



Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning

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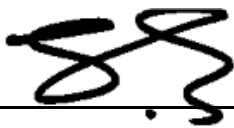
Dissertation submitted in *partial* fulfilment of the requirements for
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the North-West University

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DECLARATION

I the undersigned, hereby declare that the study: Strategies for **Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning**, and all the information contained in this dissertation is my own original work and that I have not previously in its entirety or in part submitted it at any tertiary institution for a degree.

A handwritten signature in black ink, consisting of stylized, overlapping loops and a trailing flourish, positioned above a horizontal line.

Signature

27 May 2024

Date

DEDICATION

I would like to dedicate this work to

- my wife, Jeanet, for standing by me through every night and day. Your steadfast support and encouragement, especially during my lowest moments, have been my foundation.
- my son, Jean-Hendri, for understanding from a young age that being in front of the PC doesn't always mean gaming. I appreciate your patience and promise to make up for the times I had to say no to spending time together. Always remember you are powerful beyond measure.
- my parents, Lucas and Barbara, who have eagerly anticipated my graduation since my first year and consistently reminded me of its significance. Your encouragement has been my constant motivation.
- my brother, Lucas, for being there when I needed support and for demonstrating that hard work and a little luck can make anything possible. Thank you for your support.

PREFACE

The current educational reality is characterised by rapid technological progress and digital infiltration. In a world filled with digital gadgets, education is faced with an evolutionary test. Technology is not a trend, but a necessity that must prepare learners for the 21st century. This research project considers the problem of integration between gamification as a new educational trend and self-directed learning.

The latter is a new pedagogical concept that is based on the necessity of self-directed learning. Such an approach aims to increase the responsibility of learners for their acquisition of knowledge and skills. This study will be useful in developing ways to enhance the level of self-directed learning for Generation Z. This group of learners was born between the mid-1990s and early 2010s and does not know life without the internet and social networks.

Generation Z is distinguished by a desire to use only digital tools, to respond to stimuli faster, and to seek quick results; attaining their interest in the learning process is a challenging task for teachers who use traditional teaching methods. This research defines the role of gamification in the learning process of CAT theory with Generation Z learners. The integration of gamification into the teaching and learning of theoretical content to promote self-directed learning among Generation Z learners is the focus of the study.

By including gamification elements in the educational process, it is believed that the participants of the learning process will be more interested, motivated, and responsible for their learning process. This research study was methodologically designed by following a qualitative approach.

This study aims to determine how gamification can be used to facilitate theoretical content to enhance Generation Z learners' self-directed learning. As qualitative research, the study of the participants' experiences helps to better understand the influence of gamification on promoting Generation Z learners' self-directed learning.

In the era of which education has a crucial role in preparing students for a changing world, it is essential to think beyond the horizon and implement specific strategies. I trust that this dissertation will open a new page for educational practice literature.

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ABSTRACT

The focus of this study was to determine how gamification in the teaching-learning of Computer Applications Technology's theoretical content could contribute to the development of self-directed learning characteristics of Generation Z learners. From the literature, it appears that learners could experience the learning of theoretical content as difficult and subsequently learners were often not motivated and engaged in the teaching and learning of theoretical content.

The Computer Applications Technology curriculum included a practical and theoretical component, which contributed to the development of knowledge and skills that were essential for the 21st century. It is, therefore, important that Computer Applications Technology learners should be self-directed learners, who were motivated and engaged in the learning content of the practical as well as the theoretical component of the Computer Applications Technology curriculum.

A basic interpretive study, within an interpretivist paradigm and qualitative approach, was applied as research design. The population consisted of Grade 8 to Grade 12 learners from a secondary school in the Western Cape province in South Africa. Purposive sampling was applied and 106 Grade 11 and Grade 12 Computer Applications Technology learners gave assent to participate in the research. A direct teaching approach was first followed to facilitate theoretical content during the second term, but during the third term, gamification was applied as intervention. Pre- and post-open-ended questionnaires were administered to participants. Thereafter focus group interviews were conducted.

Results indicated that Generation Z learners displayed some self-directed learning characteristics, wanted instant gratification, and lacked skills such as self-motivation, critical thinking and collaboration. A teacher-centred approach was found not suitable for facilitating theoretical content to Generation Z learners. Gamification had potential for enticing them to experience theoretical content in a more engaging and enjoyable experience and fostered self-directed learning.

A limitation of the study was that the population only consisted of male learners. Further research was suggested on the application of gamification to enhance self-directed learning learners in diverse contexts.

Key terms

Active learning; Computer Applications Technology, Generation Z, Gamification, Self-directed learning

OPSOMMING

Die fokus van die studie was om te bepaal hoe spelifiëring in die onderrig-leer van teoretiese inhoud van Rekenaartoepassingstegnologie kan bydra tot die ontwikkeling van selfgerigte leer van Generasie Z-leerders. In die literatuur het dit geblyk dat leerders die leer van teoretiese inhoud as moeilik ervaar het en gevolglik dikwels nie gemotiveerd en betrokke was by die onderrig en leer van teoretiese inhoud nie.

Die Rekenaartoepassingstegnologie kurrikulum het 'n praktiese en teoretiese komponent ingesluit, wat bydra het tot die ontwikkeling van kennis en vaardighede wat noodsaaklik was vir die 21e eeu. Dit was dus belangrik dat Rekenaartoepassingstegnologie leerders selfgerigte leerders moes wees, wat gemotiveerd en betrokke was by die leerinhoud van sowel die praktiese asook die teoretiese komponent van die Rekenaartoepassingstegnologie kurrikulum.

'n Basiese interpretatiewe studie binne 'n interpretivistiese paradigma en kwalitatiewe benadering is as navorsingsontwerp toegepas. Die populasie was graad 8 tot graad 12 leerders van 'n hoërskool in die Wes-Kaap provinsie van Suid Afrika. Doelgerigte steekproefneming is toegepas en 106 graad 10 en graad 11 Rekenaartoepassingstegnologie leerders het ingewillig om aan die studie deel te neem. 'n Direkte onderrigbenadering is eerstens gevolg gedurende die tweede kwartaal om teoretiese inhoud te fasiliteer en gedurende die derde kwartaal is spelifiëring as intervensie toegepas. Oop-einde vraelyste is as voor- en natoetse aan gewillige deelnemers uitgedeel. Daarna is fokusgroeponderhoude gehou.

Die resultate het getoon dat Generasie-Z leerders sommige selfgerigte leer eienskappe vertoon het, onmiddellike gratifikasie verwag het, en 'n tekort aan vaardighede soos selfmotivering, kritiese denke en samewerking getoon het. Daar is bevind dat 'n onderwysergesentreerde benadering nie geskik was om teoretiese inhoud aan Generasie-Z leerders te fasiliteer nie. Spelifiëring het potensiaal getoon om die fasilitering van teoretiese onderhoud 'n genotvolle ervaring vir Generasie-Z leerders te maak, hul opgewonde te maak, en hul selfgerigte leer te bevorder.

'n Beperking van die studie was dat die populasie slegs uit manlike leerders bestaan het. Meer navorsing is voorgestel om die toepassing van spelifiëring ter bevordering van selfgerigte leer in diverse populasies te ondersoek.

Sleuteltermes

Aktiewe leer; Rekenaartoepassingstegnologie, Generasie Z, Spelifiëring, Selfgerigte leer

TABLE OF CONTENTS

DECLARATION	I
DEDICATION.....	II
ACKNOWLEDGEMENTS	IV
ABSTRACT	V
OPSOMMING	VI
 CHAPTER 1: INTRODUCTION	 1
1.1 Clarification of concepts	Error! Bookmark not defined.
1.2 Problem statement	2
1.2.1 Computer Applications Technology in the South African context	2
1.2.2 Today's learners known as Generation Z.....	4
1.2.3 Self-directed learning.....	5
1.2.4 Structuring of teaching-learning environments for Generation Z	5
1.2.5 Gamification	6
1.3 Purpose of the study	6
1.4 Research design and methodology	7
1.4.1 Research approach	8
1.4.2 Research paradigm	8
1.4.3 Site, sample and sampling strategy	8
1.4.4 Data collection	9
1.4.5 Data analysis	11
1.4.6 Ethical aspects of research.....	12

1.4.7	The role of the researcher	13
1.5	Division of chapters	14
1.6	Contributions of the study	14
1.7	Time frame	15
1.8	Conclusion	15
CHAPTER 2: FACILITATING THEORETICAL CONTENT TO GENERATION Z		16
2.1	Introduction	16
2.2	Generation Z learners.....	16
2.2.1	Characteristics of Generation Z learners.....	18
2.2.2	Teaching and learning preferences of Generation Z learners	19
2.3	Computer Applications Technology in the South African context.....	20
2.3.1	General aims of the National Curriculum Statement	20
2.3.2	Computer Applications Technology: Aims and topics.....	21
2.3.3	Assessment guidelines in Computer Applications Technology.....	23
2.4	Teaching approaches, -strategies and -methods for facilitating theoretical content	24
2.4.1	Teacher-centred approach	25
2.4.2	Learner-centred approach	26
2.4.3	Gamification	27
2.5	Self-directed learning	28
2.6	Conclusion.....	29

CHAPTER 3: SELF-DIRECTED LEARNING AND GAMIFICATION	31
3.1 Introduction	31
3.2 Self-directed learning models	31
3.2.1 Long's Model (1989).....	33
3.2.2 Candy's Model (1991).....	33
3.2.3 Brockett and Hiemstra's Personal Responsibility Orientation Model (1991)	33
3.2.4 Garrison's Three-Dimensions Model (1997)	33
3.2.5 Oswald's 3-Factor SDL Model (2003)	33
3.2.6 Song and Hill's Model for SDL in Online Environments (2007)	33
3.3 Gamification.....	34
3.1 Game-based learning and gamification	35
3.1.1 Examples in the world.....	36
3.1.1.1 Piano staircase.....	36
3.1.1.2 Todoist	37
3.1.1.3 LinkedIn.....	37
3.1.2 Gamification applications in education.....	37
3.1.2.1 Classcraft	37
3.1.2.2 Goalbook.....	38
3.1.2.3 Class-Dojo.....	38
3.2 Theoretical framework of the intervention.....	42
3.3 Gamification and the link to Oswald's 3-Factor SDL Model (2003)	43
3.3.1 Learning situation	44

3.3.2	Components of learning.....	45
3.3.3	Learner attributes	46
3.4	Gamification as intervention to enhance self-directed learning	47
3.4.1	The player	47
3.4.2	Feedback.....	48
3.4.2.1	Experience points (XP).....	48
3.4.2.2	Health points (HP)	48
3.4.2.3	Power-ups and abilities.....	48
3.4.2.4	Random events	49
3.4.2.5	Leaderboards and rankings	49
3.4.2.6	Quests and challenges	49
3.4.3	Theme	49
3.4.3.1	Role playing.....	50
3.4.4	Components	53
3.4.4.1	Classcraft tools	54
3.4.5	Rules	55
3.4.6	Supporting software.....	56
3.4.6.1	Kahoot!	56
3.4.6.2	Socrative	57
3.4.6.3	Flashcards by cram.com.....	57
3.4.7	Classcraft Lesson plan	58
3.4.7.1	Preparation/prior knowledge	58

3.4.7.2	Introduction.....	58
3.4.7.3	Content.....	58
3.4.7.4	Closure	59
3.5	Conclusion.....	61
CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY		62
4.1	Introduction	62
4.2	Research approach	62
4.3	Research paradigm	63
4.4	Research design.....	63
4.4.1	Population, sample and sampling strategy.....	65
4.5	Data collection	66
4.5.1	Open-ended questionnaires.....	66
4.5.2	Focus group interviews.....	67
4.5.3	Reflective journal	68
4.6	Data Analysis	69
4.7	Trustworthiness.....	69
4.7.1	Credibility.....	70
4.7.2	Triangulation.....	70
4.7.3	Transferability	71
4.7.4	Dependability.....	71
4.7.5	Confirmability.....	71
4.8	Ethical aspects of research	72

4.9	Conclusion.....	73
CHAPTER 5: DISCUSSION OF RESULTS		74
5.1	Introduction	74
5.2	Results of pre-open-ended questionnaires	74
5.2.1	Enjoyability and value	74
5.2.1.1	Positive experiences.....	74
5.2.1.2	Mixed perceptions	75
5.2.1.3	Negative perceptions of CAT theoretical content	75
5.2.2	Challenges experienced with CAT theoretical content	77
5.2.3	Self-directed learning characteristics	78
5.2.3.1	Time management.....	78
5.2.3.2	Problem solving.....	79
5.2.3.3	Motivation	79
5.2.3.4	Active engagement.....	80
5.2.4	Finding of resources	82
5.2.5	Summary of participants' experiences of CAT theory according to pre-open-ended questionnaires	83
5.3	Results of post-open-ended questionnaires	83
5.3.1	Enjoyability and value	83
5.3.1.1	Positive experiences.....	84
5.3.1.2	Mixed perceptions	84
5.3.1.3	Negative perceptions of CAT theoretical content	84

5.3.2	Challenges experienced with CAT theoretical content	85
5.3.3	Self-directed learning characteristics	85
5.3.3.1	Time management.....	85
5.3.3.2	Problem solving	86
5.3.3.3	Motivation	87
5.3.3.4	Active engagement.....	88
5.3.4	Finding resources	88
5.3.5	Summary of results of the post-open-ended questionnaires	89
5.4	Results of post-intervention focus group interviews.....	89
5.4.1	Teaching approach.....	90
5.4.2	Outdated content and workload	91
5.4.3	Practical application and relevance of theoretical content.....	92
5.4.4	Self-directed learning characteristics	93
5.4.4.1	Finding resources	93
5.4.4.2	Engagement	94
5.4.4.3	Motivation	95
5.5	Conclusion.....	96
CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS		97
6.1	Introduction	97
6.2	Conclusions with regard to research question 1: What are the characteristics of Generation Z learners?	98
6.2.1	The characteristics of Generation Z learners	98

6.3	Conclusions with regard to research question 2: What is the essence of the teaching and learning of CAT theoretical content?	99
6.3.1	Teacher-centred approach vs learner-centred approach	101
6.4	Conclusions with regard to research question 3: What is SDL about?	101
6.5	Conclusions with regard to research question 4: What is gamification in the context of teaching and learning?	102
6.6	Conclusions with regard to research question 5: What are the experiences of Generation Z Learners in terms of the teaching and learning of CAT theoretical content?	103
6.6.1	Gamification intervention to enhance SDL	103
6.6.2	Participants' experiences of the gamification intervention	103
6.7	Final conclusion of the study	104
6.8	Limitations of the study	105
6.9	Recommendations for further study	106
6.10	Final remarks	106

LIST OF TABLES

Table 1-1: Topics in Computer Applications Technology (DBE, 2011).....	3
Table 2-1: The six main Computer Applications Technology topics	22
Table 2-2: Formal assessment requirements (DBE, 2023)	23
Table 3-1: SDL elements as adapted from Tredoux (2012)	32
Table 3-2: Comparison of SDL and Generation Z learner characteristics	39
Table 3-3: Gamification and the link to Oswald's SDL Model.....	44
Table 3-4: Gr 11 Classcraft lesson plan.....	59
Figure 4-1: Research design	64
Table 6-1: Characteristics of Generation Z	99

LIST OF FIGURES

Figure 1-1: Research design	7
Figure 1-2: Time frame	15
Figure 2-1: Generations	17
Figure 3-1: Oswald's 3-Factor Model	43
Figure 3-2: Gamification: The user perspective photo	47
Figure 3-3: The Mage	51
Figure 3-4: The Guardian	52
Figure 3-5: The Healer	53

LIST OF ANNEXURES

Annexure A: Language editor	XV
Annexure B: Ethics approval	XVI
Annexure C: Gatekeeper approval	XVIII
Annexure D: Permission letter parent	XIX
Annexure E: Informed consent learner	XXII
Annexure F: Data collection tool	XXVI
Annexure G: Pre- and post-open-ended questionnaire	XXVIII
Annexure H: Categories, themes and codes of the pre-open-ended questionnaire.	XXXII

Annexure I: Categories, themes and codes of the post-open-ended questionnaire	XXXIX
Annexure J: Post-intervention focus group interviews	XLVII
Annexure K: Categories, themes and codes of the post-intervention focus group	
Annexure L: Turnitin similarity index.....	LXIV

CHAPTER 1: INTRODUCTION

1.1 Clarification of concepts

In this section the concepts Computer Applications Technology (CAT), Generation Z (Gen Z), self-directed learning (SDL) and gamification will be explained.

- Computer Applications Technology (CAT)

CAT is an elective subject in the further education and training (FET) phase in South African schools. The Department of Basic Education (DBE) defines CAT as “The study of integrated components of a computer system (hardware and software) and the practical techniques for the efficient use of applications to solve everyday problems” (DBE, 2011, p. 8).

- Generation Z (Gen Z)

Gen Z can be defined as the generation born in the mid to late-1990s (Moore, Jones, & Frazier, 2017). Seemiller and Grace (2017, p. 21) believes that Gen Z was “born in 1995 with the internet”. With access to the internet and smartphones most Generation Z learners (GenZ-L) For the purpose of this study the researcher defines GenZ-L as a digitally enabled learner born in die mid-1990s. GenZ-L have had “more access to information than any other generation before them” (Seemiller & Grace, 2017, p. 22). Gen Z represents customers or in this case learners who are “digitally savvy” (Brill, 2019, p. 48).

- Self-directed learning (SDL)

According to Knowles (1975, p. 18), SDL can be defined as:

a process by which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes.

Many definitions of SDL can be found in the literature. Knowles (1975, p. 18) sees SDL as a “process”. Arkan and Elif et al (2016, p. 514) define SDL as a “goal of education or a skill to be mastered as part of a learning process”. Avdal (2013, p. 838) refers to SDL as a “process of self-planning for work and the knowledge to understand how and what to learn”. Bronson (2000, p. 579) refers to SDL as “our natural way of learning before formal education”. SDL can be considered the basis of learning and has become one of the primary-aims of education in recent

years (Cazan & Schiopca, 2013). Alharbi (2018) sees SDL as various skills relevant to education, such as time management, stress management, preparation for exams and assignments, note-taking, and most importantly to this study, critical thinking, problem solving and decision making. I acknowledge the definition of Knowles for this study, which sees SDL as a process that needs to be mastered to effectively assist learning and promote lifelong learning.

- **Gamification**

Gamification can be defined as using game elements in a non-game context (Deterding, Dixon, Khaled, & Nacke, 2011). Leaning (2015) has found that the term gamification refers to an approach to exchange the experience through game-like services or real-life tasks to influence behaviour, motivation and enhance engagement. In education gamification can be used for creative gameplay without jeopardising the content at hand (Nolan & McBride, 2014).

1.2 Problem statement

In education, the instructional environment has become a fundamental problem as learners often lack motivation to learn, and struggle to engage during teaching and learning (Göksün & Gürsoy, 2019). Seemiller and Grace (2016) suggest that GenZ-L need a different learning environment than the generations before them. A famous quote by John Dewey is, “If we teach today's learners as we taught yesterday's, we rob them of tomorrow” (Dewey, 1944, p. 167). His quote becomes relevant and important when designing learning environments for GenZ-L, as they have specific learning needs. It is, therefore, important that CAT teachers understand GenZ-L and their learning needs, especially when facilitating teaching and learning of CAT theoretical content. In the following paragraphs, CAT as school subject in the South African FET context, GenZ-L, SDL and gamification as teaching-learning method will be discussed.

1.2.1 Computer Applications Technology in the South African context

In South Africa, CAT is an elective subject, meaning that learners can select CAT as one of their seven subjects in the FET phase (grades 10 – 12). CAT combines theoretical concepts and practical outcomes in a well-balanced curriculum, to challenge even the brightest of learners (Hains, 2019). One of the main objectives in CAT is to empower a learner to be a “digital abled citizen” (DBE, 2011, p. 8). CAT has six overall topics to help the teacher and learner achieve the specific aims in the Curriculum and Assessment Policy Statement (CAPS). These topics are listed in Table 1-1 below, as obtained from the DBE (2011, p. 9).

Table 1-1: Topics in Computer Applications Technology (DBE, 2011)

Theme	Sub-theme	Weighting	Content
Solution Development	• Word processing • Spread sheets • Databases • Fourth applications	60%	Practical and Theory
Systems Technologies	• Concepts of computing • Hardware • Software • Computer management	13%	Theory
Network Technologies	• Personal area networks and Wide area networks • Local area networks and Wireless local area networks	5%	Theory
Internet Technologies	• Internet and World Wide Web • E-communications	5%	Theory
Information Management	• Find and access data and information • Process data and information • Present solution	12%	Theory
Social Implications	• Impact on society • Legal, ethical and security issues • Health and ergonomic issues • Environmental issues	5%	Theory

All the topics listed in Table 1-1 have a theoretical focus, except for Solution Development. Solution Development however also includes a 10% theoretical component. When adding up the percentages of the various topics, it becomes clear that CAT is a well-balanced subject, with 50% of the syllabus focussing on practical content and 50% focussing on theoretical content. Furthermore, all formative and summative assessment questions are scenario-based and learners need to apply their theoretical content knowledge to the given scenario. Learners should, therefore, not just learn facts when preparing for an exam or a test. They also need to acquire a deeper understanding of the content to apply it in real-life scenarios. Due to the fact that the theoretical content of CAT has the same weighting as the practical content, it is important that the learners are motivated and engaging in the teaching and learning of CAT theoretical content. They should thus be self-directed learners, who take ownership of learning the theoretical content.

