the NWU is still quite traditional in its teaching methods? Or if it is more student-centre and more about learning.

The possibility exists, that if a class is more traditional before a flip, the flip will be a “flip of a traditional” class. Bishop and Vergelegen does not see this as a flipped classroom. To do in one go, more constructivist AND flip must be very difficult and might hinder the successful FC implementation, for the first time anyway.

We had different expectations for the implemented FC.

13 September

No instruction of when and/or if that question must be finished was provided by the lecturer. While working on the sum, one girl asked if there will be a question like that in the test. When the lecturer said no, she immediately lost interest in the sum.

18 September

Did focus groups in Afrikaans to make students more comfortable, made transcriptions difficult and more time consuming!

They did not do higher level activities, when they did one, they had 10 minutes and gave up. (class observation). Can hinder the development of MC.

After meso-cycle 1 (September 2018)

Analysing the data and looked for themes in every interview.

Maybe I can make a network of the themes that strongly featured from each interview? And then compare for main themes?

Codes where deductively derived and I am looking for certain key issues associated with the flipped classroom as its potential to foster MC.

*Re-code the data that falls under the code: student mindset. Classify it as knowledge, skills and/or beliefs.

*Find new and recent articles on metacognition and the flipped classroom.

Summary of the data collected thus far:

All about marks, for the lecturer as well as students. Why is education structured this way? What are the kinds of pressure on lecturers for student to achieve good scores?

Some questions that I included for the second round of focus groups based on answers of the first round:

All: Why do you still prepare and how do you prepare for class and when do you prepare (last minute)?

All: Google? Textbook? Worksheet?

Henda: How do you distinguish between a good and a bad video? Do you ever pause video when you don't understand?

Elise: Which things did you want to use during practical teaching that you referred to with the previous focus group that your department head said that you can't?

Jade: how did this module support you in didactics that you mentioned?

11 September

Went onto Efundi. The module site is not well organised, and data were not easy to find. All videos and information on topics are just listed underneath each other with no headings, you have to click on it to know what it is about and you don't know which link goes with what content.

12 September

I visited the in-class session today and made some observations. The class started with a test, 10 minutes of the lesson. Re-taught some content for about 10minutes. Some student question for about 10 more minutes about the way in which the sums must be written out. Most students are bored and showing it. Also questions about where certain sources on Efundi is. A lot of talking. They started the class problem at about 13:40. The class left at about 14:00. There was still 15 minutes of the lesson left. No instruction of completing the question, no hints. Groups did discuss it among themselves.

Some students go out of their way to try and show the lecturer how bored they are – so rude. Not a lot of time is provided for solving the cube problem. It was handed out and about 10 minutes later, students were dismissed. No discussion took place. No hints. No clear instruction of when and if that question must be finished. One girl did, however, ask if there will be a question like that in the test. When the lecturer said no, she immediately lost interest in the sum.

The class was still very lecturer centred. Not sure how the test in the beginning enabled the lecturer right then and there is they prepared?

Implied messages by lecturers seems to be crucial. Two very important once that came up:

1. The LMS. Student noted that they don't take it seriously if the lecturer keeps saying that she is not confident in using the LMS. That raided the question of whether an educator need to be open and almost vulnerable with student when a learning approach is new for all involved or whether you need to act the pro.

2. Student were provided with a challenge in class. A student asked the lecturer if such a question will be asked in a test. The lecturer said no and the student lost interest. This took place during the in-class sessions that I observed. Students are marks driven. That is their incentive to learn.

10 October

I was left with the question as to why so little time is either provided or allocated to the in-class activity. What might be a time-consuming part of the in-class session is the 'diagnostic test.' Perhaps it would be worth revising the strategy of how to check for student preparation that is less time consuming that subsequently would free up more time that can be utilized for problem-solving during in-class activities.

16 October 2018

Students completed the reflection form on google forms. Some are so rude. Many students indicate that they don't watch videos.

Sent an email today with a link to a reflection form for students. She uploaded the reflection link and 26 students completed the form. The form was about their approach to preparing for class, the next class was 17 October.

Also 2 nice challenge question and I offered, that if she wants to use it, I offered to send the memo. She said that she will see if there is time, then she might do the questions.

Making sure that both the lecturer and students can navigate the LMS well is very important for an FCA implementation to foster metacognition. Using it for announcements to mention test dates etc., is completely different to using it for mediating learning like with the flipped classroom where the out-of-class component is crucial and the bedrock of in-class sessions.

17 October 2018 (micro-cycle 6)

Had a focus-group interview today.

The wrote test today so that make sense what the lecturer said yesterday that they might not have time to do class challenges.