A study performed by Leaning (2015), found that theoretical content in general has been noted to be difficult to teach and for some, even impossible (Docherty, 2005). Theory has often been

understood to be of a higher order of complexity and a higher level of thought than other aspects of a certain field (Docherty, 1993). Although teachers always seek novel instruction approaches, (Lee & Hammer, 2011) learners often have a lack of motivation and engagement and learners struggle to engage with traditional teaching methods (Göksün & Gürsoy, 2019), as well as the relevance of the theory (McQuail, 2010). Due to the lack of motivation and engagement of the learners, Kumar and Khurana (2012) believe the current education pedagogy system needs to change in order to promote learning activities.

Learners should not only master theoretical and practical content in the CAT curriculum, but should also develop specific skills. According to the DBE, CAT learners should be able to identify and solve problems by critically evaluating information, use critical and creative thinking to make decisions, collaborate effectively with others by realising that problem-solving context does not exist in isolation and to communicate effectively using various skills (DBE, 2011). Hussin (2018) has found that the preferences of GenZ-L, who are currently in our classrooms, are different to those of the previous generations. These learners will be discussed in the following section.

1.2.2 Today's learners known as Generation Z

Chicca and Shellenbarger (2018) state that Gen Z refers to a group of learners with a unique combination of attitudes, beliefs, social norms and behaviours that will impact education for years to come. It is important to look at the skills and characteristics of GenZ-L as we need to understand their skills and expectations when planning instruction for them (Moore, Jones, & Frazier, 2017). According to Schwieger (2018) GenZ-L are creative, critical thinkers, goal-orientated, require hands-on experiences and are cravers of the digital world. However, they have a lack of attention span, want instant gratification and have poor social skills.

From their characteristics, we can infer how GenZ-L prefer to learn. GenZ-L should be understood and considered when planning new and innovative means of instruction (Moore, Jones, & Frazier, 2017). We therefore need to find the link between the learner and the most effective teaching-learning strategies to address the need of GenZ-L.

Bates (2019, p. 268) believes that;

It is not a question of pouring knowledge into a learner's head, but enabling the learner to develop concepts, think critically, and apply and evaluate what they have learned, by providing opportunities and experiences that are relevant to such goals.

GenZ-L crave hands-on learning opportunities, where they are actively busy with real-life learning environments that allow them to obtain the most relevant information (Seemiller & Grace, 2017). GenZ-L expect their experience to evolve with them. Thus, for GenZ-L to be engaged with

learning, all stakeholders should continually reassess interest and communication, as communication in schools is often one-way, directed from the teacher (Loveland, 2017). Technology has allowed GenZ-L to engage in individual learning, in order for them to focus on working at their own pace and make meaning of their learning before involving others (Seemiller & Grace, 2017). When learners are able to work independently or self-directed, it allows the teacher to foster skills such as goal setting, planning and being able to self-evaluate their own learning (Seemiller & Grace, 2017).

1.2.3 Self-directed learning

Siriwongs (2015) sets out three of Knowles's (1975) reasons for SDL. The first reason is that learners, who passively wait for content to be taught to them, learn less than those learners who take initiative in learning. The second is that SDL is more aligned to our natural born process of psychological development. We should be able to become more self-directed as we grow older. The third reason is that many developments put more obligations on the learner to take responsibility of their own learning.

The major role of a teacher is to provide motivation in a positive environment and provide opportunity for self-mastery (Yasmin, Naseem, & Masso, 2019). Good teachers always try to shape the environment in which they are teaching by choosing the right approach that will facilitate learning and will benefit the learner (Bates, 2019).

1.2.4 Structuring of teaching-learning environments for Generation Z

According to Hadžimehmedagic and Akbarov (2014), the teaching method teachers use should be chosen according to knowing the needs, the ability and how the learners in front of them develop. They also found that learning is most effective in the classroom when learning is active, experimental, problem based and provides immediate feedback.

Teachers have the responsibility to educate our learners and develop 21st century skills to enable them to understand issues and address them by being digitally enabled (Bates, 2019). Learners of today may be more digitally enabled than before, but they also think differently (Bates, 2019). This means that before we can assume how learners need to be taught, we need to understand who they are and how they want to learn.

The education system thus faces challenges as it has to redesign the method of instruction based on the needs, preferences and orientations of the “digital natives”, also known as Gen Z (Brill, 2019), sitting in our classrooms today (Göksün & Gürsoy, 2019).

In this study, I shall therefore search for ways to deliver CAT theoretical content that fits and benefits GenZ-L and encourage them to learn skills that will help them cope with the demands of the 21st century.

1.2.5 Gamification

Gamification can be used in classrooms for creative gameplay in the classroom without jeopardising the scientific nature of a curriculum. Gamification can provide a possible opportunity to solve problems in education such as the lack of learner motivation and engagement. Using gamification can lead to more learning and learners actively taking care of their school work (Lee & Hammer, 2011). According to Kapp (2012, p. 13) "Gamification is a serious approach to accelerating the experience curve of the learning, teaching complex subjects, and systems thinking." According to Nolan and McBride (2014) there is nothing gamification could not solve in terms of learning. Some software and apps available like Classcraft, Kahoot! and Class-Dojo can easily be used to transfer any teaching content to game-based content.

1.3 Purpose of the study

The purpose of this study was to determine how gamification can be used to facilitate CAT theoretical content in order to enhance GenZ-L SDL.

The main research question of this study was:

How can gamification be used to facilitate CAT theoretical content in order to enhance GenZ-L SDL?

The sub-research questions of this study were:

- (1) What are the characteristics of GenZ-L?
- (2) What is the essence of the teaching and learning of CAT theoretical content?
- (3) What is SDL about?
- (4) What is gamification in the context of teaching and learning?
- (5) What are the experiences of GenZ-L toward the teaching and learning of CAT theoretical content?
- (6) To what extent does the use of gamification in the teaching and learning of CAT theoretical content contribute to the enhancement of SDL?

To fulfil the above research questions, the aims and objectives of the were to do:

- (1) a literature review to discuss the characteristics of GenZ-L.
- (2) a literature review to discuss the teaching and learning of CAT theoretical content.
- (3) a literature review to communicate what SDL is about.
- (4) a literature review to unpack gamification in the context of teaching and learning.
- (5) an empirical investigation to determine the experiences of GenZ-L toward the teaching and learning of CAT theoretical content.
- (6) an empirical investigation to indicate to what extend does the use of gamification in the teaching and learning of CAT theoretical content contribute to the enhancement of SDL.

1.4 Research design and methodology

A research design serves as a strategic process, or roadmap, which researchers use as guidelines to do their research. The research methods, strategies and/or techniques I am going to use in order to get answers for the research questions form part of my research design (Kumar, 2014). I shall be doing a basic interpretive qualitative study (Merriam, 2002) for my research. A basic interpretive qualitative study is used when the researcher seeks to understand how participants make meaning of a phenomenon, process, perspectives, world views or a combination of these (Merriam, 2002). Figure 1-1 depicts a condensed layout of my research design.

For this study, I want to determine the lived experiences of GenZ-L towards the teaching of CAT theoretical content and whether the use of gamification in this teaching-learning experience can enhance their SDL. I shall therefore need to describe the data obtained from participants accurately and appropriately and will need to make sure that the data and results are produced and checked according to good practice (Denscombe, 2010).

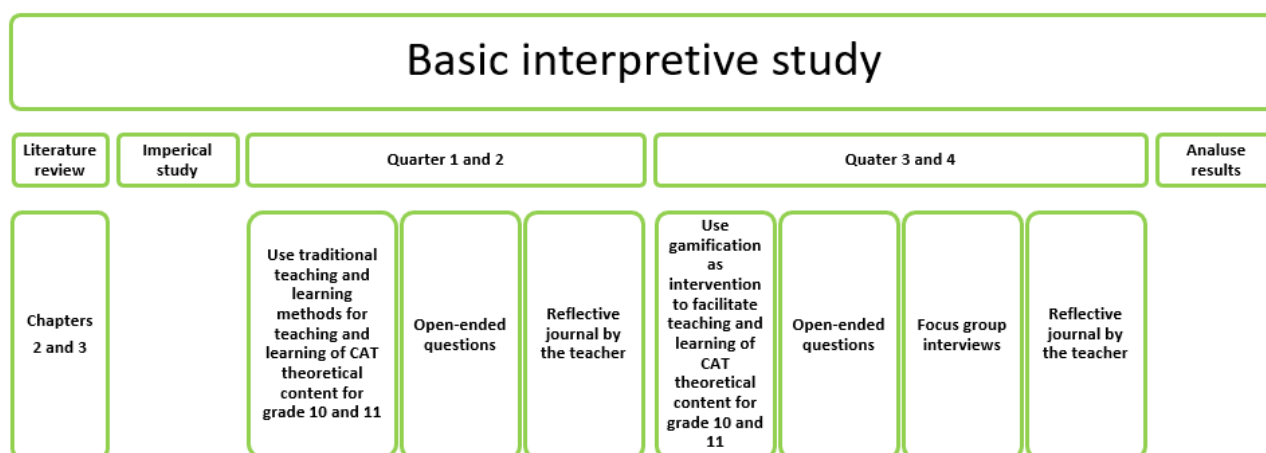


Figure 1-1: Research design

The trustworthiness and consistency of the data will be tested using Given and Saumura's (2008, p. 895) opinion of trustworthiness in qualitative research. According to them trustworthiness emanates through credibility, dependability, transferability and confirmability. To ensure trustworthiness and objectivity of the information gathered in this study from the participants, all information will be verified by the participants and my study leaders after the researcher has coded and interpreted the data.

1.4.1 Research approach

I opted to use a qualitative approach as, according to Creswell (2009, p. 4), it is used for "exploring and understanding the meaning of individuals or groups ascribed to a social or human" problem. This will thus be suitable/ideal for finding the lived experiences of learners towards the teaching and learning of CAT theoretical content and whether these experiences in the gamification intervention impacted on their SDL.

1.4.2 Research paradigm

A paradigm can be defined as, the reference frame and beliefs that a person uses to explain their perceptions/lived experience of the world and the place that a person has in the world (Houghton, Hunter, & Meskell, 2011). Fouché and Schurink (2011) believe that an interpretive paradigm is concerned with deeper understanding and explanations. The qualitative research approach is situated within this paradigm. An interpretative paradigm will therefore be used for finding and interpreting participants' experiences towards the teaching and learning of CAT theoretical content.

1.4.3 Site, sample and sampling strategy

The site for the study will be an anonymous double medium secondary school located in the Western Cape with around 1300 learners enrolled from grades 8-12, which offers the subject CAT as an elective. The learners in the CAT classroom of this school represent male learners from various ethnic- and cultural groups with different home languages. Purposive and convenient sampling will be used for selecting the individuals who will be participating in the study. A sample refers to the population or individuals who were selected to participate in the study (Fraenkel, Wallen, & Hyun, 2011). Only learners who have CAT as an elective subject in Grade 10 or 11 will be invited to form part of the study, after permission for the study has been obtained from the relevant parties. Only Grade 10 and 11 were selected as only Grade 10 to Grade 12 can select CAT as a subject choice. Grade 12s were left out due to their minimal contact time at school with full exams from Term 2 to Term 4. Participants in the study will represent GenZ-L who have

CAT as elective subject in Grade 10 or 11. Any other learner who does not have CAT as an elective subject will skew the results.

1.4.4 Data collection

The data collection phase consists of: setting boundaries for the study, collecting information for the study and establishing the protocol for recording and record keeping of the information (Creswell, 2009). Cohen, Manion and Morrison (2007) identified seven main data collection instruments. These seven instruments include questionnaires, interviews, accounts, observation, tests, personal construction and role playing. In many qualitative research studies, researchers use multiple forms of data collection to gather information (Creswell, 2009).

In this study, I shall be using open-ended questions, focus group interviews and a reflective journal to gather data from the participants before and after the intervention. Participants will complete a document with open-ended questions (narratives) about their experiences of teaching and learning of CAT theoretical content. After the participants' responses will be analysed, interviews will be conducted for more information. During the school term the teacher will keep a reflective journal in order to obtain data that could contribute to determine the effect of the intervention.

Data will be analysed and processed using an analytic induction process. The analytic induction process is where data are scanned to generate categories and to find relationships between the data (Cohen, Manion, & Morrison, 2007).

Questionnaires (narratives) are the "most commonly used method for collecting information from program participants when evaluating educational and extension programs" (Colosi, 2006, p. 1). One can use two different types of questions, namely close-ended and open-ended questions to collect data (Colosi, 2006).

Close-ended questions are questions where participants can choose an answer from the different answers provided by the researcher (Colosi, 2006). The close-ended questions can be restricted, having many structured responses such as close-ended questions, forced choices, agree/disagree and Likert scales (Colosi, 2006). Close-ended questionnaires are normally used with quantitative research as the answers can be statistically analysed and are directly to the point (Cohen, Manion, & Morrison, 2007).

With open-ended questions (narratives), the participants can answer the question with a range of possible answers that are not suggested in the question and which participants are expected to answer in their own words (Brace, 2004). This can often be tricky as respondents can provide

responses that the researcher did not anticipate. This can help the researcher explore all alleys but can also set a researcher back if the respondent does not know what to answer or does not understand the question.

For this study, open-ended questions (narratives) will be used. The validity of the open-ended questions document will be tested through corroborating the evidence found in the open-ended questions document (narratives) with the follow up semi-structured focus group interviews. This will provide triangulation and will provide validity for the findings (Creswell & Poth, 2017).

The document will comprise of ten open-ended questions and will take about 30 minutes to complete. The learners will answer the questions in a session that is convenient for all the participants in order to not use official teaching time. It will be important to obtain the lived experiences of the participants and not influence participants' opinions to get certain results. The language for the questions will be in Afrikaans and English to assist with possible language barriers.

Interviewing can be defined as the careful asking of relevant questions to find out how participants think or feel about something (Fraenkel, Wallen, & Hyun, 2011). Interviews can be conducted face to face, telephonically, or with a small focus group of 6-8 learners (Creswell, 2009). According to Fraenkel *et al.* (2011), there are four different types of interviews: structured, semi-structured, informal and retrospective.

Structured and semi-structured interviews are used to ask a set of questions that are designed to get answers about a specific topic, usually used for comparison at a later stage (Fraenkel, Wallen, & Hyun, 2011). The biggest difference between these two types of interviews is that in semi-structured interviews the researcher can ask follow up questions, whereas the structured interview only allows a certain set of questions.

Informal interviews are much less structured and usually resemble a casual conversation with the main purpose of sharing ideas about a topic so as to compare participants' views with each other at a later stage (Fraenkel, Wallen, & Hyun, 2011).

Retrospective interviews are used to ask participants to recall and describe previous events that have taken place, and it can take the form of a structured, semi-structured or informal interview (Fraenkel, Wallen, & Hyun, 2011).

For this study, I shall be using semi-structured focus group interviews. A semi-structured interview enables the researcher to gather more detailed information by adding sub-questions to the existing questions (Powell & Singel, 1996). Interview questions will be prepared to sufficiently

comprise open-ended questions that will assist the interviewer to successfully ask questions to obtain answers that can be explored and will lead to further probing of their lived experiences (Cohen, Manion, & Morrison, 2007) towards learning of theoretical content. Individual interviews are best suitable for studies where an in-depth knowledge of one's personal life is important, when the topic is concerning, or when the respondents are difficult to recruit. Focus group interviews normally best suit studies with a range of attitudes, opinions and behaviours that are explored, and where issues of public interest or common concern are researched (Gaskell, 2000).

Focus group interviews will thus be conducted with the participants for this study in order to investigate the lived experiences of the teaching and learning of CAT theoretical content and to establish whether these experiences impacted on CAT learners' SDL. The interviews will also be conducted in small groups as school learners tend to be shy or scared in one-on-one interviews (Cohen, Manion, & Morrison, 2007).

The focus group interviews will be scheduled for 20 minutes with groups no bigger than five participants. There will be at least five questions discussed in the focus group interviews.

A reflective journal is often used in qualitative research to "record personal assumptions and goals and clarify individual belief systems and subjectivities" (Michelle, 2008, p. 695). I shall be using the reflective journal to observe variables such as the learners' overall involvement in the classroom towards: involvement in class lessons, homework completion, collaboration with other learners and preparation for classroom activities. The overall purpose for the use of a reflective journal in this study is to see if the intervention that was implemented has possibly contributed to the enhancement of SDL or not.

1.4.5 Data Analysis

Grosser et al. (2018) describe the following process of data analysis for qualitative research.

The first step is immersion in which the researcher must collect all the data. For my study, the data will be collected through open-ended questions and a focus group interview which will be transcribed *verbatim* afterwards. The completion of the open-ended questions will be conducted first and will be followed with focus group interviews. A reflective journal will be kept of everything observed throughout the research process.

In the second step, the reflecting step, the researcher must step back and look at all the data. For this study, I shall be reflecting on the process and the answers given by the participants.

In the analysis step, the information must be taken apart to be itemised and categorised. For this study, the answers from every question will be placed into different categories according to the responses of the participants. I shall be categorising the participants' responses myself. I shall be doing content analyses, where the focus will be to analyse and identify the transcripts for key concepts (Nieuwenhuis, 2010), and a connection will then be made between answers. Lastly, these will be categorised under the research aims to identify relationship. The entries in the reflective journal will be placed under different categories from the beginning.

In this study, the transcription from the open-ended questions (narratives) will be analysed and evaluated to develop questions for a further line of enquiry with the semi-structured group interviews. The answers from the open-ended questions will be itemised and categorised and then placed within the different themes raised from the answers.

With the recombining step, the data will be reconstructed to form meaning. The data will be organised into different classifications to help find patterns and similarities. All the answers from the interviews, open-ended questions and reflective journal will be analysed into categories and recombined to construct information that can be used to answer the research questions (Wellington, 2000).

Relate and locate is the final step to ensure the data gathered are relatable to other data gathered. In this study, the information gathered from the interview, open-ended questions and reflective journal will be compared and combined to information gathered in the literature review.

1.4.6 Ethical aspects of research

Tustin (2006, p. 14) defines ethics as what is deemed to be "acceptable or unacceptable in human conduct". For qualitative research, ethical aspects become a key aspect as the researcher becomes one of the main instruments for collecting data (Schulze, 2002), and the researcher must be wary of not letting his personal beliefs and philosophical orientation have an impact on the participants (Merriam, 2001). The researcher will do everything in his power to ensure that the research will be conducted fairly and ethically (Denscombe, 2010). This includes, but is not limited to, the following ethical considerations.

Ethical considerations are concerns, dilemmas and conflicts of the way the research is conducted by the researcher (Kumar, 2014). De Vos et al. (2011, p. 113) have identified the following ethical considerations: "harm to respondents, voluntary participation, informed consent, deception of the respondents, violation of privacy/anonymity/confidentiality, denial of treatment, compensation, debriefing of co-researchers, actions and competence of researchers, cooperation with

contributors and sponsors, and release or publication of the findings". Grosser et al. (2013) identified the following ethical considerations: Informed consent, anonymity and confidentiality, invading participants' privacy, use of volunteers, honesty, fair treatment, permission from participants and schools, no risk to the participants and debriefing.

As my target participants are classified as vulnerable because of their age, I need to receive permission from the North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics committee (NWU-EMELTEN-REC) for formal clearance and approval. This will happen after the acceptance of the proposal. After gaining ethical clearance, permission will be sought from the DBE to conduct the research in their province. After permission is gained by the two parties mentioned above, permission will be sought from the principal of the school and lastly from the participants' parents/guardians and learners themselves. Informed consent will be gathered from the learners' parents/guardians as they are younger than 18 years old and assent will be obtained from the learners (Grosser et al., 2018).

Participation in the study will be voluntary and all participants will be informed of their right to withdraw at any time. Participants, who do not take part in the research, will not be disadvantaged in any way. There will be no compensation for the participants of this study. The identities of the participants and the school will be kept confidential and anonymous throughout the reporting of the findings.

1.4.7 The role of the researcher

Since the researcher will be writing the report after data collection, qualitative research requires of the researcher to fulfil multiple roles, such as the role of making sense, the role as designer of necessary data collection techniques, fulfilling the role of a research instrument and author (Fouché & Delport, 2005; Nieuwenhuis, 2007). A good qualitative researcher asks "probing questions, then listens to the response, thinks about what the participant has said and then asks more probing questions to benefit the study" (Simon, 2011, p. 1).

In this study, I shall be the one collecting the data, thus I shall be the one responsible for writing the report. I shall be conducting the semi-structured focus group interviews and will also be the one conducting and managing the answering of the open-ended questions. The analysing of the data will also be performed by me. It is important for the researcher to stay true to the ethical aspects and trustworthiness mentioned in this study. Data can be checked and verified after interpretations have been made to prevent bias from the researcher.

1.5 Division of chapters

Chapter 1: Introduction

Chapter 2: Facilitating CAT theoretical content to GenZ-L

Chapter 3: Self-directed learning and gamification

Chapter 4: Research design and methodology

Chapter 5: Discussion of results

Chapter 6: Conclusions, and recommendations

1.6 Contributions of the study

Knowledge about the characteristics of GenZ-L will help the CAT teachers understand the way GenZ-L prefer to learn. If teachers know how GenZ-L prefer to learn, they would be able to structure the class activities in such a way that it will enhance teaching and learning of CAT theoretical content. Using appropriate teaching and learning strategies for GenZ-L could contribute to more motivated learners who take responsibility for their own learning. Therefore, this study could possibly contribute to the enhancement of SDL and other skills that are necessary for adapting to the change of the 21st century.

Finally, this study may provide useful information that could be used in the future to develop a framework that could be used to improve the teaching and learning of theoretical content of various other subjects.

1.7 Time frame

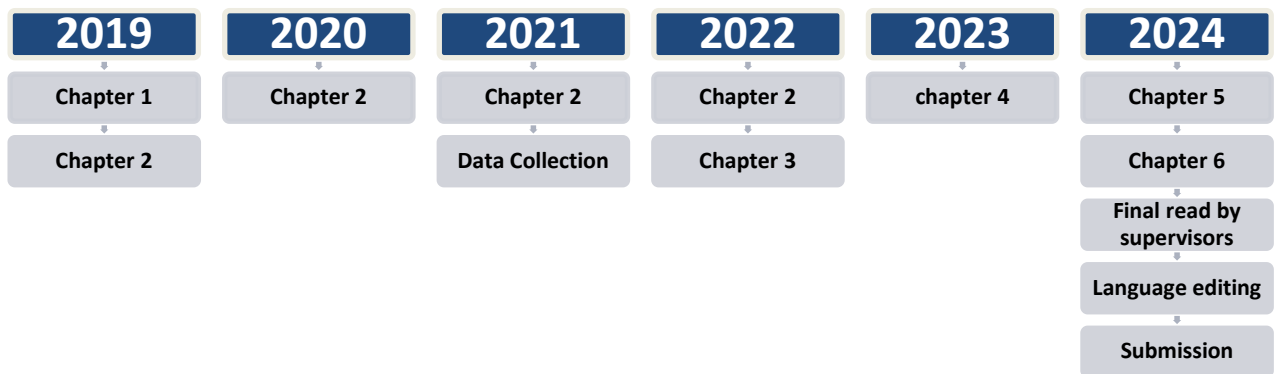


Figure 1-2: Time frame

1.8 Conclusion

This chapter clarifies key concepts relating to CAT, GenZ-L, Gamification and SDL. The chapter outlines the purpose of the study, including the main research question, sub-research questions, and the study's aims and objectives. The chapter concludes with an overview of the research design and methodology, a division of chapters, contribution of the study and the timeframe of the study.

The following chapter will address how theoretical content can be facilitated towards GenZ-L.

CHAPTER 2: FACILITATING THEORETICAL CONTENT TO GENERATION Z

2.1 Introduction

In 2024, learners are categorised as GenZ-L because they were born between 1995 and 2010 (See Table 2-1). Chicca and Shallenberger (2018, p. 180) argue that GenZ-L “have a unique combination of attitudes, beliefs, social norms, and behaviours”. Due to their uniqueness, they “inevitably struggle to engage with traditional teaching methods” (Göksün & Gür soy, 2019, p. 16). This struggle becomes even more intense when theoretical content is being taught. Teaching methods should subsequently address the characteristics and needs of GenZ-L (Redmer et al., 2021). When GenZ-L are, however, actively engaged during teaching and learning, they become intrinsically motivated and are willing to put more time and effort into their own learning process (Afshar et al., 2019). Educators should therefore rather focus on making sense of the content instead of focussing on the content (Seemiller & Grace, 2016).

This chapter will focus on the characteristics of GenZ-L (research aim 1), the essence of CAT theoretical content, and applicable teaching-learning approaches, -strategies, and methods for facilitating CAT theoretical content (research aim 2).

2.2 Generation Z learners

There are no clear guidelines for setting the boundaries between different generational groups (Moore et al., 2017). Generation as a concept can refer to a group of people who are born over a period of 15-20 years and highlights a change in society (Düzenli, 2021). Redmer *et al.* (2021, p. 96) uses “generation cohort” to identify different generations by grouping people according to the

time they were born. They assume that generation cohorts have similar characteristics and behaviours, and can be distinguished from other age groups.

Figure 2-1 displays five recent generations with a suggested timeframe and primary characteristics. These generations are most likely to be currently found in the classroom as teachers or learners. Generation Alpha is included in Figure 2-1, because they will be the next generation who will enter the CAT classroom.

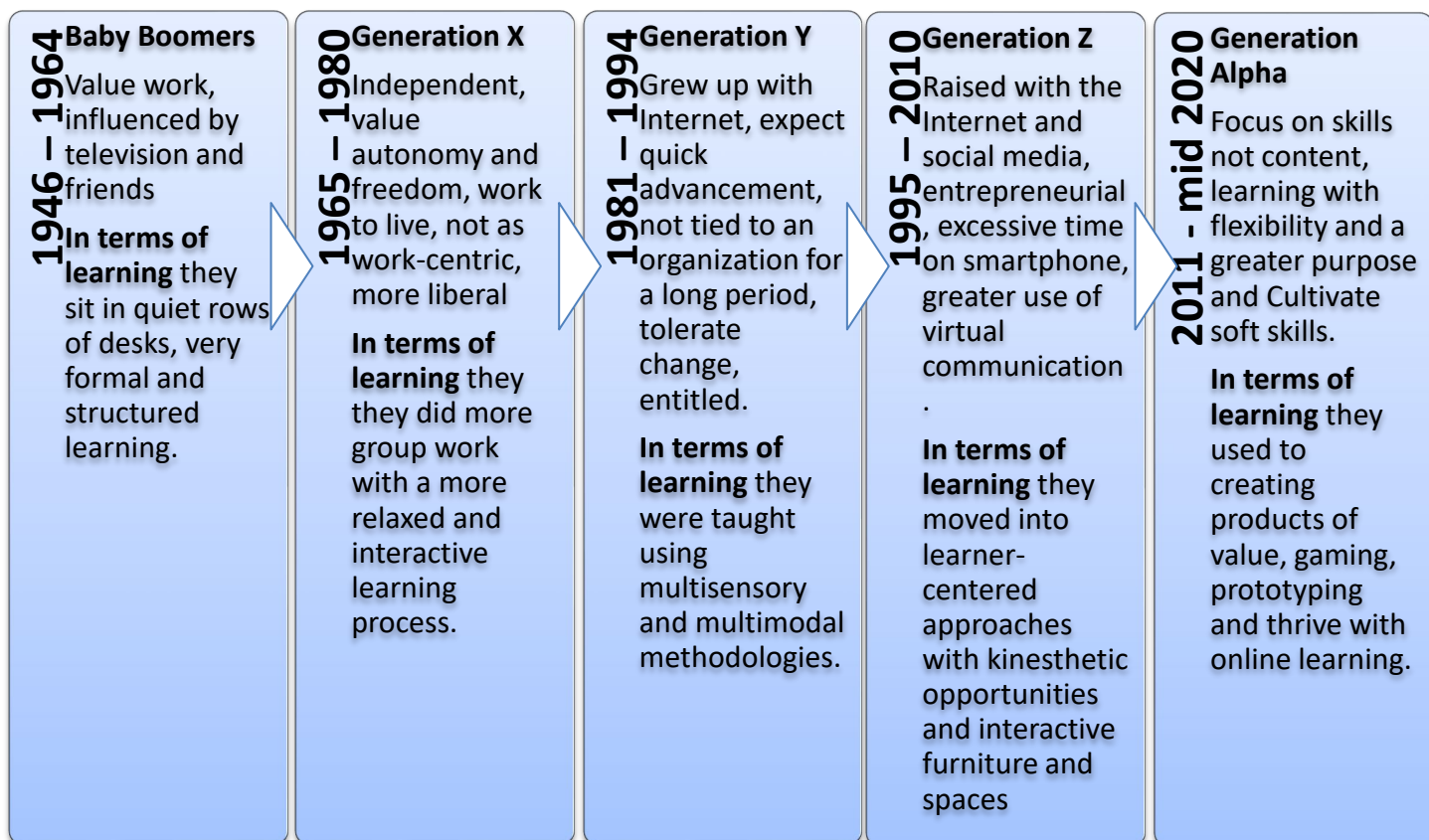


Figure 2-1: Generations

(adapted from Moore et al. (2017), Redmer et al. (2021) and Zmuda et al. (2017))

Different opinions exist about the exact dates that GenZ-L were born. As a starting point, GenZ-L can be defined as the generation born between the mid to late-1990s (Moore et al., 2017; Seemiller & Grace, 2017; Turner, 2015). GenZ-L are also referred to as “digital natives”, the “Net Generation” or “iGeneration” (Cipoletta, Malighetti, Cenedese, & Spoto, 2020; Huang & Wang, 2020). Twenge (2017) believes GenZ-L were born in the mid-1990s to the mid-2000s and McCrindle (2014) indicates that GenZ-L were born between 1995 and 2009. According to the various perspectives about the timeframe of GenZ-L, they will in this study be defined as learners born between 1995 and 2010 as indicated by Moore et al. (2017).

The attitudes, beliefs, social norms, and behaviours of a generation are often used to describe how a generation thinks and prefers to interact. These aspects can be used to guide teaching and learning approaches (Chicca & Shellenbarger, 2018). Traditional teaching approaches, old resources, and old content however still seem to be the norm in schools (Zmuda et al., 2017). This emphasises the need for a revision of teaching approaches to accommodate GenZ-L.

In the next paragraphs, the characteristics of GenZ-L will be discussed, to obtain an indication of their learning preferences. The discussion will end by discussing applicable teaching and learning strategies, especially with regards to CAT theoretical content, and by giving guidelines from literature of how GenZ-L can be motivated and engaged in teaching and learning.

2.2.1 Characteristics of Generation Z learners

Characteristics can be defined as a “distinguishing trait, quality, or property” (Merriam-Webster, n.d.). A prominent characteristic of GenZ-L is that they are avid consumers of technology, because they “were raised with internet and social media” (Redmer et al., 2021, p. 96). They are cravers of the digital world and are called “true digital natives” (Chicca & Shellenbarger, 2018, p. 181). As a result, Schwieger and Ladwig (2018) argue that GenZ-L are often distracted by their smartphones.

GenZ-L are being shaped in a world with communication ubiquity from social media to WhatsApp (McCrindle, 2014). They are constantly engaged with their devices and communicate through “instant messaging, internet chat and social media instead of direct contact” (Rothman, 2014, p. 1). Monster (2016) argues that because of this “always on” technology, GenZ-L want to determine their own schedules, create their own career paths, and want to apply their own personal preferences on completing tasks (Merriman, 2015). Although they prefer self-study online modules due to their need for “flexibility in curriculum” (Chicca & Shellenbarger, 2018, p. 182), they still want to be “interactive and hands-on” (McKibben, 2017, p. 36).

According to Monster (2016) GenZ-L are motivated by a variety of factors and will do whatever it takes to reach their goals. GenZ-L have a high expectation for themselves as they are “intuitively innovative, uber-productive, goal-orientated and realistic” (Merriman, 2015, p. 9), but no clear indication of self-motivation could be found. According to Adobe (2016), GenZ-L view themselves as more creative, and more passionate about making things better than the past generations (Adobe, 2016).

It is furthermore argued that GenZ-L have lower critical thinking skills (Second wave, 2019). This argument is based on the availability of a vast amount of online information they are confronted

with and which they often accept as the truth, without critical evaluation (Seemiller & Grace, 2016). Moreover, GenZ-L have a “short attention span, they prefer visuals, they want to be interactive and hands-on, they are curious and love challenges” (Lohman, 2016, p.183; McKibben, 2017, p. 36). GenZ-L can quickly shift between working and playing (Beall, 2017).

Chicca and Shellenbarger (2018) identified the following characteristics about Gen Z: they are pragmatic, high consumers of technology and cravers of the digital world, they are the only true digital native generation as they were raised exclusively with technology influences, they have underdeveloped social and relationship skills because of this craving. GenZ-L use technology as naturally as breathing (Rothman, 2014). With communication being an important part of the 21st century GenZ-L are struggling with underdeveloped social and relationship skills.

As indicated by Moore, Jones and Frazier (2017), the characteristics, skills and expectations of GenZ-L should be understood and considered when designing instructional environments to address their needs. Therefore, various teaching approaches, -methods, -techniques and -strategies will be discussed in the next section to eventually suggest strategies to facilitate CAT theoretical content to GenZ-L.

2.2.2 Teaching and learning preferences of Generation Z learners

GenZ-L are goal-orientated and driven (Merriman, 2016) and have high expectations of themselves and those around them (McKibben, 2017). Moreover, they seem to prefer individualised (Moore et al., 2017) education. This does not necessarily mean that they want to be taught on their own, but they prefer to focus on their individual interests as they are the most “individualistic generation yet” (Howard, 2018, p. 1).

GenZ-L also want to engage actively with subject content (McKibben, 2017) and subsequently feel part of the learning process. As argued by Lohman (2016), traditional teaching approaches will not adequately address their curiosity, love of challenges and preference of mobile technology and visual material (Düzenli, 2021).

The implication of the abovementioned characteristics for the teacher is that GenZ-L no longer only want to sit and receive information. Teachers subsequently must think about ways they can engage GenZ-L and incorporate smartphones and technology in the lessons. Games like Kahoot! can be integrated into lessons, or learners can be required to search for answers on their smartphones (Clarke, 2018). Group learning can be considered to accommodate learners who do not have a smartphone or data (White, 2017).

GenZ-L are active learners, they prefer to be engaged and “learn by doing” (Thomas, 2019) in classrooms where active, learner-centred teaching and learning strategies are applied. (Düzenli, 2021). In the next section, the subject CAT will be elaborated on, to provide the context for relevant teaching and learning approaches that can be applied when facilitating CAT theoretical content to GenZ-L.

2.3 Computer Applications Technology in the South African context

The CAPS (DBE, 2011), describes the subject content and assessment that are required for CAT, Grades 10 to 12. The CAPS document also includes the National Curriculum Statement Grades R-12 (NCS) which describes the knowledge, skills and values that are required in South African schools.

CAT is an elective subject in the FET phase. The FET phase requires learners to select a minimum of seven subjects, which consists of four compulsory subjects and a minimum of three other elective subjects. CAT is one of those elective subjects.

In this section, the general aims of the NCS and CAT subject content will be explained. This discussion is necessary to provide a context for applicable teaching strategies to facilitate theoretical content in CAT to GenZ-L.

2.3.1 General aims of the National Curriculum Statement

The NCS stipulates certain skills that should be developed in each learner who is enrolled for subjects in the South African School Curriculum that “gives expression to the knowledge, skills and values worth learning in South African schools” (DBE, 2011, p. 4). These general aims apply to all school subjects and are linked to 21st century skills of problem solving, critical and creative thinking, the ability to communicate and collaborate effectively, and sound organisational skills (DBE, 2011).

The first general aim is to “identify and solve problems and make decisions using critical and creative thinking” (DBE, 2011, p. 4). Critical thinking is interrelated with problem solving. Problem-solving skills are viewed as fundamental 21st century skills (Rahman, 2018) and crucial skills for human survival that can be learned (Mayer, 2013). In education, problem solving can be used to focus on accomplishing an objective for which the learners do not have a solution (Mayer & Wittrock, 2006). This is where creative thinking plays an important role. Creative thinking entails the evaluation of original ideas to improve or create new and worthwhile ideas (Chiruguru, 2020).

To be able to “demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation” (DBE, 2011, p. 4) learners must be able to solve problems using critical and creative thinking while they “work effectively as individuals and with others as members of a team” (DBE, 2011, p. 4). Learners therefore need to collaborate effectively with others, as collaboration is a necessary skill for learners and employees, due to globalisation, the rise of technology (Chiruguru, 2020) and the increasing complexity of tasks (Wang & Burton, 2010).

Learners within die South African curriculum should be able to “organise and manage themselves and their activities responsibly and effectively” (DBE, 2011, p. 4). This aim focuses on SDL. As stated by Knowles (1975), self-directed learners must be able to identify goals and plan on how they will achieve their goals. To achieve their goals, learners must be able to organise their study environment with these goals in mind. They should be able to monitor their learning and be able to accept help from others when they need it.

Learners must be able to “collect, analyse, organise and critically evaluate information” and be able to communicate the information “effectively using visual, symbolic and/or language skills in various modes” (DBE, 2011, p. 4). With technology being an integral part of our lives, it is easy to gather information, and often challenging to communicate effectively. The different platforms to communicate can become overwhelming (Cooper, 2016). Learners must be able to effectively analyse and process the overwhelming amount of information that they are exposed to (Cooper, 2016). Moreover, information and communication media allow for communication over a multitude of platforms, and teaching communication skills to learners are of high importance (Chiruguru, 2020).

2.3.2 Computer Applications Technology: Aims and topics

According to the CAPS, the purpose of the subject CAT is to develop “digitally enabled learners” who can apply the integrated components of computer systems to solve real-life problems (DBE, 2011, p. 9). The subject content comprises practical and theoretical content, which is divided into six overarching main topics. The main topics are Solution Development, Systems Technologies, Network Technologies, Internet Technologies, Information Management, and Social Implications (DBE, 2011).

Table 2.1 summarises the main topics of the CAT curriculum, as well as their respective weightings in the curriculum. In the weighting column, it is also indicated whether the content is theoretical or practical. All the topics include theoretical content, and the total weighting of theoretical content adds up to 50% of the curriculum. (DBE, 2011).

Table 2-1: The six main Computer Application Technology topics

(adapted from DBE (2011, pp. 9-17))

No	Topic	Description	Weighting
1	Solution Development	Learning to use computers to find solutions by using appropriate tools such as word processing, spreadsheets and databases to solve problems represented by real-life scenarios.	60% (50% practical and 10% theoretical content)
2	Systems Technologies	This refers to the physical and non-physical components of a computer system such as the concepts of computing, hardware, software and computer management.	13%, theoretical content
3	Network Technologies	Ways to distribute digital and electronic data from one point to another.	5%, theoretical content
4	Internet Technologies	How to use the Internet, World Wide Web and E-communications.	5%, theoretical content
5	Information Management	The use of techniques and technologies to collect and process data and information and present solution that leads to knowledge and decision-making.	12%, theoretical content
6	Social Implications	Legal-, ethical-, security-, health-, agronomical- and environmental issues when using computers.	5%, theoretical content

Solution Development focuses on the use of application software to solve real-life problems (DBE, 2011). Solution Development is the only topic that has a weighting of 50% practical and 10% theoretical content. The 10% theory can be added as all textbooks has a theoretical component to be mastered before starting with the practical work. They have practical theoretical questions and are also assessed in exams. Where learners need to answer practical questions in a theoretical test without the use of a device. The other five topics all focus primarily on theoretical content. Systems Technologies focus on hardware and software to perform the basic functions of a computing system and has a weighting of 13%. Network Technologies facilitate the management and distribution of digital data from one point to another and has a weighting of 5%. Internet Technologies focus on using the internet, World Wide Web and e-communication technologies with a weighting of 5%. Information Management focuses on techniques and technologies to collect and process data and information, and presenting solutions that contribute to knowledge and assists decision making and has a weighting of 12%. The sixth topic, Social Implications explore legal-, ethical-, security-, health-, ergonomics, and environmental issues when using ICT and has a weighting of 5% (DBE, 2011).

In the above section, the six main topics in CAT were briefly described and it was indicated that the topics related to theoretical content cover 50% of the curriculum. To further emphasise the importance of theoretical content in CAT, assessment guidelines as indicated in the CAPS, will be elaborated on.