The students shared that they don't have class the 24th October. I wanted to do the open-ended questionnaire with them! They said the class is only for checking marks. It was my error, the lecturer did mention this in an email from the 2nd of October, I misinterpreted and didn't realise that there will be no class.

Three things that stood out in this interview:

Students think that more challenging question will be good, but with good structured feedback.

The lay-out of the LMS: all necessary things for a specific lesson needs to be together.

The request for a specific video that everyone must watch. To be able to ask about specific things in the video if you don't understand.

18 October 2018 (micro-cycle 5)

Focus group 4

Joh -students are really frustrated with this class! The content, everything.

19 October

Maybe students can design questions for a module like this that they don't find to hard? How can question development foster metacognition?

20 October

Some might argue that students should go look for their own videos and that that will be a way to support SDL and metacognition. I agree with Sarah (MC 1), who mentioned that it is dangerous to let them just find their own videos on the internet. Not merely because of bad quality, but if you just have a topic from a module plan, for example, the area of a circle, you will get millions of sources when you just type it into Google, where will you start … and where do you stop? How will you monitor and evaluate learning? I searched: area of a circle on

Google, in 0.39 seconds, there were 129 000 000 results. Scaffolding is proving to be crucial for the design of a flipped classroom with the potential to support metacognition.

There seem to have been a disconnect between the experiences by students and the perceived student experiences by the lecturer regarding the content level of the work.

26 October

Remain focussed on the research question!

I was almost shocked as to how often my own beliefs and bias based on previous experience was noted and had to be dealt with.

After meso-cycle 2 (October 2018)

3 November

During data analysis I realized some student dominated the focus-group interviews.

6 November 2018

Lecturer reflection interview

No other researcher journal other than the prompts provided.

Log of important emails:

12 July	The lecturer confirmed in an email that the content of the module stayed the same as previous years.
13 July	Email sharing that I will forward helpful sources
23 July	Emailed the lecturer for a meeting that week to hear how flipped classroom planning is going and to offer my help. She unfortunately didn't respond to the email.
3 August	Sent an follow up email to the lecturer to set up a meeting to discuss the design. Confirmed a meeting for the 6th of August at 3.

10 August	Emailed the lecturer for the venue in order to visit the lecture the 15th of August, Wednesday. She didn't reply.
13 August	Sent a follow up email, since I couldn't find the venue of the class on eFuni. Venue was confirmed for the next lesson. This was for participant recruitment.
4 September	Sent an email to arrange for the semi-structured interviews with the lecturer offering different timeslot. She replied that she will let me know closer to the time, what time suits her.
10 September	Sent a follow up email to arrange an interview. She agreed and we met today at 14:30. I also asked in the email if it will be possible to load some sources on Efundi and she that that it is a possibility. She also confirmed in the email that the content for the week is the area of 2D shapes.
11 September	Sent an follow up email to check if sources, as agreed the day before, were indeed sent since I haven't received a notification and she confirmed that they were. She mentioned that she had to send it again as she didn't check the 'sent as notification' box the first time. It worked and the announcement came through. So, I know the student received the notification and I can ask them about it in the next round of focus group interviews.
12 September	Received an email from the lecturer about the problem-solving question the students did in class and we agreed upon the answer.
16 September	Emailed the lecturer thanking her for writing notes for me for the study. Spent the weekend transcribing and thought I'd just sent an email as a reminder about the note keeping.
2 October	Emailed the lecturer to ask when student will have their last class in order to administer the open-ended questionnaire. They had 2 more classes left, 17 and 24 October.

16 October	I emailed an worksheet with a nice challenge on 3D shapes and she replied that if they get time for it, she will do it with them. Sent an email today with a link to a reflection form for students. Also 2 nice challenge question and I offered, that if she wants to use it, I offered to send the memo. She said that she will see if there is time, then she might to the questions.
30 October	Emailed the lecturer to organise an interview. We agreed upon the 6th of November.
10 December	Emailed to lecturer and asked her if she is willing to send me the results as well as the paper that the student wrote. She sent both, grateful.

8 November

I made assumptions that she knew my role. I beat around the bush and made suggestions about design changes without discussing it with the lecturer. MC 5 we spoke about whether we think student would still come to class if they didn't have to submit the assignment at the beginning of class. We should have discussed why it is important for both the study and the lecturer to know.

Should have been more involved in the design. Should have assumed or expected the lecturer to make the changes to the design on her own. I didn't want to impose, and both our time was limited. I should have communicated more clearly with the lecturer in what she would have wanted support with. I should have helped her plan and execute collaboratively.

I found it difficult to ask the lecturer for her time. Lecturers are so busy, and she was teaching different classes.