2.3.3 Assessment guidelines in Computer Applications Technology

CAT teachers need to perform various forms of assessment to identify, gather, and interpret information about the performance of the learners (DBE, 2011). Table 2-2 shows the guidelines for assessment in Grade 10 and Grade 11. CAT learners need to write a minimum of five tests during a year. Two tests must focus on theoretical content and two tests must focus on practical content. The fifth test can be a theory, practical, or open-book theory task. Apart from tests, a practical assessment task (PAT), written examinations and practical examinations are also included in the assessment plan. The written exam paper will cover all six main topics. The learners' understanding of the content will be assessed by conducting assessments where learners need to make informed decisions, to find a solution to a real-life end-user scenario based on the theoretical content taught to them.

Table 2-2: Formal assessment requirements (DBE, 2023)

Formal assessment			
Grade 10 and 11			
40%	60%		
School based assessment (SBA)	Practical assessment task	End of year examinations	
40%	20%	20%	20%
6 tests 3 x Practical 2 x Theory 1 x Alternative assessment* * An alternative type of assessment for CAT is a survey and a case study.	Project Information management project based on providing a solution to a specific scenario by using the applications as indicated under Solution Development	Written exam: Theory aspects of all content, concepts, and skills of all topics	Practical exam: Solution Development

CAT learners must master both practical and theoretical content. Theoretical and practical content are equally assessed and count the same weight towards the final year-end mark.

In the above section, it was indicated that theoretical content covers 50% (see Table 2-1 and Table 2-2) of the CAT curriculum. This information underscores the importance of following a balanced approach when facilitating both theoretical and practical content of

the subject. Learners however struggle to find the relevance of theoretical content (McQuail, 2010) and subsequently lack motivation and engagement with theoretical content. Because of the high percentage of theoretical content in the CAT curriculum, it is thus important to find appropriate strategies to facilitate theoretical content for GenZ-L, to get learners more motivated and engaged in the teaching and learning of CAT theoretical content.

2.4 Teaching approaches, -strategies and -methods for facilitating theoretical content

John Dewey made the following statement: “If we teach today as we taught yesterday, we rob our children of tomorrow” (Dewey, 1944, p. 167).

“It is estimated that about 85% of the jobs that today’s learners will be doing in 2030 haven’t been invented yet” (Slone, 2019). Now, more than ever, education must empower learners to become global and conscious learners (Chu, Reynolds, Tavares, Notari, & Lee, 2017). Bradman University (2020) argues that to succeed in teaching and learning, teachers need to continually adapt their teaching methods to account for the interests, struggles and goals of new generations. Therefore, teaching approaches, teaching strategies and teaching methods need to be evaluated, revised, and evolve with time. Because these concepts are sometimes used interchangeably (Dotse, 2018) it will first be clarified.

A teaching approach refers to how teaching and learning is viewed, (Gill & Kusum, 2016) with a set of ideas, principles or beliefs about the “nature of learning” (Hoque, 2016, p. 3).

Grill and Kusum (2016, p. 6695) sees a teaching strategy as “the means to achieve a learning objective” while Saputra (2014, p. 1) believes a teaching strategy is a “generalised plan for a lesson”. Dotse (2018, p. 1) sees the teaching strategy as a “careful plan of teaching activities” to ensure effective teaching and learning of that specific topic. The purpose of a teaching strategy is to help the teacher to “optimally use methods and instructional materials” (Kindsvatter et al., 1996). Kindsvatter et al. (1996) further classified four different types of teaching strategies namely: direct teaching, mastery learning, cooperative learning and problem-based learning.

A teaching method is the “systematic way of doing something” which implies an orderly logical arrangement of steps (Hoque, 2016, p. 4). Gill and Kusum (2016, p. 6693) believe that the method is the “procedure within the approach, the step-by-step scientific way of presenting the subject matter”.

In the following paragraphs, the most common teaching approaches, teaching strategies and teaching methods will be briefly discussed. The discussion will focus on the role of the teacher, the role of the learners and a critical evaluation of suitability of these for GenZ-L.

Two main teaching approaches namely teacher-centred and learner-centred (Dotse, 2018) are described in the literature.

2.4.1 Teacher-centred approach

The teacher-centred approach is also referred to as direct instruction, deductive teaching or expository teaching (Gill & Kusum, 2016). With this approach, learners are typically exposed to lecture-type presentations, where the teacher is in charge of what is to be taught and how information will be presented to educate learners of what they are meant to learn (Renard, 2019). In the teacher-centred approach a teacher will make use of direct teaching as strategy and teaching methods such as lectures, presentations, demonstrations and dictations.

The direct teaching strategy is directed by the teacher to create an environment where the teacher acts as a transmitter of knowledge and prescribes material used in the class (Kora, 2019). The teacher normally stands in front of the classroom and presents the information with clear and directed instructions to the learners (Renard, 2019). The two core principles of direct instruction are firstly based on the assumption that all learners can learn when taught correctly, regardless of their history and background. Secondly, it is assumed that all teachers can be successful when using presentation techniques.

In the following paragraphs, the discussion will be focussed on the roles of the teacher and learner when using this teaching approach.

In the teacher-centred classroom, the teacher is the “sole leader” (Garrett, 2008) and holds “ultimate authority” (Serin, 2018) over the content and learners. The teacher stands in front of the classroom and instructs through lectures. The teacher controls the routine of learning, the amount of content to be covered and the punishment the learners receive when not following instructions. With the teacher taking the role as the sole knowledge provider, the learners assume the role of “passive recipients of information” (Muganga & Ssenkusu, 2009, p. 17). The learners listen and write what the teacher dictates. The teacher often prevents learners from expressing themselves and asking questions and learner engagement is discouraged (Anuradha, 2021). If learners should ask questions, these will mostly be answered by the teacher (Emaliana, 2017). Wright (2011, p. 17) subsequently defines a teacher-centred learner as an “empty vessels to be filled with knowledge.” With learners passively sitting and receiving information as empty vessels they

can soon become learners that will not take any responsibility for their own learning (Darsih, 2018).

Tumbaach (2022) identifies the lecture method, demonstration method and team teaching as common teacher-centred methods. The lecture method can be seen as “long-winded explanations of information, deemed important by the lecture” (Tumbaach, 2022). Main disadvantages of the lecture method are the one-way communication, learners that are listening passively, shallow understanding and boredom (Hub & Freed, 2000; Renard, 2019).

Traditional, teacher-centred approaches subsequently do not leave space for learners to form part of the process, to collaborate, to be curious about the content or even to be challenged by the content (Anuradha, 2021). This all indicate that teacher-centred approaches, strategies and methods are not suitable for GenZ-L, as they are pragmatic and want to be part of the process (McKibben, 2017).

2.4.2 Learner-centred approach

Learner-centred approaches place a strong emphasis on the learner's role in the learning process (Gill & Kusum, 2016). Both learners and teachers have equal focus in the learning process (Anuradha, 2021). The learner-centred approach focuses more on how learners learn in the classroom instead of how teachers teach (Wohlfarth et al., 2008). The learners are actively busy learning and have a greater input into their learning, how they learn it, and when they learn it (Wohlfarth et al., 2008). The teacher will still set the learning programme and outcomes but will have much less direct control over how learners achieve them (Gill & Kusum, 2016).

With shifting the focus to the learner in the learner-centred approach, the belief is that learners are not empty vessels who need to be imparted with knowledge. Learners can construct knowledge and learn on their own if correctly guided by the teacher in the learning process (Gill & Kusum, 2016).

Teachers in the learner-centred classroom play a very important role in planning and conducting an effective learner-centred classroom. Learner-centred approaches therefore do not mean learning without teachers (Darsih, 2018) but refer to starting with the teachers. Teachers are not enforcers anymore, but have the role of facilitators who must guide learners with questions opposed to giving answers (Keiler, 2018). Teachers will furthermore encourage learners to participate actively and empower learners by sharing of authority in the classroom (An & Reigeluth, 2012).

The abovementioned will allow learners more choice and control in the classroom, will activate prior knowledge and encourage connection with prior experiences, and will address learner needs (Sudderth, 2022). Learners will subsequently play an active role in their learning to discover new knowledge with the teacher and their peers (Darsih, 2018). The learner's main role in the learner-centred approach is therefore to work actively and collaborate with others to solve problems (An & Reigeluth, 2012). While learners engage in dialogue about the content it will challenge their beliefs and promote knowledge construction (Wright, 2011).

The following paragraphs will focus on gamification as teaching strategy and the role of the teacher and the learners. This will be done to indicate why gamification could be an effective teaching strategy for GenZ-L.

2.4.3 Gamification

Hernández-Prados, et al. (2021) describe gamification as a “ground breaking methodology” within innovative education that is here to stay. Moreover, the use of games in general and gamification in particular is considered one of the most prominent instructional strategies to motivate learners and increase their engagement during the learning process (Dehghanzadeh et al., 2016).

The goal of gamification is to inspire learners to participate and interact with each other within an activity or goal-orientated community through applying game-based approaches and mechanics to non-game activities to promote learner participation and motivation (Israel, 2017). Gamification can subsequently address GenZ-L who have a lack of motivation, the need to feel part of the learning experience and be actively involved, and their need for instant gratification (Deterding, Dixon, Khaled, & Nacke, 2011).

The role of the teacher in gamification will be that of a game master (Hernández-Prados et al., 2021). The game master is the person who oversees the game, the length of the game, and establishing and finalising challenges, among others (Hernández-Prados et al., 2021). The game master designs the game rules to guide players (learners), to reward positive behaviours and to discourage negative behaviours (Al-Azawi, Al-Faliti, & Al-Blushi, 2016). Although this may seem that the teacher is in control of the learner, these rules are carefully compiled to guide learners, which are actively involved in the learning process.

Learners can make choices of which actions they want to take within the boundaries of the set of rules and have freedom to play and learn (World Government Summit, 2016). The player or learner must discover the rules as they play, and then learn the skills to optimise their behaviour within those rules to maximise their scores (Juul, 2011). Classroom rules will base favourable

conditions on educational outcomes and behaviour such as regular class attendance, answering questions and completing tutorial exercises (Featherstone, 2016).

Using learner-centred approaches such as gamification, helps to promote a more in-depth learning experience, which will develop learner autonomy (Darsih, 2018). Furthermore, a learner-centred approach will also foster curiosity, creativity, and collaboration – all of these being skills that are needed to thrive in the 21st century (Sudderth, 2022) and that can be linked to SDL (Guglielmino, 1977).

2.5 Self-directed learning

The aim of this section is to define SDL and to discuss the characteristics of self-directed learners. Various perspectives on SDL are found in the literature. SDL can be defined as a process of taking increased responsibility for own learning (Knowles, 1975). SDL can also be defined in terms of learner characteristics or attributes (Guglielmino, 1977). SDL will first be discussed as a process, which is defined by Knowles (1975, p.18) as:

a process by which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes.

When describing SDL as a process, it is not referred to as step-by-step actions to fulfil a learning goal or objective (Song & Hill, 2007). SDL can also be related to the autodidactic process (Sefton-Green, 2004) where learning takes place without formal guidance from a teacher.

SDL is recognised by learner characteristics or attributes (Candy, 1991). Guglielmino (1977) found that self-directed learners display initiative, are independent, persistent, self-confident, self-disciplined, creative and have emotional security. Self-directed learners find joy in learning, have a sense of responsibility for their own learning, have a strong desire to learn or change and show a preference towards active participation in educational settings. They have a tolerance towards ambiguity and a tendency to view problems as challenges with a preference for independent study or relatively unstructured sources. They pose a high degree of curiosity with an exploratory view of education.

SDL possess the basic study skills such as the ability to organise one's time and set an appropriate pace for learning, to develop a plan for completing work, to evaluate one's own progress, to accept and use criticism, to discover new approaches for dealing with problems, to

formulate learning objectives, and the knowledge on how to select and use many learning strategies and potential learning resources. They have a positive orientation toward the future with an above average risk-taking behaviour.

“SDL is best understood as a continuum that exists to varying degrees in every learner” (Tan & Koh, 2014, p. 11). Candy’s (1991) model states that the learner’s self-direction in learning will differ in different contexts (Song & Hill, 2007). Teachers therefore, must keep in mind that learners will approach learning content from a different frame of reference (Tredoux, 2012). Moreover, learners will have different levels of SDL, and learners with lower SDL levels will need more support from teachers (Brockett & Hiemstra, 1991).

Teachers should subsequently consider the characteristics of learners (Miranda, 2020) when choosing their teaching strategies. Not only should teaching strategies address the preferences of a specific generation and satisfy their learning needs, but teaching strategies should also develop the necessary skills and characteristics that learners need to address the challenges of society.

In the above sections, the characteristics of GenZ-L and self-directed learners were discussed. We will now compare the characteristics of GenZ-L, the characteristics of SDL, and gamification with each as basis for the intervention in this study which will be discussed in the next chapter.

Self-directed learners have an inquisitive nature and accept constructive feedback. GenZ-L on the other hand wants to work independently and question rules, procedures and assumptions regarding learning to form their own opinions and convictions.

2.6 Conclusion

In this chapter GenZ-L, their characteristics and learning preferences were discussed. The importance of applying relevant teaching approaches in CAT theoretical content to develop SDL was motivated. Characteristics of GenZ-L were compared with characteristics of self-directed learners, to indicate the gap in GenZ-L characteristics that teaching strategies for CAT theoretical content need to focus on.

From the literature, it was learned that GenZ-L lack some SDL characteristics such as a high degree of self-motivation, self-confidence, a strong desire to learn and collaboration. Teachers subsequently need to adapt their teaching approaches, teaching strategies and teaching methods to appeal to GenZ-L and to address the lack of certain SDL characteristics. As a result,

gamification was identified as a teaching strategy that can be applied to facilitate theoretical content in CAT.

CHAPTER 3: SELF-DIRECTED LEARNING AND GAMIFICATION

3.1 Introduction

In the previous chapter GenZ-L, the CAT curriculum and teaching and learning approaches, -strategies and methods and SDL were discussed. From the literature that was studied, the assumption was made that teachers need to adapt their teaching approaches, -strategies and methods in order to foster skills like problem solving, critical thinking and creative thinking as indicated in the CAPS for CAT. Furthermore, they need to take note of the characteristics of the learners in their classrooms in order to teach according to their teaching and learning preference. Finally, they have to equip learners with knowledge and skills so they can adapt to the changes in the future and to become lifelong learners. With this in mind, an intervention has been developed that will be elaborated on in this chapter. This chapter also aims to answer sub-research question 4 to determine what gamification is in the context of teaching and learning.

In education the instructional environment for the 21st century learner has become a fundamental problem as learners lack motivation to learn and struggle to engage with traditional teaching methods (Göksün & Gürsoy, 2019). It seems that GenZ-L have a need for instant gratification and developing critical thinking, problem solving and communication rather than relying on memorising information (Lohman, 2016). For digital natives like GenZ-L, motivation to interact with the teacher or task can be increased with instant gratification or at least instant feedback (Csapó & Funke, 2017). Chicca and Shellenbarger (2018, p. 180) argue that GenZ-L have a unique combination of “attitudes, beliefs, social norms, and behaviours” and therefore teaching methods should subsequently be adapted to address the characteristics and needs of GenZ-L (Redmer et al., 2021). GenZ-L subsequently require a different learning environment than the generations before them, that applies active teaching methods, is less content driven and more about making sense of all the information available (Merriman, 2015).

3.2 Self-directed learning models

When SDL is defined as a process, it is not understood as a stepwise action to fulfilling the learning goal or objective, but rather the importance of the processes being undertaken by learners to control their own learning situation (Song & Hill, 2007). To help understand the process undertaken by the learners, and for educators to assist the learners in the process. We need to look at different SDL models. The elements that are included in these models, are briefly summarised in Table 3-1 and explained afterwards.

Table 3-1: SDL elements as adapted from Tredoux (2012)

	SDL components	Models					
		Long	Candy	Brockett & Hiemstra	Garrison	Oswald	Song and Hill
Learning situation	Opportunity	Educators have a responsibility to give students the opportunity for SDL.	Nothing explicit	Educators have a responsibility to give students the opportunity for SDL.	Educators have a responsibility to promote student control.	Extent to which educators foster SDL.	Nothing explicit
	Support	There should be a balance between Pedagogical and Psychological control.	Nothing explicit	Educators need to support students regardless of their personal responsibility.	Nothing explicit	Expertise, guidance and materials provided by educators.	Designed by the instructor as instructional support.
	Collaboration	Possible but not necessary	Mentioned the importance	Students do not learn in isolation.	Collaboration with others promote control over learning context.	Student group and student-educator interaction.	Peer collaboration provide support to the learning context
Components of learning	Motivation	Nothing explicit	Nothing explicit	Nothing explicit	Entering motivation, task motivation and volition	Enthusiasm or eagerness of doing something. Self-efficacy and volition	Motivated to overcome the procrastination challenge.
	Context	Nothing explicit	Distinguishes between student control in an Institutional setting and being autodidactic	Defines social context as institutions of learning.	Students taking control of resources in the learning context.	Resources, peers and external factors in the learning environment.	Intrinsic motivation and resourcefulness, together with their prior knowledge of the content area and prior experience with the learning context.
	Cognitive	Nothing explicit	Nothing explicit	Nothing explicit	Construct own meaning, critical thinking and reflection.	Critical self-reflection	Nothing explicit
Students' Attributes	Content Skill	Nothing explicit	Student's SDL skills may differ in different learning areas.	Nothing explicit	Nothing explicit	Mastering basic skills within a content area promotes SDL.	Prior knowledge and experience within the content area promote SDL.
	SDL Skill Level of self-directedness	High psychological control will proceed to SDL without pedagogical assistance.	Level of SDL will be higher in familiar learning areas.	Students assume responsibility for planning, implementing and evaluating the learning process.	Nothing explicit	Level of SDL in specific learning area is influenced by skill level in that area.	The instructor's design of the course influences the level of SDL.
	Willingness Willingness to direct own learning	Willingness to direct own learning leads to improved SDL.	Willingness and capacity to direct own learning.	Willingness and desire.	Self-management and goal setting.	Personal decision to invest time and effort.	Online learning affords much control for learners to create their own learning space.

Several SDL models have emerged over the years, each highlighting unique aspects of SDL from Long's instructional model in 1989 to Song and Hill's online learning model in 2007 (Bosch, Mentz, & Goede, 2019). We shall briefly take a look at some of the different models.

3.2.1 Long's Model (1989)

Long's model focuses on the balance of control in learning, proposing that SDL thrives when learners have significant control. This model is delineated into four quadrants balancing pedagogical and psychological control, challenging traditional teacher-dominated classrooms (Long, 1989; Tredoux, 2012).

3.2.2 Candy's Model (1991)

Candy's model suggests that context plays an important role in SDL, and encompasses learner control, autodidaxy, personal autonomy, and self-management. It posits personal autonomy as a principal educational goal and emphasises the importance of collaborating in active, student-centred environments (Candy, 1991; Song & Hill, 2007; Loyens et al., 2008; Tredoux, 2012).

3.2.3 Brockett and Hiemstra's Personal Responsibility Orientation Model (1991)

This model presents SDL as both an instructional process and an individual trait, emphasising self-responsibility and the importance of learning in social contexts (Brockett & Hiemstra, 1991).

3.2.4 Garrison's Three-Dimensions Model (1997)

Garrison's model introduces motivation, self-monitoring, and self-management as central to SDL, focussing on the learner's internal control mechanisms (Bunt, 2023; Garrison, 1997).

3.2.5 Oswald's 3-Factor SDL Model (2003)

Oswald identifies three essential elements for SDL, namely opportunity, support, and collaboration, incorporating motivational, contextual, and cognitive factors (Oswald, 2003).

3.2.6 Song and Hill's Model for SDL in Online Environments (2007)

This model adapts SDL to online learning contexts, considering SDL as a personal attribute, a learning process, and influenced by environmental factors (Song & Hill, 2007).

Each of the above models contributes to a nuanced understanding of SDL, emphasising the importance of learner control, environmental context, and the interaction between individual traits and the learning process.

In an ever-changing world, the educational environment needs to keep up with change. Learners, particularly Gen Z-L, require interactive learning opportunities. These opportunities could potentially be offered by gamification. Gamification allows teachers to effectively incorporate learner engagement and address motivation issues in the current educational settings.

This following chapter will explore the theoretical aspects and real-world applications of gamification and how gamification can positively influence learning and better equip learners for future challenges.

3.3 Gamification

As established in Chapter 2, GenZ-L prefer an active, learner-centred approach to teaching. Gen-Z L need to engage with learning methods that will provide them with a much-needed break from mundane routines or teacher-centred methods such as direct teaching. With the rapid development of technology and digitalisation in the 21st century and everyday life, GenZ-L need and require to be more interactive and engaging in their learning experience. Educators should not simply stick with traditional approaches and methods. They should adapt with time and to the learners' needs to satisfy and fulfil their requirements to stay interactive, motivated, and address the need for instant gratification in the learning process.

Following up on the discussion of different teaching methods and strategies, the chapter will now focus on how gamification can help learners learn CAT theoretical content. Gamification could furthermore enhance SDL (See Table 3-2). Subsequently the focus will now be placed on how gamification can enhance SDL.

Gamification is defined as “*the use of design (rather than game-based technology or other game-related practices) elements (rather than fully developed games) characteristic of games (rather than play or playfulness) in non-game contexts (regardless of specific usage intentions, contexts, or implementation media)*” (Deterding et al., 2011, p. 5).

Games have always been a natural part of informal schooling, for all ages. In contrast to reading books and listening to seminars, games provide a more convenient and enjoyable way to learn (Schwieger & Ladwig, 2018). As a result, learning takes on a compelling and inspirational quality.

3.1 Game-based learning and gamification

Gamification and game-based learning are often confused with each other as they are two closely related concepts. The main difference between game-based learning and gamification is that game-based learning uses actual games (such as Age of Empires or Sim City) to achieve educational goals, while gamification only uses some of the game-based elements (scores, badges) to promote engagement and motivation in an educational setting (Deterding et al., 2011). Classcraft subsequently falls in the gamification category.

From the literature it was derived that learners do not engage in the teaching and learning of theoretical content when traditional teacher-centred teaching methods are applied. Since the rise of gamification, evidence research has indicated that gamification can increase learners' engagement, strengthen their social relations, raise their satisfaction, help to identify personal strengths and weaknesses, and provide personal feedback (Charles et al., 2011). The increasing use of technology has brought along new abilities and skills that learners need to have. One of these abilities is the ability to learn how to learn (Knowles, 1975) and lifelong learning (Pacheco et al., 2020).

Game-based learning (GBL) and gamification are two distinct methodologies that use the captivating aspects of games in educational settings, however they vary considerably in their execution and educational principles. GBL is the use of real games to enhance learning, with the game serving as the means of instruction, intentionally intended to achieve certain learning objectives (Qian & Clark, 2016). This strategy incorporates instructional information or abilities seamlessly into the structure of the game, placing learning at the heart of the gaming experience (Plass et al., 2015). Conversely, gamification is the use of game design components and ideas in situations that are not related to games (Deterding et al., 2011). Gamification is the use of game-like elements, such as points, badges, and leader boards, to increase motivation and participation in educational activities. No game is actually played when applying gamification (Hamari et al., 2014). GBL however, emphasises utilising games for educational purposes to accomplish specific learning goals. On the other hand, gamification is primarily concerned with motivating learners and modifying their behaviours by including game-based components, even if learners are not actively participating in a full-fledged game (Dichev & Dicheva, 2017).

GBL facilitates learning by laying its foundations upon the game (Kapp, 2015). The reason GBL methods are so effective to use is the ability to adapt to the particularities of each individual learner. Learners subsequently react emotionally as they get involved in the process. This often leads to learning being an added-on surprise, a special guest to the

gamified system. GBL as well as gamification allows learners to be motivated as they feel they can control the learning environment as they establish relationships with other players. This links to SDL, as motivation is a key dimension of SDL. GBL methods can incorporate different competitive aspects such as rankings, prizes, skills and scores which serve as motivation. What aids GBL to a great extent is the manner in which GBL clearly defines the goals that the learners must achieve, which can assist with promoting SDL

While the use of gamification can enhance learning and result in learners who actively engage in their school work (Lee & Hammer, 2011). According to Kapp (2012, p. 13) “Gamification is a serious approach to accelerating the experience curve of the learning, teaching complex subjects, and systems thinking.” According to Nolan and McBride (2014) “there is nothing gamification could not solve concerning learning”. Gamification does not require of learners to play games or for the teacher to create an elaborate system or game, or have any coding knowledge. Gamification applications such as Classcraft, Goalbook and Class-Dojo, can easily be used to assist in transferring teaching content into a game-like situation with game elements.

Following are some examples of how game elements have successfully been implemented in the world and education.

3.1.1 Examples in the world

There are several examples of gamified digital applications. This next section will explain some of the more widespread examples, and then justify as to why Classcraft was selected for the intervention in this study. Other common examples are the iconic Piano staircase, Todoist and LinkedIn. These will be briefly discussed in the next section.

3.1.1.1 Piano staircase

Probably the most common example of gamification in our everyday life would be the famous Piano staircase experiment in Stockholm (Peeters et al., 2013). This experiment motivated commuters, to prefer using the stairs over the escalator and stimulate exercise. Researchers used a location in Stockholm where a staircase and an escalator were located next to each other. On the first day that they filmed, almost all the commuters used the escalator. They changed the stairs to a piano overnight where commuters discovered that the “piano” makes noises when they walk on it. This experiment succeeded because it was more enjoyable to create music while climbing the stairs, and also challenged those who were more musical to try and compose a piece of music. The staircase encouraged and convinced 66% more people to use the stairs instead of the escalator throughout the day. This was evident from the video

that they took that day (Volkswagen, 2009). When people were introduced to the innovative idea, the piano staircase significantly improved things by attracting their interest and inspiring them.

3.1.1.2 Todoist

Todoist applications uses a reward system to motivate and engage the user. Todoist is an application to manage personal and professional tasks (Miles, 2024). The app uses karma as a measure to rate how well the user is doing. When the user finishes the task, the application rewards the user with karma, and when the user postpones a task it will reduce the karma of the user. The application uses the karma to clearly show the progress over time and gives status, levels and rewards.

3.1.1.3 LinkedIn

LinkedIn, like many other websites, are using the profile completeness bar if the user profile is less than 100% complete. LinkedIn effectively uses progress and incentives to encourage users to complete their profile information completely (Kanazawa, 2022). This is an example of how game mechanics can effectively and effortlessly incorporate small parts of content or process with ease. The completeness bar can be used to motivate learners in the CAT classroom to complete tasks like the practical assessment task they have to do throughout the year for example.

3.1.2 Gamification applications in education

Some of the most common examples of gamification applications in education are Classcraft, Goalbook and Class-Dojo, which will be discussed briefly.

3.1.2.1 Classcraft

Classcraft is a free online educational role-playing game that turn your classroom into an adventure (Boggan, 2020). Classcraft uses game-based elements like levelling up, working in teams, and earning powers that can be used, and have real-life consequences in the classroom. These game-based elements can be assigned by the teacher to any existing curriculum with ease. Teachers can use Classcraft throughout the year to track learners' progress when learners perform any tasks like helping another learner to study, receive a high score on an assessment, or even answering a question in classroom. Teachers can assign experience points to a learner or a group for any aspect. The experience points are subsequently custom-made by the teacher for any classroom rewards or consequences.

3.1.2.2 **Goalbook**

Goalbook is a Facebook-like interface where teachers, learners and parents can organise an individualised education programme with goals and behavioural plans that focuses on learning for a specific individual learner (Boggan, 2020). Goalbook, however, is not a free application.

3.1.2.3 **Class-Dojo**

Class-Dojo is recommended for younger learners and is a free application similar to Classcraft, that allows teachers to give positive or negative feedback based on customisable rewards and consequences (Boggan, 2020). Class-Dojo can also be used as a communication tool with parents where teachers can post and showcase classwork, short videos, and pictures of the day. This could even be used to communicate homework and other important information.

In the next section, the implementation of gamification with the focus to enhance SDL, will be discussed. Oswald's 3-Factor SDL Model (2003) has been selected as the main foundational model for implementing gamification to enhance SDL, because it incorporates nine dimensions under three different elements to enhance SDL (see Figure 3-1). Other models for SDL were also considered, and in the next section it will be indicated how Classcraft links to these models.

Table 3-2 illustrates the link between the characteristics of SDL, GenZ-L and gamification. The table exhibits SDL traits like creativity, critical thinking, and a strong sense of responsibility for their own learning (Guglielmino, 1977; Knowles, 1975). GenZ-L share several of these attributes, including creativity, goal orientation and their preference for hands-on learning (Adobe, 2016; Merriman, 2015; McKibben, 2017).

Gamification enhances these traits mentioned before by fostering creativity, promoting critical thinking, and increasing learner engagement through interactive learning scenarios. By integrating gamified elements into the educational environments, educators can cater to the intrinsic motivations of both SDL and GenZ-L, ultimately fostering a more engaging and effective learning experience for the learners.

Table 3-2: Comparison of SDL and Generation Z learner characteristics

Learner characteristics	Self-directed learners	Generation Z learners	Gamification
Creative	✓(Guglielmino, 1977)	✓ (Adobe, 2016)	Fosters creativity
Critical thinkers	✓ (Guglielmino, 1977)	✓ (Seemiller & Grace, 2016)	Promotes critical thinking through complex problem-solving
Responsibility for own learning	✓(Knowles, 1975)	✓ (Moore et al., 2017)	Increases learner engagement
Independent	✓(Guglielmino, 1977) (Knowles, 1975)	✓ (Chicca & Shellenbarger, 2018)	Facilitates assessment
Tolerance towards ambiguity	✓(Guglielmino, 1977)	×	Boosts enthusiasm
Views problems as challenges	✓(Guglielmino, 1977)	×	Lessens disruptive behaviours
Enjoys challenges	✓(Guglielmino, 1977)	✓(Lohman, 2016; Hilton Segal & Hatami, 2023)	Adding challenges and decisions throughout the process
Displays initiative	✓(Guglielmino, 1977)	×	Encourages growth and development
Love of learning	✓(Guglielmino, 1977)	×	Improves attention span
Goal orientated	✓(Guglielmino, 1977)	✓ (Merriman, 2015; McKibben, 2017)	Improves ability to follow directions
A preference for independent study	✓ (Guglielmino, 1977)	✓ (Chicca & Shellenbarger, 2018)	Promotes intrinsic motivation
Inquisitiveness	✓(Guglielmino, 1977)		Development of technological skills
Curiosity	✓(Guglielmino, 1977)	✓ (Lohman, 2016)	Increases learners' ownership of learning
Positive orientation towards the future	✓(Guglielmino, 1977)		Builds trust, bonds, and cooperation

Learner characteristics	Self-directed learners	Generation Z learners	Gamification
Above average risk-taking behaviour	✓(Guglielmino, 1977)	✓ (Hilton Segal & Hatami, 2023)	Increases comfort levels
Intrinsic (self) motivated	✓(Guglielmino, 1977)	x	Encourages inquiry
Self-confident	✓(Guglielmino, 1977)	x	Provides learners with deeper understandings of concepts and their applications
Self-discipline	✓(Guglielmino, 1977)	x	Encourages time management and goal setting
Organised	x	x	Instant and authentic feedback which allows the learners to learn, adapt and succeed
Perseverance	x	x	Increases problem-solving skills
Persistence	✓ (Guglielmino, 1977)	x	Results in new and innovative solutions
Collaboration	✓ (Knowles, 1975)	x	Results in urgent optimism
Lack of attention span	x	✓ (Schwieger & Ladwig, 2018)	Leads to blissful productivity
Individualistic	x	(Howard, 2018)	Provides learners with an opportunity to take an active role in producing content
Social skills	✓(Guglielmino, 1977; Knowles, 1975)	x	Provides learners with agency in learning
Instant gratification	x	✓(Schwieger & Ladwig, 2018)	Effectively provides information just when it is required for learning
Goal orientated	✓ (Guglielmino, 1977; Knowles, 1975)	✓ (Merriman, 2015; McKibben, 2017)	Anchors new concepts and understandings to experiences
Consumers of technology	x	✓ (Redmer et al., 2021)	Encourages system thinking
Cravers of digital world	x	✓ (Chicca & Shellenbarger, 2018)	Makes education a joyful experience
High expectations	✓(Guglielmino, 1977)	✓ (McKibben, 2017)	Can be met through personalized challenges

Learner characteristics	Self-directed learners	Generation Z learners	Gamification
Multitasking	×	✓ (Beall, 2017)	Supports simultaneous engagement with multiple tasks at once
Pragmatic	×	✓ (Chicca & Shellenbarger, 2018; Hilton Segal & Hatami, 2023)	Applies real-world scenarios for learning theory
Prefers hands-on experience	×	✓ (McKibben, 2017)	Encourages experiential learning through interactive game-based elements
Identifies learning needs	✓ (Knowles, 1975)	✓ (Moore et al., 2017)	Allows for self-assessment and reflection
Finds appropriate resources	✓ (Knowles, 1975)	×	Guides learners to resources through in-game challenges
Evaluates learning	✓ (Knowles, 1975)	×	Facilitates regular feedback and progress tracking
Realistic	✓ (Guglielmo, 1977)	✓ (Merriman, 2015)	Uses simulations and scenarios for practical application of theoretical content
Prefer visuals	×	✓(Lohman, 2016)	The use of visuals throughout the game

3.2 Theoretical framework of the intervention

Long's SDL Instructional Model, developed in 1989, is a framework for facilitating independent learning. This style prioritises control, which is crucial when interacting with GenZ-L who excel in autonomy. By integrating Classcraft, a free online educational role-playing game that empowers learners to take charge of their learning, a conducive atmosphere is established that caters to the preferences of GenZ-L for autonomy and personalised learning. Nevertheless, this level of control is counterbalanced by providing organised direction to mitigate the risk of disengagement, which may be a concern for learners who have limited attention spans.

Candy's Self-Directed Learning Model (1991) recognises that SDL is expressed in many ways depending on the subject matter. This is especially important for GenZ-L, who have a wide range of learning preferences and interests. Classcraft's adaptable nature enables it to be customised for different curriculum areas in CAT, adapting to the specific tastes of individual learners and so increasing their engagement and motivation.

The Personal Responsibility Orientation Model (1991) by Brockett and Hiemstra emphasises the significance of SDL as both a pedagogical approach and a manifestation of individual characteristics, aligning with the inclination of GenZ-L towards self-accountability and communal learning settings. Classcraft promotes learner autonomy and fosters collaborative social learning, to address the lack of GenZ-L inclination towards social engagement and collective problem solving.

Garrison's Three-Dimensions Model (1997) emphasises motivation, self-monitoring, and self-management, which are important for GenZ-L who may struggle with these aspects of SDL. Classcraft tackles these aspects by offering a gamified platform that incentivises learners via prizes, facilitates self-assessment through progress tracking, and promotes self-regulation by establishing explicit goals and empowering learners to control their learning paths.

Oswald's 3-Factor Self-Determination Theory Model (2003) highlights opportunity, support, and cooperation as crucial elements for successful SDL. Classcraft incorporates these elements by offering learning opportunities via game-based assignments, giving help through instant feedback and tips, and promoting cooperation through team-based challenges. This structure is in line with the characteristics of GenZ-L, who need to develop their collaboration skills, need ongoing assistance, value experiential learning.

The model proposed by Song and Hill (2007) is designed to promote SDL in an online environment. Considering GenZ-L's extensive knowledge of digital settings, Song and Hill's

concept is very relevant. With this in mind, Classcraft exemplifies the importance of the online environment in promoting SDL. It does this by offering an immersive online platform that caters to the digital proficiency of GenZ-L, hence increasing their involvement and knowledge.

ClassCraft seamlessly interacts with the digital lifestyle of GenZ-L, using their technical fluency to enhance engagement and facilitate learning. Nevertheless, in order to tackle obstacles like their reduced ability to focus for long periods of time and need for rapid rewards, the proposed intervention includes organised game elements that provide fast feedback and incentives. This approach promotes engagement, retain their attention on learning activities for longer periods of time.

3.3 Gamification and the link to Oswald's 3-Factor SDL Model (2003)

Oswald (2003) indicated nine dimensions under three different elements required for SDL as displayed in Figure 3-1.

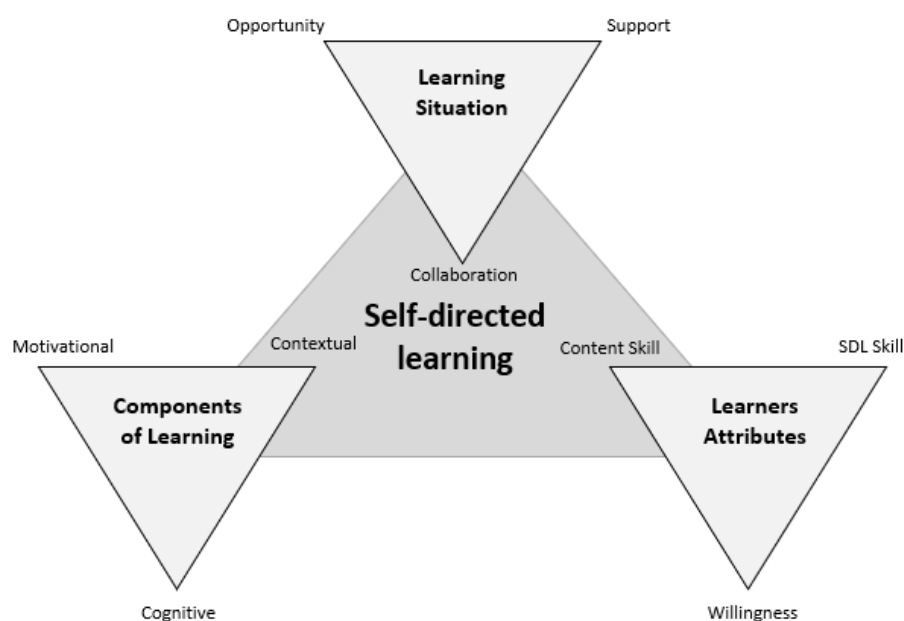


Figure 3-1: Oswald's 3-Factor Model

(adapted from Bosch et al. (2019) and Oswald (2003, p. 24))

We will compare Oswald's 3-Factor SDL Model with gamification by looking at each of the elements and dimensions identified by Oswald (2003). Table 3-3 shows a brief summary of how Oswald's SDL model can be compared to gamification with the nine SDL dimensions that he identified. All these SDL dimensions can be linked to gamification.

Table 3-3: Gamification and the link to Oswald's SDL Model

Element	SDL dimensions		Gamification
Learning Situation	Opportunity	The extent to which educators foster SDL.	Provides regular feedback and status of information and content.
	Support	Expertise, guidance and materials provided by educators.	Support can be received from fellow learners, the teacher and the game.
	Collaboration	Student groups and student-educator interaction.	Working and acting together as a team.
Components of learning	Motivation	Enthusiasm or eagerness of doing something. Self-efficacy and volition.	Incentives can provide motivation through intrinsic or extrinsic incentives build into the game environment.
	Context	Resources, peers and external factors in the learning environment	Context is always salient for a learner to invest time and effort into the game.
	Cognitive	Critical self-reflection	Supports learning through self-reflection.
Learner Attributes	Content Skill	Mastering basic skills within content area promote SDL skill.	Although the main goal of gamification is still to improve learner engagement and not necessarily aims to teach them something new, it can enhance content comprehension and promote better retention of information by motivating learners more.
	SDL Skill	Level of SDL in specific learning area is influenced by skill level in that area.	SDL improves through openness to new ideas, self-confidence and internal locus, organisation and discipline and critical thinking.
	Willingness	Personal decision to invest time and effort.	The use of game design elements motivates learners to start learning on their own and to invest time and effort.

3.3.1 Learning situation

SDL can occur when the learning situation contains three dimensions necessary for the success of the SDL experience. These dimensions are opportunity, support, and collaboration (Oswald, 2003).

Opportunity is the commitment of the teacher to provide opportunities to promote SDL in the learning situation. This can only happen if the teacher is willing to support learners' successful direction of their own learning in the classroom. When using gamification, instant feedback, immediate feedback or shortened feedback cycles (Lee & Hammer, 2011) can be achieved by using game elements such as scores, badges, rankings and rewards (Glover, 2013). The Classcraft intervention, as a gamification application, has these achievement mechanisms

built into it. Stott and Neustaedter (2013) believe that gamification can provide rapid feedback which links directly to formative assessment. This can provide learners with constant feedback on their activities.

Although learners must take responsibility for directing their own learning, it is necessary for teachers to provide resources and scaffolding to support learners' endeavours with new or unfamiliar knowledge and skills. In the support dimension, the teacher provides expertise, guidance, and materials to the learning situation. Accordingly, in Gamification the game master (in this instance the teacher), fellow learners and teammates, external resources such as videos and the game can all support the learner in the learning context (Lorås, 2017).

Collaboration is an essential aspect of SDL (Sebatana & Dudu, 2021). Successful self-directed learners in both formal learning situations (schools) and non-formal learning situations (playground and sport) most often utilise the help of peers and peer-support networks. In gamification one of the most common advantages are collaboration for motivation. Learners can collaborate in small groups or as a class against the game itself, to reach a common goal.

3.3.2 Components of learning

In this model for the learner to be an effective self-directed learner, the learner must take responsibility of all three factors of the components of learning. These three dimensions are motivational, contextual and cognitive (Oswald, 2003).