13 November

I assumed that both the lecturer and students can navigate the LMS well. If other classes during the first semester was not flipped classrooms, then maybe they didn't use the LMS all that much for learning purposes or a communication tool. Using it for announcement to mention test dates etc is completely different as using it for mediating learning like with the flipped classroom where the out-of-class component is crucial and the bedrock of in-class sessions.

24 November

Is the paradigm shift to great from traditional class to flipped classroom to foster metacognition?

The fact that I was not much involved in the planning of the design does not account for basic teaching and learning such as providing feedback and clear objectives was not in place. That would have been an area worth revising within a flipped classroom or not.

Important meeting:

Supervisor 3 August

Title change – we wanted to bring 21st century in.

Discussed coding, + and – attached to a code like motivation.

Inductive and deductive discussion.

Comments about the flipped classroom implementation design to foster MC:

My understanding of the flipped classroom design features:

Principles: In-class; out-of-class; educator role.

Don't reteach; active learning; changed roles; Technology. Higher order thinking and problem solving.

Strategies: How to make the FC successful for learning.

Check for prep; scaffolding; LMS usage; feedback; higher-order tasks; facilitator.

My understanding of how the flipped classroom can support metacognition:

Bridging gap between research and practice

Get time for higher order thinking like problem solving

Active learning and lecturer support

Peer support

To become more aware of learning process

My understanding of how metacognition fostered:

By reflection, by forcing to think deeply. By provided time to do so. No opting out.

Evaluating their attempts at learning. Provided feedback in order to make changes.

The class test in the beginning of the lesson is to check for student understanding. How does this help the lecturer see if they prepared? And if the lecturer found that they didn't, what then? This strategy needs revision as to what is the best way to check for student preparation.

Possible strategies

Followed eFundi as a student to be ablew to se and have access to what they have access to. S

Sent an email to the lecturer. Attached two articles, the one with the design principles by Kim 2014 as discussed in the literature and the article by Rotellar. Both have design principles for the flipped classroom. Also, a Khan academy video with an interesting introduction to Geometry. I also asked if all videos are in English and if she will make use of the previous lectures' PPT's. She never replied to my email.

Initial design

Out-of-class and in class component were flipped around.

Explain the approach

Developed challenges for class to see how participant react to that.

Spoke to lecturer about student feedback****

Uitgevind oor klas demografie end at almal wisk hoofvak mense is.

Fokusgroup questions changes – why?

Design changes:

Worksheet for prep as asked by students.

*lack of clear objectives.

Videos, student suggestions. Didn't realise.

The suggestions were made for clear instructions of exactly what you need to know for the next lesson.

*students that referred to the textbook in this case was applying MC, strategy.

*Video by one's own lecturer doesn't seem important for MC, but assigning the same video to everyone.

Findings

Students seem to be more aware of their learning.

Reflection does not come naturally to people! It must be taught and learnt.

Motivation is a big deal in learning. Not just the desire to do something but also the reason as to why you want to do something.

Another meso-cycle would have been good.

Understanding technology use in effective learning proved to be crucial. Technology is the main communication tool between the lecturer and students. Strategies needs to be revised as to how this communication can be "controlled" and/or monitored.

What seem to have hindered MC development was: objectives & feedback & level of questions.

Investigate the following topics:

I already did ethics training as well as academic writing workshop.

Can a Flip with a traditional approach work and furthermore exploit and foster metacognitive skills?

Comment about "aandagafleibaarheid"

Atlas.ti is incredible software.

Atlas.Ti report: toolbar. Click on document, click on report. Then you can save and print.

Atlas.Ti: click op create new network. Pick your own codes to form a network with your own connection between codes. Quotes from interviews can be pulled into networks as well.

Inductive and deductive coding

Axial coding

Software for efficient online learning

Has research been done on the requirements for a class to be considered a flipped classroom?

Read more about scaffolding

Guy Boysen: hitting MC target with learning objectives.

Challenges that I experience:

Disappointment of only being able to collect data a year after which I was planning to.

All the forms and admin. I didn't realise the importance of Ethics and the task of being granted permission to perform research. I tend to want to use quotes too much. Coherence

Time consuming nature of FCA

It is not merely the making of videos that is time consuming in an FCA. Realising exactly how much planning goes into an FCA might be over-looked. The level of the out-of-class learning, the level of the in-class learning, implementation of checking for student preparation, motivating students, providing feedback, facilitating, being flexible and making necessary changes. I think what take more time than a traditional class, initially, is the videos yes. But considering all these aspects to take into consideration, a class that is not 'flipped' but effective teaching and learning won't require less time. Especially a class where the lecturer is available for questions online. In this way the FCA might actually safe time compared to a non 'flip' class in that now there might be less questions during out of class learning and the lecturer can address problem areas in class when the group is together instead of having to answer it to individuals online. (Chapter 5)

Motivation

Since they could complete class work without having prepared for class, led to low motivation to prepare for class.