Motivational factors include both self-efficacy and volition. Self-efficacy can be seen as to what the learner's confidence (or lack thereof) is in the learner's ability to succeed or fail (Oswald, 2003). Volition is defined as "the learner's ability to stay on task despite things in the environment that compete for the learner's attention" (Oswald, 2003, p. 25). Gamification attempts to use the natural motivational power of game-based elements to help the learner stay focussed on the current objective (Lee & Hammer, 2011). Various intrinsic motivational incentives such as avatars, storyline, choices and feeling connected could be combined with extrinsic incentives such as points, rewards, bonuses and leader boards, because it all adds to the flow and enjoyment of the gamified experience (Bittner & Shipper, 2014). Kasurinen and Knutas (2018) believe that gamification is very context-dependent because of all the different intrinsic and extrinsic motivation factors associated with all the different activities.

Contextual factors include those components of the learning environment that the learner has control over, such as "resources, peers, and other external factors in the learning environment" (Oswald, 2003, p. 26).

Cognitive factors of learning include “critical self-reflection” on both the learners’ learning process and the knowledge and skills the learner is attempting to master (Oswald, 2003, p. 26). As previously indicated when using gamification, it can lead to rapid feedback and leave the learner with constant opportunities to self-reflect on their learning process.

3.3.3 Learner attributes

Learning attributes integrate content skill, SDL skills and the willingness to direct one’s own learning. Oswald (2003, p. 25) argues that the learner’s “skill level or knowledge in a content area will directly impact their ability to direct their own learning within that specific content area”.

For content skills, the learner’s knowledge of the specific content will have a direct impact on their ability to direct their own learning in that domain. If learners have developed a prior understanding of basic concepts or have even mastered basic skills in a specific content area, these learners will be more willing to take charge of their own learning. In a study conducted by Leaning (2015) he found that gamification encouraged learners to work harder, put in more effort towards preparation and this led to learners feeling they were more effective in the retention of information, and learning on a deeper level.

When learners are asked to direct their own learning, they will be required to apply SDL skills. These learners’ SDL skills will have an impact upon the ability and willingness of the learners’ skills in a specific content area or knowledge domain to direct their own learning in a similar context. Pacheco et al. (2020) believe that gamification improves openness to new ideas, self-confidence and internal locus, organisation and discipline, and critical thinking.

Learners must be willing to direct their own learning. SDL can thus only occur successfully if the learner is willing to make the investment of time and. The learners must therefore also be willing to dedicate time to a content domain for which learning goals may not initially match with their personal goals of learning. Gamification supports learning through self-reflection by using game elements such as scores, badges, rankings and rewards (Glover, 2013). By using game-based elements, it may aid engagement of learners and enhance their intellectual activities by enriching their learning journey.

When looking at how gamification links to Oswald’s SDL Model it is concluded that gamification occurs in all of the nine components identified by Oswald. Gamification thus provides the opportunity to enhance SDL. In the following section the difference between gamification and game-based learning will be explained.

3.4 Gamification as intervention to enhance self-directed learning

Gamification was used as an intervention to facilitate theoretical content in CAT. The intervention was designed with the aim to promote SDL. SDL is an important factor for this

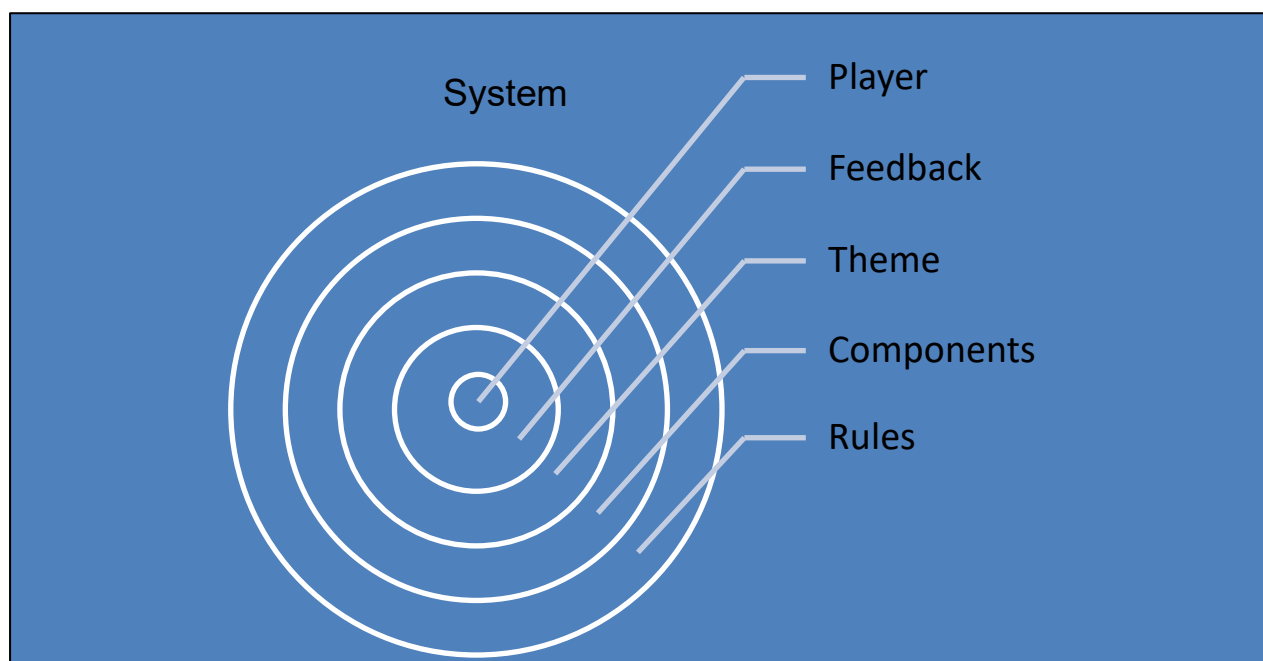


Figure 3-2: Gamification: The user perspective photo (adapted from Marczewski (2014)) study to adapt to change and promote lifelong learning. These are also aims of the DBE and aligns with the aims and objectives of the CAT curriculum. The use of gamification is not new to learning. As we have used games to learn to play since we were small on the playground, Gamified systems such as competition, points scoring, collecting, player reputation, theming, medals, etcetera are all transferable between different types of games and are effective in different combinations, even in non-gaming settings. Most gamification systems use reinforcement via points, levels, badges, leader boards, etcetera to promote engagement and motivation in users (Dicheva et al., 2015).

3.4.1 The player

It will be explained how game-based elements were used in gamification for this intervention based on the general guide indicated by Marczewski (2014) as seen in Figure 3-2. The players or in this case, the learners, are mostly impacted by the system, the system being Classcraft in our intervention, as the feedback from the game will form the experience for the learners.

Classcraft has been chosen as main intervention software to introduce gamification to the learners. This software is very easy to use for the teacher and by using many of the game elements found in games today, learners can level up, work in teams, and earn powers that

have real-world consequences. Classcraft uses inspiration from role-playing video games to transform any classroom into a role-playing platform that fosters stronger learner collaboration and encourages better behaviour (Sanchez et al., 2017). Learners can create a character and play as part of a team to gain experience points and rewards based on class-related behaviours and actions. Learners can choose from three different roles: Mages, warriors and healers, each possessing unique properties that are needed to contribute towards the team's success (Sanchez et al., 2017). Game rules are quite simple and many of the rules are even created instantly by Classcraft with the pre-set settings. Classcraft also allows entering of own rules and customising of elements.

3.4.2 Feedback

According to Marczewski (2014) feedback can be “anything from the word, correct, on a test, to the outputs of a full virtual economy and the screen flashing and dancing!” Immediate feedback is one of GenZ-L’ cornerstones. Classcraft can provide feedback in several ways, such as experience points (XP), health points (HP), power-ups and abilities, and random events.

3.4.2.1 Experience points (XP)

Learners earn XP for completing assignments, demonstrating positive behaviour, or achieving learning goals set by the teacher and Classcraft. Conversely, they may lose XP for negative behaviours or incomplete tasks set by the teachers or Classcraft (Sanchez et al., 2017). This system allows teachers to provide immediate feedback on learner performance.

3.4.2.2 Health points (HP)

Similar to XP, learners have HP which represent their overall well-being and engagement in the classroom. Positive actions can restore HP, while negative actions can result in HP loss. This mechanic provides feedback on learners' emotional and mental states as well as the players' overall classroom engagement. HP could also closely replicate the school's disciplinary system (Sanchez et al., 2017).

3.4.2.3 Power-Ups and abilities

Teachers can award learners with special powers or abilities for exceptional performance or good behaviour. For example, a learner might earn a power-up that allows them to skip a homework assignment or to listen to music in class. This provides positive reinforcement and feedback for learners' achievements. As they move to new levels, they unlock more abilities

and power-ups for themselves. Learners can choose between power-ups to help themselves (listening to music in class) or the team (preventing damage to teammates).

3.4.2.4 Random events

Classcraft incorporates random events into the gameplay that can affect the learner's progress and behaviours. These events may provide unexpected rewards or consequences based on the learner's actions, adding an element of unpredictability to the feedback system. For this study, at the beginning of the lesson, the random event was performed once in a lesson. Some events included the classroom to become pirate-themed and forced everyone to speak like pirates, or could just award a random learner with some XP points. The event could take a turn for the worse, because the event could deduct HP from the players leaving some of the learners' health depleted, and activating random punishments for those learners.

3.4.2.5 Leaderboards and rankings

Classcraft includes leaderboards that display the learners' performances by ranking them within the class or their team according to XP and HP. This can motivate learners to improve their performance and behaviour to climb the ranks, providing indirect feedback on their progress.

3.4.2.6 Quests and challenges

Teachers can create quests and challenges related to academic tasks or behavioural goals. With the completion of these quests, learners successfully earn rewards and recognition, serving as feedback on their accomplishments. These can be performed as individual-, team- or classroom quests by providing immediate rewards when defeating the quest or losing against the quest. Typically, this can be carried out after a section of theoretical content has been facilitated. The teacher can then create a quest that the learners need to follow and complete. The question will provide the teacher with feedback on what the learners truly understood and the learners' XP points for completing tasks.

The feedback system in Classcraft is a truly active and ongoing theme throughout the game. This is accomplished by following a pre-determined theme or storyline. Teachers can also create and use their own themes and storylines.

3.4.3 Theme

Whilst the theme for the intervention and Classcraft may not be important to all, it will impact the user enjoyment factor in different ways – especially if not handled appropriately.

3.4.3.1 Role playing

Role playing in Classcraft adopts a role-playing game (RPG) theme where learners create their own characters to a certain extent, choosing from different classes of characters such as Warriors, Mages, or Healers. Each class has unique abilities and characteristics that learners can utilise throughout the game. For the role-playing to work effectively in Classcraft learners need to be part of a team as there are different roles to choose from. All these roles play an important part in engaging and fostering teamwork and collaboration between a team or group of learners. This naturally creates collaboration among the group as the learners need to work together to succeed. Learners can use action points (AP) to help other learners in the group, or to get an advantage in class. There is however a limit, and can only be used in class while the learner has some AP left (Papadakis & Kalogiannakis, 2018).

- **The Mages**

The Mages can only have 35 max HP and 50 max AP - AP is used to perform the different power-ups and abilities. This would normally be the leader of the group or the learner who is the most reliable. As HP can be lost quickly this person needs to be on time and prepared for class more than the others. The role of the Mage is to use their powers to restore their teammates' AP so they can continue using their powers regularly. The mage role is important as learners cannot restore their own HP. Figure 3-3 displays the starting powers of the Mage.

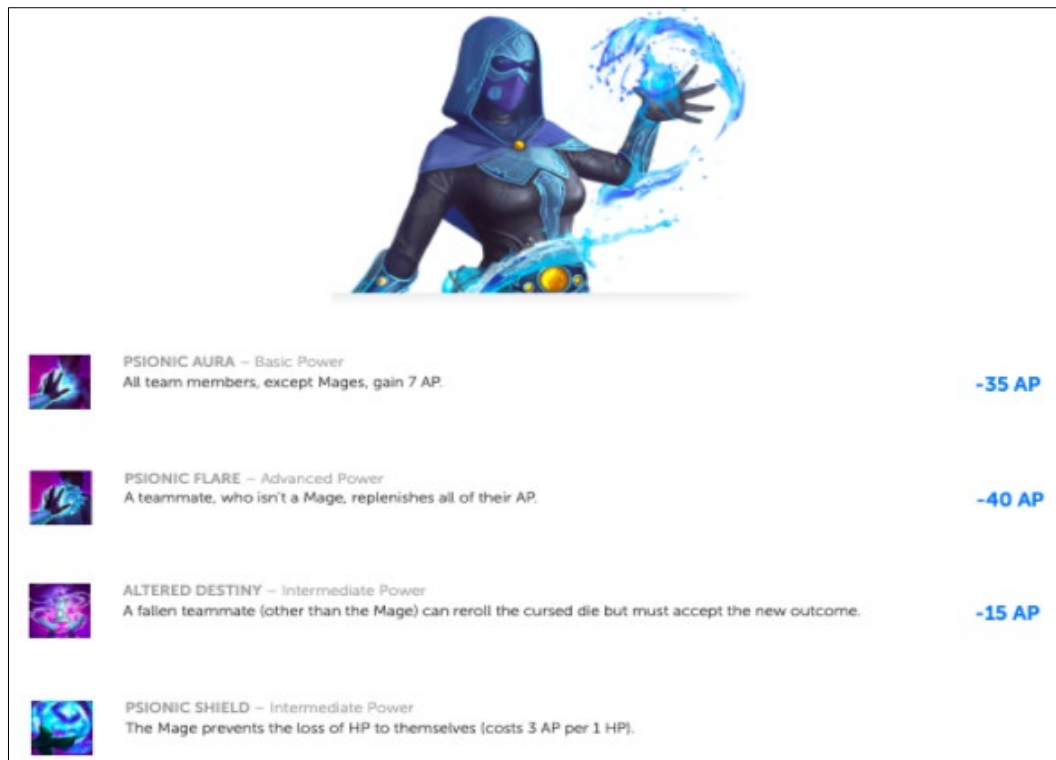


Figure 3-3: The Mage

- **The Guardians**

The Guardians can only have 70 max HP and 30 max AP. This learner is the defender of the group. The Guardian can take a lot more damage compared to the rest. Normally this will be the learner who is not always the best prepared in class. However, in this game the Guardians are the team's protectors. They need to use their powers to defend their teammates from taking damage in the game. This learner can become a great player and even a better teammate if they prepare well for class and almost never lose HP on their own account, but rather help out players with low HP. Figure 3-4 shows the different amounts of damage it can take. The Guardian could typically save the Mage from taking damage, while the Mage could provide AP when necessary.



Figure 3-4: The Guardian

- **The Healers**

The Healers can only have 50 max HP and 35 max AP. The role of the Healer is to restore their teammates' HP so they do not lose all their HP and die in the game, resulting in a punishment determined randomly. These punishments can be something such as extra homework or doing something as silly as singing a song in class. Figure 3-5 displays the Healer that must mainly restore the HP of the Mage. Healers are normally the learners who are in class and participate most of the time.

The three roles described above provide the opportunity for all learners of different academic capabilities and level of interest in the subject content, to play an important role for themselves and the team. The three roles are also important to improve and provide the opportunity for the integration of social features like collaboration, competition, and sharing within the gamification environment.

The minimum group size for proposed for the intervention, is a group of three learners. The sizes of the groups were determined by the different Classcraft roles. Learners had to choose at least one of each character in their group or team, as every character needs to rely on the other two characters and their powers to succeed in Classcraft as a game. Teamwork and collaboration are key features in Classcraft.

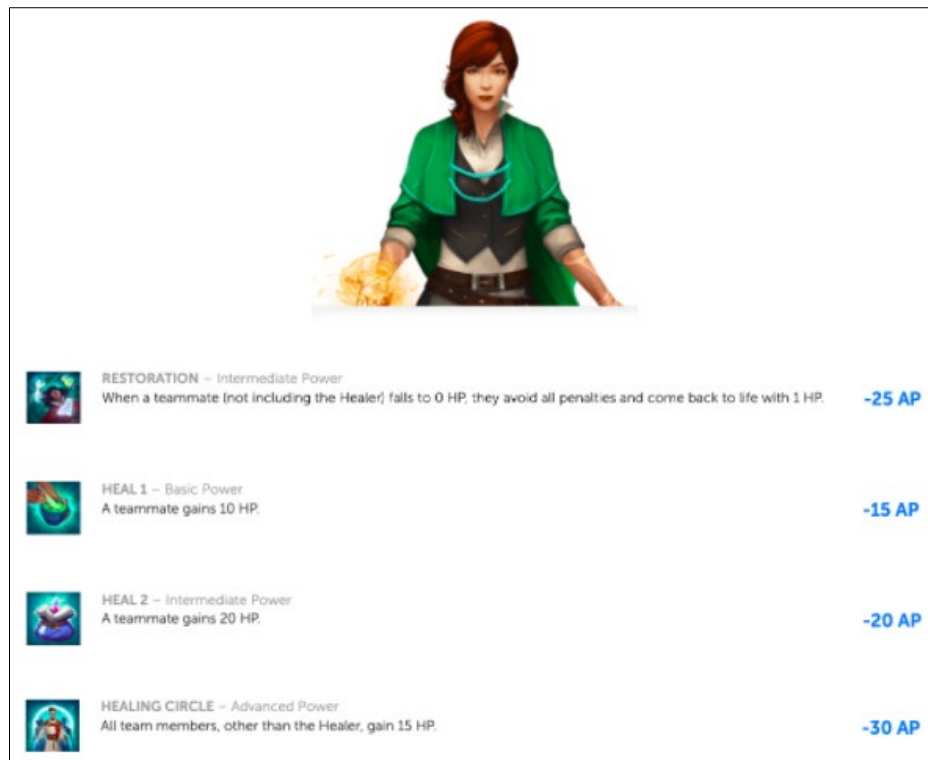


Figure 3-5: The Healer

3.4.4 Components

Components are aspects such as XP, HP, leaderboards and rankings. While these components are all mainly part of Feedback, the design behind the components is not always that important to the user, as long as they work and do not interfere with the user's experience of the game (Marczewski, 2014). With these components in mind, it will now be discussed how the teacher can set up the game by providing some recommendations (Anon, 2015).

Customising the game rules can help the teacher to adjust the game by accommodating the classroom, school and amount of time spent on the game throughout the year. Teachers can create, edit and delete most powers, random events, sentences for falling in battle, and change fundamental game values such as how many XP a player needs to move a level up and how many HP and AP are regenerated each day.

Valuable advice would be to "never postpone inputting data" (Anon, 2015). One of the main reasons for Classcraft is to provide immediate feedback which seems obvious, but also not to give yourself as the teacher, a bigger workload later or run the chance to forget dealing with the loss of HP or gain of XP. Enter it as soon as possible.

"Always be consistent" (Anon, 2015), as learners will easily lose interest if consistency and fairness are not upheld. Even if some of the random events seem silly or inappropriate for the

current lesson plan, you as the teacher need to go along with them or Classcraft will not be effective.

3.4.4.1 Classcraft tools

Classcraft has some class tools to help the teacher to make the game more engaging, foster a positive learning environment, motivate learners, and to gamify the learning experience. Most of these tools are available on the free version of the website.

- Random Picker (The Wheel of Destiny)

This tool helps the teacher to choose learners or teams at random to answer questions. This adds an element of excitement and fairness to the classroom dynamic as the teacher can more easily keep the learner's attention, as their name or their team's name can be next.

- Random Events (The Riders of Vay)

The Random Events (The Riders of Vay) is a pleasant and easy way to start the class and grab the learner's attention from the start of the lesson. This adds an element of surprise to the day by starting the class with a fun event or condition such as requiring everyone to call each other names like 'majesty' or even winning free XP. Kudos (Shrine of the Ancients)

A very easy way to allow learners to foster a positive class climate is by publishing uplifting messages from one learner to another learner. This can encourage and highlight random acts of kindness, teamwork, or academic achievement by the learners.

- Boss Battles (Adventures in the Wild)

Boss Battles (Adventures in the Wild) turn revision lessons or quizzes into interactive challenges where learners work together to defeat a mythical creature by answering questions correctly. This can be used as a class activity either in teams or individually. For example, a quick formative assessment or revision exercise after a module has been completed.

- Volume Meter (The Makus Valley)

This tool can be used to measure the classroom's volume and encourage learners to self-regulate their volume when working on important tasks. For example, when the classroom noise-level goes over a certain level, the learners lose HP points. Ironically the teacher just needs to remember not to be the cause of loss of HP when speaking to the class. Luckily the teacher can easily add XP/HP as random rewards if something happens which they did not anticipate when setting up the game in the beginning.

- Timer (The White Mountains) Premium feature

The timers are especially useful when assisting learners to pace classwork, tests/quizzes, or other class events. Pacing is a very important skill needed for CAT learners as working too slow can lead to running out of time in tests, and working too fast could lead the learners to not effectively answer the questions in full.

- Stopwatch (The Forest Run) Premium feature

The stopwatch and the timer have similar objectives, but the stopwatch could be used during game activities, requiring learners to complete the task as soon as possible.

- Grade Converter (Treasures of Tavuros) Premium feature

The grade converter (Treasures of Tavuros) integrates very well with Google Classroom which is a bonus for teachers and schools already using Google Classroom. Teachers can allocate XP according to the grades obtained by the learners.

The abovementioned Classcraft tools are add-ons to help the teacher manage the classroom effectively and to achieve the set goal for the lesson. To make Classcraft have the expected results when teaching CAT theory content, the teacher needs to reward participation as often as possible, by giving learners XP during the session by asking questions to encourage class participation. The teacher should also address class disruptions by deducting HP and encourage latecomers to come to class sooner by consistently deducting HP for them. All of these rewards and punishments can be set up by the teachers, by changing the rules according to the behavioural changes that they want to see in their own classrooms.

3.4.5 Rules

The rules are used to promote motivation and engagement in the classroom. However, it doubles as a way to promote the correct behaviour in the classroom. These will mostly be done by adjusting the rules in how and how much HP the learners will lose when they behave in a certain way. Some of the examples are (Anon, 2015):

- Disturbing the class: -5HP
- Arriving late to class: -10HP
- Being negative or slacking off in class: -15HP
- Incomplete homework: -20HP
- Using cell phone without permission during class: -50HP

- Eating or drinking in class: -30HP
- Being disrespectful to a classmate: -30HP
- Using curse words: -30HP
- Arriving late to class (unexcused): -10HP
- Dress code violation: -10HP
- Disturbing the class: -10HP

Rules can also be used to encourage certain behaviours by awarding more XP to the learners for certain tasks. Some examples are (Anon, 2015):

- Correctly answering a question in class: +60XP
- Helping another learner with his/her classwork: +75XP
- Being positive and hard-working in class: +100XP
- Finding a content (non-grammar) mistake in the class notes: +50XP
- Seeking help on assignments from classmates: +40XP
- Helping another learner with his/her classwork (not just giving answers): +75XP

All of these elements have been implemented by Classcraft to achieve its mission to motivate learners to realize their greatest potential via engaging, cooperating, and long-lasting learning opportunities that foster development and interpersonal relationships. (Classcraft Studios Inc, n.d.).

3.4.6 Supporting software

Classcraft was applied weekly or for every class that focused on theoretical content. The other three supporting software applications that were used in the study are Kahoot, Socrative and Flashcards by cram.com which were only used on certain occasions. The results from these three supporting software were used to award XP points to the learners on Classcraft.

3.4.6.1 Kahoot!

Kahoot is a free learner-response tool for administering quizzes, facilitating discussions, and collecting survey data for the teacher. With Kahoot the teacher projects the questions on a shared screen such as a projector in the classroom, while the learners answer the questions with their smartphone, tablet or computer. Kahoot allows for the design of multiple-choice quizzes as well as polls and surveys that populate on-the-spot, showing the data in real time

on the projector. Kahoot allows for questions and polls to stimulate quick instructional decisions as well as whole-class discussion (University of Massachusetts Amherst, n.d.). Learners preferred to use instructional quizzes like Kahoot and Quizizz in the classroom due to the learners' strong need for immediate feedback (Göksün & Gürsoy, 2019).

3.4.6.2 **Socrative**

Socrative is a cloud-based learner-response system developed in 2010 by a Boston-based graduate school learner. Socrative allows the teacher to create simple quizzes that learners can take quickly on laptops, tablets, personal computers or smartphones. These quizzes can be true/false, multiple choice, graded short answer, or open-ended short responses. These quizzes can be teacher-paced (for use during a classroom discussion) or learner-paced (for a quiz or exit-ticket). They have also introduced a space race feature where learners, individually or in teams can compete against one another to launch rockets into space. Results can immediately be displayed with names or anonymously to facilitate discussion.

These results can also be changed into XP in Classcraft or let the learners keep on repeating the activity until the learners achieve a certain percentage goal to receive XP points in Classcraft.

3.4.6.3 **Flashcards by cram.com**

Cram.com can help learners to memorise all the difficult-to-remember content with online flashcards. What makes cram.com very useful is that the teacher or learners can even make their own set of flashcards with the web-based flashcard maker on the website. Flashcards can be exported and shared to any device.

These flashcards can be used in an individual or group activity. In the intervention, these were used in group activities. Teams faced each other in a round-robin (every team played every team) activity. Learners had to look at the picture/name and then define the word, while taking alternating turns to answer. The other team checked the definition and awarded a point if it was correct. After a certain time, the teacher stopped the activity, and learners had to hand in the cards and move to another team. Teams then received new cards and repeated the process.

In the next section, a typical lesson plan incorporating Classcraft will be discussed.

3.4.7 Classcraft Lesson plan

The Classcraft lesson plan is summarised in Table 3-4 and displays a common lesson plan with gamification for GenZ-L. These activities are all chosen with GenZ-L's preferences and to promote SDL. Each stage of the lesson plan will be discussed briefly.

3.4.7.1 Preparation/prior knowledge

The preparation and prior knowledge phase are important to ensure the success of the lesson. The preparation of the gamification lesson is important, because failure to plan gamification lessons will lead to failed lessons.

The learners can ensure they have a basic understanding of computer hardware and networking concepts by preparing for the lesson. Part of using Gamification and supporting software are for the teacher to use as a prior knowledge test or after the module has been completed. This will start learners to become SDL learners as they need to prepare for the lessons beforehand. Teachers can use previous lessons and some content from the days lesson to embed preparation activities. The Classcraft activity must also be prepared.

3.4.7.2 Introduction

As introduction, the teacher activates the random event wheel. This helps with engaging the learners in the game from the start of the lesson. The outcome of the event needs to play out before learner's prior knowledge can be activated.

The teacher can introduce the topic after providing the learners with their XP, but introducing the topic completely should not be necessary if the learners did the extra XP activity. The extra activity experience should be added after the random event for all the learners who completed the task online.

3.4.7.3 Content

During the content phase, the teacher must facilitate the content. The teacher can encourage active participation and engagement in discussions through asking questions with the wheel of destiny. This allows for constant feedback and encourages classroom engagement.

When learners do not know the correct answer or do not understand the content, the teacher can allow for a quick group discussion of the content between teams before assessing the learners' answers.

3.4.7.4 Closure

With this intervention, the closure and informative testing of the learners' progress will be done by using a Classcraft quiz as an exit activity. After the learners completed the exit activity, the teacher can award more XP to learners based on their results.

The learners will then be introduced to another activity which can be seen as homework. What makes these activities different is the fact that they are not compulsory. This provides an opportunity to foster SDL, as individuals can complete this for the next theory session for extra XP. Subsequently, when learners prepare for the lesson, they end up receiving more XP.

Table 3-4: Gr 11 Classcraft lesson plan

Grade:	11	Time:	Week 3
Duration:	45 minutes	Lesson Theme:	Network Technologies
Materials and Resources:			
- Module 2.1 PowerPoint (Study Opportunity textbook) - Classcraft			
Preparation:			
- Ensure learners have a basic understanding of computer hardware and networking concepts as prior knowledge. - Prepare visual aids such as PowerPoint slides to illustrate and provide network components. - Classcraft setup prior to the lesson, ongoing from previous lessons.			
Learning Objectives:			
By the end of this lesson, learners will be able to: - Identify and differentiate between various types of networks, including PANs, HANs, LANs, Internet, and Intranet. - Evaluate the benefits and drawbacks of LANs in terms of file accessibility, resource sharing, security, and maintenance. - Demonstrate understanding of LAN concepts, network security principles, and ethical considerations through written responses.			
Prior Knowledge			
- As this was not the first encounter for learners with Classcraft, they know how the Classcraft website works. The teacher runs the software while the learners answer the questions. They will also use powers throughout the lesson by communicating with the teacher. - Self-directed learners would have prepared Module 2.1 before the lesson for prior knowledge, as they know they will be asked questions and answering correctly rewards XP towards them.			
Introduction:			
To start the lesson, the teacher activates the random event wheel. The events outcome needs to play out before the teacher can begin to activate the learner's prior knowledge by explaining a LAN in context of the school.			

Teacher	Learner
- Engage learners with a random event from Classcraft. - Introduce the network topics by highlighting the importance of LANs in modern computing environments for example the school environment.	- Participates in the random event - Listen attentively to the scenario and think about how LANs could impact their own experiences with technology.
Content:	
- Game - Classcraft will be used to encourage engagement, motivation and collaboration. The teacher can use it to call on random learners to explain concepts or summarise concepts. - Discussion - The teacher can allocate sections in the lesson for some informal conversation on networks, where the teacher facilitates the learners in group discussions. - Feedback - Constant feedback to and from the learners and the teacher will take place with the use of Classcraft and classroom discussions.	
Teacher	Learner
- Teaching and explaining content - Provide clear explanations of the content and concepts. - Use examples and visual aids to facilitate understanding. - Facilitating discussions - Encourage active participation and engagement in discussions. - Prompt critical thinking by asking relevant questions. - Guiding reflection - Prompt learners to reflect on their understanding of the content. - Provide feedback and guidance to support learning.	- Active engagement - Actively participate in classroom activities and discussions. - Learners can ask and answer questions. - Summarising - Take notes and summarise content during discussions. - Critical Thinking - Analyse information presented by the teacher and answers questions. - Evaluate concepts and ideas to deepen understanding. - Self-assessment: - Reflect on personal understanding and areas of strength and weakness of the content. - Identify strategies for improvement and self-directed learning.
Assessment:	
- Assessment can be done throughout the lesson by using Classcraft. Asking questions as revision and activate prior knowledge. - Informal assessment will be done as an exit activity on Socrative. The activity can be kept opened for learners to complete the activity for the next class.	

Closure:	
• Class discussion • The teacher consolidates and summarises the content. • Quiz • A quiz will be given for learners to complete as an exit activity. Learners will log into Socrative and begin the quiz. The quiz will consist of multiple-choice and true and false questions.	
Teacher	Learner
• Recap key points covered in the lesson, summarising important concepts.	• Reflect on the lesson content and consolidate understanding by summarising key points in their own words.
Homework/Assignments:	
• Assignment • Socrative: The informal quiz about the content given to the learners to complete • Homework • Socrative: Learners complete the activity provided by the teacher as individuals for the next theory session for extra XP.	

3.5 Conclusion

In this chapter SDL models and the gamification intervention to promote SDL were discussed.

A summary of the proposed intervention described above for a Grade 11 CAT theoretical content lesson with the theme of Network Technologies, is given as a Classcraft lesson plan in Table 3-4.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

In Chapter 3, I researched the importance of matching teaching methods with SDL principles to successfully incorporate learner-centred approaches like gamification in education. The introduction of gamification as an intervention for teaching and learning was dealt with.

This chapter will focus on the research design and methodology that was followed for the empirical research. A qualitative research approach from an interpretive paradigm was used to investigate the significance of the participants' experiences.

The chapter begins by outlining the research approach. Data collection methods are explained, including the pre- and post-open-ended questionnaires and focus group interviews, and reflective journal. Ethical considerations were carefully addressed, emphasising informed consent, voluntary participation, confidentiality, and protection of participants' rights. The role of the researcher is highlighted, by acknowledging the multifaceted responsibilities that the researcher has while doing data collection, analysis, and reporting.

The aim of this dissertation was to determine how gamification can be used to facilitate CAT theoretical content in order to enhance GenZ-L' SDL. This chapter, will focus on the research design that was applied to answer sub-aims five and six:

- (5) To do an empirical investigation to determine the experiences of GenZ-L toward the teaching and learning of CAT theoretical content; and
- (6) To do an empirical investigation to indicate to what extent does the use of gamification in the teaching and learning of CAT theoretical content contribute to the enhancement of SDL.

4.2 Research approach

Due to the fact that I wanted to determine the lived experiences of GenZ-L towards the teaching of CAT theoretical content and whether the use of gamification in this teaching-learning experience could enhance their SDL, I opted to use a qualitative approach. According to Creswell (2009) a qualitative approach is used for "exploring and understanding the meaning of individuals or groups ascribed to a social or human" problem. This approach was thus suitable for determining the lived experiences of learners towards the teaching and

learning of CAT theoretical content and whether these experiences in the gamification intervention had an impact on their SDL.

4.3 Research paradigm

A paradigm was defined as, the reference frame and beliefs that a person used to explain their perceptions of the world and the place that a person had in the world (Houghton, Hunter, & Meskell, 2011). Four paradigms will briefly be discussed.

The positivist paradigm related to a philosophical approach to knowledge and entailed working with an observable social reality to produce law-like generalisations, uninfluenced by human interpretation or bias by often using hypothesis testing, quantitative data collection, and statistical analysis to validate theories and establish causal relationships (Saunders, Lewis, & Thornhill, 2009).

Fouché and Schurink (2011) believed that an interpretive paradigm was concerned with deeper understanding and explanations of the social process as it unfolded over time and was not concerned with searching for specific answers. Interpretive studies considered the complexity of the participants by collecting what was meaningful for the study (Saunders et al., 2009).

Postmodernism emphasises the role of language and the power of relations such as the interpretation that some realities are more dominated therefore silencing others. Generally, postmodernism question the accepted ways of thinking by providing a voice to alternative narrative (Saunders et al., 2009).

Pragmatism focuses on making a difference by focussing on the practical effects of ideas, and knowledge. It is argued that the meaning and truth of concepts are determined by their practical effects and outcomes. Pragmatism selects relevant methods and theories to address the research questions rather than being bound to a specific discipline. This allowed for flexible research and using a range of methodologies (Saunders et al., 2009).

This research study focussed on a qualitative research approach. An interpretative paradigm was therefore used for finding and interpreting participants' experiences regarding the teaching and learning of CAT theoretical content.

4.4 Research design

A research design serves as a strategic process, or roadmap, which researchers use as guidelines to do their research (de Vaus, 2001). Figure 4-1 portrays a summary of the research

design. Figure 4.1 differs from the planned research design as depicted in Figure 1.1. Although pre-intervention focus group interviews and post-intervention focus group interviews were initially planned for this study, only post-intervention focus group interviews were conducted. Due to the continuous COVID-19 lock-down procedures, there was limited time to conduct the empirical research.

Figure 4-1: Research design

Basic interpretive qualitative study				
Literature review	Intervention	Term 2	Term 3	Analyse results
Chapter 2	Chapter 3	Use traditional teaching and learning methods for teaching and learning of CAT theoretical content for grade 10 and 11	Use Gamification as intervention to facilitate teaching and learning of CAT theoretical content for grade 10 and 11	
		Reflective journal by teacher		
		Pre-open-ended questions	Post-open-ended questions	
			Focus group interviews	

The research design can be described as a basic interpretive, qualitative study (Merriam, 2002). A basic interpretive qualitative study was used when the researcher seeks to understand how participants made meaning of a phenomenon, process, perspectives, world views or a combination of these (Merriam, 2002). For this study, I wanted to determine the lived experiences of GenZ-L towards the teaching of CAT theoretical content and the extent to which incorporating gamification enhanced their SDL.

Hart (2001) defines the literature research as a selection of available documents for the researchers that contain information, ideas, data or evidence that fulfilled certain aims to effectively evaluate the documents in relation to the research proposed by the researcher. For the literature review the researcher, searched for information on Google Scholar, EBSCOhost, ERIC, as well as the World Wide Web. The keywords mostly used to search on these databases were “gamification”, “theoretical content”, “Generation Z”, “self-directed learning” and “Computer Applications Technology”.

For Term 2 the researcher did not conduct any intervention. Direct teaching was conducted in the classroom for this term. The direct teaching strategy is a teacher-centred strategy, where the teacher directs the classroom and the material used in the class (Kora, 2019). At the end of Term 2 willing participants answered a pre-open-ended questionnaire to get more

information from the learners regarding their lived experiences toward the teaching and learning of CAT theoretical content in the classroom.

Throughout Term 2 as well as Term 3 the researcher kept a reflective journal reflecting on the teacher's perception of how the learners reacted towards the theoretical content. In Term 3 the researcher conducted the gamification intervention in the classroom where learners were introduced to using different gaming elements in the classroom. At the end of Term 3, willing participants answered the post-open-ended questionnaire. This was followed by the focus group interviews.

4.4.1 Population, sample and sampling strategy

The population for the study was Grade 8 to Grade 12 learners from a dual-medium secondary school located in the Western Cape province in South Africa, which offered the subject CAT as an elective. At the time of the research, around 1300 learners from grades 8-12 were enrolled in the school. A dual-medium secondary school means the school provides education through two languages of learning and teaching, and learners received their education in both languages. The population was represented by male learners from various ethnic- and cultural groups with different home languages.

Purposive and convenient sampling were used for selecting the individuals who participated in the study. A sample referred to the population or individuals who were selected to participate in the study (Fraenkel, Wallen, & Hyun, 2011).

Purposive sampling refers to intentionally selecting participants based on their characteristics, knowledge, experiences, or some sort of relevant criteria (Acharya, Prakash, Saxena, & Nigam, 2013). Purposive sampling was applied, because only Grade 10 or Grade 11 learners who had CAT as an elective subject were invited to participate in the study. This sample represented GenZ-L who have CAT as an elective subject in Grade 10 or Grade 11. Any other learner who did not have CAT as an elective subject would have skewed the results.

Convenience sampling involved recruiting individuals primarily because they were available, willing, or easy to access or contact on a practical level (Acharya, Prakash, Saxena, & Nigam, 2013). Convenience sampling was used for this study as the participants were easy to access as they were already in the school, with CAT as an elective subject.

Non-random sampling was also applied, because all the learners who adhered to the criteria, were invited to participate in the research. Out of the possible 1300 learners attending the school, 201 learners were invited to participate in the study as they had CAT as an elective

subject and were in Grade 10 or Grade 11. From the 201 learners only 106 assented to participate in the study. From the 106 only 104 completed the pre-intervention open-ended questionnaire. From the 104 participants, only 56 completed the post-intervention open-ended questionnaire. Only 48 participants were willing to participate in the semi-structured focus group interviews.

Limited time was available to conduct the semi-structured focus group interviews as many of the participants were preparing for exams and were working on their practical assessment task (PAT) project (counting 25% towards the year mark). Moreover, COVID-19 regulations were hampering the progress at the time the participants were asked to complete the forms.

4.5 Data collection

The data collection phase consisted of setting boundaries for the study, collecting information and establishing the protocol for data collection (Creswell, 2009). Cohen, Manion & Morrison (2007) identified seven main data collection instruments. These seven instruments included: questionnaires, interviews, accounts, observation, tests, personal construction and role playing. In this research open-ended questionnaires and focus group interviews were used as data collection instruments to gather rich data and to improve the trustworthiness of the results (Creswell, 2009).

4.5.1 Open-ended questionnaires

Online Google Forms were used to administer the pre- and post-open-ended questionnaires (see Annexure G). Online questionnaires were used because COVID-19 restrictions were still in place and not all learners were always at school. Online questionnaires also had the advantage of receiving data electronically ready to be analysed.

Two different types of questionnaires can be used for data collection, namely closed-ended and open-ended questionnaires (Colosi, 2006). In closed-ended questionnaires participants can choose an answer from the different answers provided (Colosi, 2006). Closed-ended questionnaires are normally used with quantitative research as the answers can be statistically analysed (Cohen, Manion, & Morrison, 2007).

Open-ended questionnaires, also referred to as narratives, are the most commonly used method for collecting information from participants when evaluating educational and extension programmes (Colosi, 2006).

With open-ended questionnaires, the participants are expected to answer in their own words and can answer the question with a range of possible answers that are not suggested in the question (Brace, 2004). Subsequently, participants can provide responses that the researcher did not anticipate.

In this study, the open-ended questionnaire contained ten open-ended questions and took about 30 minutes to complete. The learners answered the questions in a convenient time, outside of official teaching time. The questions were in Afrikaans and English to assist with possible language barriers. The same questions were used for the pre- and post-open-ended questionnaires.

After the participants' responses were analysed, interviews were conducted to obtain deeper insight on results from the open-ended questionnaires. Focus group interviews were then conducted to collect rich data and to obtain deeper insight into results from the open-ended questionnaires.

4.5.2 Focus group interviews

Interviewing can be defined as the asking of relevant questions to find out how participants "think or feel" about something (Fraenkel, Wallen, & Hyun, 2011, p. 451). Interviews can be conducted face-to-face, telephonically, or with a small focus group of six to eight learners (Creswell, 2009). According to Fraenkel *et al.* (2011), there are four different types of interviews: structured, semi-structured, informal and retrospective.