Even though the content is related to their field of work, which should lead to more motivation to master the content, the purpose was not didactics. Extrinsic motivation of marks and having

to pass is what made students come to class and prepare. Intrinsic motivation? Some student indicated intrinsic motivation when speaking about exploring different sources for out-of-class learning.

Cognitive levels

The fact that they couldn't solve the problem, indicated that the content can be asked in ways that challenges students. However, the course outcomes

The magnitude of the paradigm shift must not be underestimated. It is evident from comments made by both the lecturer and the student. Examples:

"I am tempted to re-teach" Lecturer. Only know what they've learnt after test and/or exam.

Students had difficulty reflecting about the learning process and explaining their thought processes to me.

Personally, I do not agree with people that say the FCA can just be done once a week. It won't bring about the required mind shift and getting into the new way of doing things. Confusing. And will take more planning.

LMS

Kirsh – visual designs role in metacognition.

E-learning components is a huge aspect of FCA for MC. Design, lay-out. (Chapter 5)

Disconnect: students kry nie announcements nie.

FCA knowledge and understanding of their role:

Make sure students know how the class will work. Explain in class, provide a video, discuss. Teach metacognition. (Chapter 5)

Desember 2018

There seem to have been a between the experiences by students and the perceived student experiences by the lecturer regarding the content level of the work. Or rather, if she became aware of issues in the class, she didn't, or didn't know how to address it. She said from the onset that the FCA design needs to be sustainable and she didn't show a lot of openness to

change to the design. Every time something was suggested she either noted that she will think about it, she does not know how to do that with the LMS.

Critical reflection seemed very difficult for the lecturer. She mentioned more than once that the design must be sustainable, the it is working for her and that the success is measured against the pass rate. Reflecting about how to improve the actual learning was difficult to achieve.

Chapter 5

The FCA has no more potential than a traditional class supporting students in MC gains. A well-planned traditional class can foster better MC than a mere flip of a class without utilising the benefits of the FCA such as the integration of technology and active collaboration on problem-solving during in class. Integrating technology is not merely just the videos, which can just be a traditional lecturer. Exploiting visual (programs and software), used to provide feedback and collect data such as students watching videos etc.

A summary of most important findings from all collected data.

Therefore, summarise data to answer research questions.

Sub-research Q 1 answered in Chapter 2.

Sub-research question 2 and 3 answered in Chapter 4. Highlight those findings and how it answered the research questions. Can summarise it per the main two themes?!

Sub-research question 4 answered in this question.

Provide the guidelines. Incorporate MC teaching and assessing strategies. LO, confirms of contradict.

Our classroom experiences suggest that successful pedagogical innovation

always requires fine tuning (Dehler & Welsh, 2014).

Certainly, acquiring information is a component of the learning process (Dehler & Welsh, 2014).

but learning begins when we recognize that we do not know something

Proved to be very important: scaffolding!

The general frustration with the module content seemed to have had a general effect on student of being negative towards everything for this module.

The importance of supporting students in their new role, they are not just going to walk into it and thrive when their previous experiences has been the opposite, especially with a lack of clear guidance and expectation. Supporting students in their new role is crucial.

Supporting lecturers in their new role is equally crucial. Part of a community of support, don't reinvent the wheel, learn from others. That intrinsic motivation is not easy to come by if extrinsic motivation has driven you your whole life.

What would I have done different looking back?

Lecturer not in focus groups. Should have asked the lecturer how it is that I can support her instead of just sending emails with information that I found helpful. Like the articles with design principles by Kim and the one by Rotellar. Student participants can keep a journal for future research. Read research that mentioned it is a nice scaffolding tool (Engin, 2011). Or also for future research, simple content bit problem-solving. What I realised was that more valuable data might have been found in metacognition if more time was spent on what metacognition is. And not merely a broad definition. If students had a more in depth understanding of metacognition, they would have been more aware of it within themselves and would have been able to answer interview questions with that in mind.

APPENDIX H

Language editor declaration

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CERTIFIED STATEMENT OF EDITING AND TRANSLATION

It is hereby certified that the dissertation:

Implementing a flipped-classroom approach for metacognitive gains to prepare mathematics student-teachers for the 21st century

By Celizma Lotz

has been edited by me, using the APA method for both text and reference list, according to the method as it is contained in the ***BIBLIOGRAPHIC STYLE & reference techniques*** by Dr Marlene Burger (UNISA, 2010)

Date: 28th February 2021

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