Structured and semi-structured interviews are used to ask a set of questions that is designed to get answers about a specific topic, usually used for comparison at a later stage (Fraenkel *et al.*, 2011). The biggest difference between these two types of interviews is that in semi-structured interviews the researcher can ask follow-up questions, whereas the structured interview only allows a set of predetermined questions. A semi-structured interview enables the researcher to gather more detailed information by adding sub-questions to the existing questions (Powell & Singel, 1996). Interview questions will be prepared to sufficiently comprise open-ended questions that will assist the interviewer to successfully ask questions to obtain answers that can be explored and will lead to further probing of their lived experiences content (Cohen, Manion, & Morrison, 2007) towards learning of theoretical content.

Informal interviews are much less structured and usually resemble a casual conversation with the main purpose of sharing ideas about a topic to compare participants' views with each other at a later stage (Fraenkel, Wallen, & Hyun, 2011). Retrospective interviews are used to ask

participants to recall and describe previous events that have taken place, and can take the form of a structured, semi-structured or informal interview (Fraenkel, Wallen, & Hyun, 2011).

Interviews can be done individually or in focus groups. Individual interviews are best suitable for studies where an in-depth knowledge of one's personal life is important, when the topic is concerning, or when the respondents are difficult to recruit. Focus group interviews normally best suit studies with a range of attitudes, opinions and behaviours that are explored, and where issues of public interest or common concern are researched (Gaskell, 2000). Focus groups typically consist of only four to six participants in a group (Creswell, 2009).

For this study, I used semi-structured focus group interviews. Semi-structured interviews were suitable when the researcher already had some grasp of what was happening within the sample. Because the researcher already had analysed the pre- and post-open-ended questionnaires, the researcher had relation to the research question (Crimson & Leontowitsch, 2016).

The interviews were conducted in small groups of six to eight participants as school learners can feel uncomfortable in one-on-one interviews (Cohen, Manion, & Morrison, 2007). Participants were grouped by similar grades and had all been exposed to gamification to facilitate CAT theoretical content.

The focus group interviews were scheduled for 20 minutes. There were five interview questions discussed in the focus group interviews.

Annexure F specified the questions used for the semi-structured focus group interview (Annexure J) and how relevant the ten questions were in terms of gamification, Gen Z-L, and SDL.

4.5.3 Reflective journal

A reflective journal is often used in qualitative research to record personal opinions and assumptions from the researchers' beliefs regarding the participant's experiences of the intervention (Michelle, 2008).

The purpose of the reflective journal was to document observations about learners' involvement in the classroom activities, homework completion, collaboration with other learners, and preparation for classroom activities. Moreover, the intention was to also record the reflections of the teacher of the intervention itself and possible adjustments that could be recommended. The overall purpose for the use of a reflective journal in this study was to add rich data to determine if and how the intervention contributed to the enhancement of SDL.

4.6 Data analysis

Grosser *et al.* (2018) describe the following process of data analysis for qualitative research. When working with data the first step was to familiarise yourself with your data. When working and looking at the open-ended questionnaires the researcher in this step read through the data, while making notes of anything they deemed important at this stage. For this step, the researcher downloaded the online pre- and post-open-ended questionnaires in the form of Google Forms to Microsoft Excel. All the Afrikaans and English answers for each question were combined under the relevant questions. Recordings of the focus group interviews were transcribed verbatim by the researcher in Microsoft Word. While working through the documents the researcher initially identified and wrote down codes and themes that emerged.

After becoming acquainted with the data and creating an initial list of ideas about the data and what was found to be interesting, the researcher started to generate initial codes for both documents. This was carried out by working systematically through the entire data set to identify key aspects across the answers provided by the learners.

The researcher opted to code the data manually by writing notes on the texts in Microsoft Excel. With the interviews, the researcher highlighted and commented on codes by using Microsoft Word. Extracts and codes from both data sources (open-ended questionnaires and focus group interviews) were then copied into a table to visually see the full picture.

By searching for themes, the researcher started to analyse codes, and considered how the different codes may combine. Sorting the different codes into potential themes, and ordering all the relevant coded data and extracts within the identified themes were then done.

The researcher then refined the themes by working through them to consider whether there were codes that did not fit in the current themes. The themes that were not applicable to the research questions or codes that did not fit into existing themes were reworked or moved to another theme that was more suitable for the codes.

In this study, the results of pre- and post-open-ended questionnaires, focus group interviews and a reflective journal, were compared and combined with results of the literature review to answer the research questions.

4.7 Trustworthiness

The trustworthiness and consistency of the data were tested using Given and Saumura's (2008) opinion of trustworthiness in qualitative research. According to them trustworthiness

emanates through credibility, dependability, transferability and confirmability. To ensure trustworthiness and objectivity of the information gathered in this study from the participants, results were verified by the study leaders. This provided triangulation as well as validity of the findings (Creswell & Poth, 2017). To ensure trustworthiness, the researcher interpreted the data under four criteria; credibility, transferability, dependability and confirmability.

4.7.1 Credibility

Credibility to some degree, relies on the credibility of the researchers themselves. It refers to the researcher's internal validity on how confident the qualitative researcher (Applied Doctoral Center, 2024) is in the truth of the research study. Credibility can, however, also be achieved with data triangulation, investigator triangulation, theoretical triangulation and/or environmental triangulation (Stahl & King, 2020).

4.7.2 Triangulation

- Data triangulation

Data triangulation was performed when the researcher used more than a single type of data to establish findings (Stahl & King, 2020). For this study the researcher used data found from theoretical research, pre- and post-open-ended questionnaires and the focus group interviews to establish data triangulation.

- Investigator triangulation

Investigator triangulation is when two or more researchers work together on the same study (Stahl & King, 2020). This allowed for researchers to provide multiple observations. Using investigator triangulation can lead to better conformation of findings. In this study investigator triangulation was not used. However, the study was carried out under the supervision of study leaders adding a layer of investigator triangulation to some extent.

- Theoretical triangulation

Theoretical triangulation implies the use of multiple theoretical orientations to understand and analyse findings or to direct the research (Stahl & King, 2020). For this study the researcher did not use theoretical triangulation.

- Environmental triangulation

Environmental triangulation is about using more than one situation or context to study the intended focus (Stahl & King, 2020). For this study, environmental triangulation was not used. This could very likely be seen as a recommendation for further study as this study did not include more than one school or more than one gender.

4.7.3 Transferability

Transferability indicates if the study can be replicated to a similar context of other schools for example as was done in this study (Stahl & King, 2020). As this study was done with GenZ-L in grades 10 and 11 that had CAT as a subject, the population for the study could easily be replicated. The intervention used in the study made use of free online software that had a small learning curve with very detailed videos and tutorials to assist the educator. Thus, this study lends itself to be transferrable to a similar school context in South Africa.

4.7.4 Dependability

Dependability is used to measure and track the precise methods used for data collection to improve reliability of your study's results (Stahl & King, 2020). This was where the researcher should have explain the data collection methods to such an extent that it should have been easy for other researchers to replicate the study. For this study the data collection methods (see 4.5 data collection) for pre- and post-open-ended questionnaires, focus group interviews and the reflective journal were explained.

4.7.5 Confirmability

In qualitative research comfortability aims to demonstrate the impartiality of the researcher from any form of potential researchers' bias or personal assumptions (Stahl & King, 2020). This involved maintaining neutrality when reporting of finding by ensuring that the findings stemmed solely from research and participants' responses. Strategies like clear coding, member checking and triangulation all contribute to confirmability. For this study the data were coded by the researcher, documents throughout the coding proses were checked by study

supervisors to ensure member checking. The coding of the documents could all be seen in the addendum (see Annexure H, Annexure I, and Annexure K) to ensure clear coding. Triangulation was used to answer questions throughout the study.

4.8 Ethical aspects of research

Tustin (2006, p. 14) defines ethics as “what is deemed to be acceptable or unacceptable” in human conduct. For qualitative research, ethical aspects become a key aspect as the researcher becomes one of the main instruments for collecting data (Schulze, 2002), and the researcher must be wary of not letting his personal beliefs and philosophical orientation overflow to the participants (Merriam, 2001). The researcher ensured that the research was conducted fairly and ethically where possible (Denscombe, 2010). This included, the following ethical considerations.

Ethical considerations are concerns, dilemmas and conflicts of the way the research is conducted by the researcher (Kumar, 2014). De Vos et al. (2011) have identified the following ethical considerations: harm to respondents, voluntary participation, informed consent, deception of the respondents, violation of privacy/anonymity/confidentiality, denial of treatment, compensation, debriefing of co-researchers, actions and competence of researchers, cooperation with contributors and sponsors, and release or publication of the findings. Grosser *et al.* (2013) identified the following ethical considerations: informed consent, anonymity and confidentiality, invading participants' privacy, use of volunteers, honesty, fair treatment, permission from participants and schools, no risk to the participants, and debriefing.

The study population in this study was classified as vulnerable because of their age (between 15 and 18). The researcher was also in a power relationship with the learners, as he was also the CAT teacher. To mitigate the power relationship, influencing decision-making for the participants, data was collected by an independent third party. The researcher also conducted the focus group interviews under the supervision of the independent third party. Furthermore, all appropriate permissions were obtained to conduct this research. The researcher received permission from the North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics committee (NWU-EMELTEN-REC) for formal clearance and approval. This happened after the acceptance of the proposal by the Scientific Committee. After gaining ethical clearance, permission was sought from the DBE to conduct the research in their province. These approvals from the department were done by an independent official from the Western Cape education department. After permission was gained by the two parties mentioned above, permission was sought from the principal at the school, the school governing body, and from the participants'

parents/guardians and learners themselves. Informed consent was gathered from the parents/guardians of the learners as they were younger than 18 years old and assent had to be obtained from the learners (Grosser, Oosthuizen, Simmonds, & van der Vyver, 2018).

The study was explained to the participants by the independent recruiter. After explaining the study, the consent forms were handed out and explained by the independent recruiter.

Participation in the study was voluntary and all participants were informed of their right to withdraw at any time. Learners, who did not take part in the research, were not disadvantaged in any way. The gamification intervention was done in the class for all learners, as it formed part of the teaching strategy to facilitate theoretical content for Term 3. Only data from participants who gave assent and whose parents/guardians signed the consent forms, were used. There was no compensation for the participants of this study. The identities of the participants and that of the school have been kept confidential and anonymous throughout the reporting of the findings. Alias participant codes were used.

Qualitative research required the researcher to fulfil multiple roles, such as the role of making sense, the role as designer of necessary data collection techniques, fulfilling the role of a research instrument and author, as the researcher could be writing the report after the collection of the data (Fouché & Delport, 2005; Nieuwenhuis, 2007). A good qualitative researcher asks probing questions, then listens to the response, thinks about what the participant said and then asks more probing questions to benefit the study (Simon, 2011).

In this study, the researcher collected the data, analysed the data and was also responsible for writing the report. The researcher conducted the semi-structured focus group interviews and managed the online open-ended questionnaires. The researcher aimed to stay true to the ethical aspects and trustworthiness mentioned in this study.

4.9 Conclusion

In this chapter, the research design and methodology of the study were discussed. The research followed a qualitative approach and an interpretive paradigm and applied a basic interpretative qualitative research design. Data were collected from pre-and post-open-ended questionnaires, semi-structured focus group interviews, and a reflective journal. Lastly, reliability, validity and ethical issues were discussed.

CHAPTER 5: DISCUSSION OF RESULTS

5.1 Introduction

In this chapter, the results of the data analysis for the pre- and post-open-ended questionnaires, and focus group interviews will be discussed. No notable entries were made in the reflective journal, and therefore the reflective journal will not be included in results as planned (see Figure 1-1). This chapter will lay the foundation for answering research question 5 (What are the experiences of GenZ-L toward the teaching and learning of CAT theoretical content?) and research question 6 (To what extent does the use of gamification in the teaching and learning of CAT theoretical content contribute to the enhancement of SDL?).

5.2 Results of pre-open-ended questionnaires

The purpose of the pre-open-ended questionnaire was to determine the experiences of GenZ-L regarding the teaching and learning of CAT theoretical content when following a traditional teacher-centred approach.

The questionnaire was completed by 104 participants. A raw summary of the codes, themes and categories and codes that emerged from the pre-intervention questionnaire is given in Annexure H. The themes that emerged from the data were grouped in the following categories: enjoyability and value, challenges experienced with CAT theoretical content and SDL characteristics. In the paragraphs to follow these categories will be discussed with the relevant quotes to support the discussion.

5.2.1 Enjoyability and value

Overall, participants reported a positive and enjoyable experience of CAT theoretical content. However, several challenges and negative aspects were also reported. Reports of neutral or mixed emotions were also noticed. The enjoyability and value theme mainly emerged from answers to questions 1,3,4, and 11 in the pre-open-ended questionnaire (see Annexure G).

5.2.1.1 Positive experiences

Many participants stated that they enjoy CAT theoretical content. Participant 1QN034 in question 1 described CAT theory with the following three adjectives: “*Interesting, fun, enjoyable*” while Participant 1QN082 used: “*Fun, informative, enjoyable.*”

Participants indicated that they were interested in CAT and have a positive outlook towards CAT theory content as an elective subject. Participant QN037 in question 4 stated: *"I have a lot of interest towards the subject that is why I chose it."* and Participant QN019 claimed: *"I am very interested in CAT. It is enjoyable for me to learn new skills on the computer."* Although not all participants shared the same sentiment about the subject, some participants indicated the importance of theory in question one. Participant QN033 said: *"It's enjoyable, very useful, it's important."* QN062 remarked: *"Fun, Easy, Important, Helpful"* and QN027 wrote: *"Fun, interesting, important."* Important however does not always mean that learners will find the subject interesting, as in the case of Participant 4QN081 who indicated clearly that not all of the theoretical content is interesting: *"In terms of interest, most of the theory I'm not that interested in, mostly I'm only interested in theory that contains content related to "normal" computers and network, the rest of it is quite boring."*

According to Participant 11QN027 the method of instruction plays an important role in making CAT theory interesting and enjoyable: *"Yes. A lesson can be presented in an interesting way, making it more enjoyable for me to be a part of it."* Participant QN021 had mixed opinions on the difficulty level of CAT theory, but acknowledged that he acquired a substantial amount of knowledge: *"The difficulty level of CAT theory is not too high or too low. I have learned a lot about computers in the short time I have had CAT as a subject."*

5.2.1.2 Mixed perceptions

The second category represented participants with mixed perceptions towards CAT theoretical content. Although Participant 1QN044 reported that CAT theoretical content is interesting and lessons are sometimes boring he also enjoyed the current way CAT theory is taught: *"Interesting, cool, boring: CAT theory is not bad to learn compared to other subjects because it is easy to learn and remember. But sometimes the lessons can get boring I still like the way it is taught."* Participant QN104 described CAT theoretical content as: *"long, tiring, interesting."*

5.2.1.3 Negative perceptions of CAT theoretical content

Negative perceptions involved boredom, not developing critical thinking and problem solving. Participant 1QN062 believed that the theory content is not recent, therefore it does not promote critical thinking and problem-solving skills: *"Not quite it's not up to modern standards."* While Participant 1QN099 thought the content does not develop problem-solving skills: *"It provides a better understanding on how the world works but does not necessarily develop problem solving skills."*

A significant number of participants highlighted challenges and negative aspects towards CAT theory content. Participant 13QN083 wrote: *"Procrastination."* or just clearly expressed plain disinterest in the content.

The most prominent answer among participants was "boring", as in the case of Participant QN053 who claimed: *"Exhausting, long, boring."* Participant 13QN009 agreed: *"The work is boring and I do not have a lot of interest in it."* Participant QN054 said: *"Boring, waste of time, long."* and QN010 commented: *"Boring, minimal interaction, a lot."* Participant QN026 experienced the amount of work as a challenge in question three: *"The theory is not really difficult; it's just a lot."* Some participants indicated reasons why CAT theoretical content could possibly be viewed as boring, for example Participant 13QN015 indicated it can be uninteresting at times: *"The amount of work and how uninteresting it is at times."* This could lead to participants being less interested in theory for example Participant 13QN012 lost focus when the work was not captivating: *"When the work isn't captivating or interesting to me. It could possibly make me less interested or focussed."* Participant 9QN026 did not connect with the work: *"No, not really, I don't really connect with the work."* Participant 9QN070 believed theory lessons to be boring and should be taught in a fun or interesting way to keep the participants' attention: *"Not really but if the theory is taught in a fun or interesting way then I will pay better attention."*

Some participants mentioned redundancy. Specifically referring to the theory being duplicated over the grades, because some learners also take Information Technology (IT) as a subject, and some learners prefer doing practical work. Participant 2QN055 reported: *"It's redundant to me, since I take IT."* While other participants just want to do practical work *"Too much theory just wants to do the practical work."* (Participant 2QN074); *"I think CAT should be more practically based because I believe one will only use the practical knowledge and not the theory."* (Participant 2QN016); *"It is a lot of work seeing that the reason I take the subject is mainly for the practical knowledge."* (Participant 2QN054).

One of the contributing boring factors is because of the practical nature of the subject since some learners prefer to work on the computers more often. Participant QN016 claimed: *"I am more interested in the practical aspects"* and Participant QN043 confirmed that the practical component was interesting: *"The work is not very hard to study, just not as interesting as practical work."* When not paying attention in class one can also be left with a negative perception as in the case of Participant QN007 who said: *"Quite difficult if you don't pay attention."*

Apart from enjoyability and value, participants further reported challenges with CAT theoretical content.

5.2.2 Challenges experienced with CAT theoretical content

Challenges mainly emerged from questions 1, 2, 3, 4, 11 and 13 (see Annexure G). The most prominent challenges that emerged from the data were the volume of theoretical content, specifically the homework load and study workload, time constraints, difficulty of content and the teaching approach. Participant 2QN087 stated: *"CAT theory is not very interesting when discussing it in class."* Because most theory is based on the computer and participants work on computers it was not surprising that Participant 3QN088 felt his computer knowledge is an advantage: *"Not too hard if you have some knowledge about computers."*

Most of the participants experienced that the homework load for theoretical content was too much. Participant 2QN087 stated: *"We get flooded with a large amount of homework and study work for theory when only half of it is asked. As a result, I lose interest in studying for it and paying attention"* while Participant 2QN036 felt overwhelmed with the amount of content: *"The workload is too much."* However, not all of the participants experienced the content to be overwhelming. Many of the participants felt keeping up with the workload and content to be an effective strategy to counter the workload, as Participant 2QN047 commented: *"If you keep up with the work given each day it really does not become a lot of work to do. We are given time in class to complete the work and ask questions. By doing these little amounts of work each day it really helped me be prepared for the test series."* Participant 2QN100 said: *"It isn't that much work as long as you listen in class"* and Participant 2QN071 stated: *"The workload is not overwhelming. Most work can be completed in class before the end of the lesson."* As with of the questions some participants always managed a way to mention their preference of practical content over theoretical content, as expressed by Participant 4QN029: *"I think it's unnecessary work that I have to know, but the practical aspect is understandable."*

On the other hand, Participant 3QN034 felt that the work was easy, saying that they struggled to remember all the theory, possibly due to the amount of content: *"Not that hard but challenging to remember all theory."* High study workload was also a concern for most of the participants. Participant 2QN002 claimed: *"The amount of homework we get is entirely right and not too much, but we receive a lot of information to study for exams and tests."* Participant 2QN082 agreed: *"The amount of theory and detail that we have to learn is a considerably large and difficult amount."* Likewise, Participant 2QN036 said: *"The workload is too much, with so much information to keep in mind that is important. I know all the information will help, but tests should be broken down into multiple tests, each focusing on separate sections and groups of contents."*

5.2.3 Self-directed learning characteristics

SDL characteristics emerged from the data. Finding of own resources emerged as the strongest theme. Other characteristics were persistence, time management, problem solving, motivation and engagement.

5.2.3.1 Time management

Time management represented different patterns of behaviour and preferences regarding the timing of completing theory tasks. This included various levels of time management strategies. Some participants applied effective time management strategies, while others would do assignments if they had the time, and others did not do their assignments at all.

The following participants all indicated completing the tasks as soon as possible: Participant 6QN001 stated: *“As soon as possible.”* Likewise Participants 6QN030, 6QN083 and 6QN103 all claimed: *“As soon as possible.”*

Several participants all showed good time management skills. Participant 6QN087 completed homework or tasks a few days before the submission date: *“About 2-4 days before the submission date”*, while Participant 6QN029 referred to several days: *“Several days before the submission date.”* Participant 6QN066 claimed to work on tasks little by little: *“Slowly each day.”* Participant 6QN096 preferred to do the homework or task a week in advance: *“Before it is given by at least a week.”*

Other participants, however, lacked time management skills. Multiple participants indicated a preference for a flexible approach meaning they mainly did the tasks as it suited them, as in the case of Participant 6QN098: *“Whenever the time suits me.”* Participant 6QN007 stated: *“When I have time to do it.”* Participant 6QN021 did homework and tasks when he had time for doing it between studying and sport commitments: *“When I don’t have to study for tests or have sports commitments. (Over open weekends).”* In contrast to this, Participant 6QN063 left the tasks for the last minute: *“When I have to.”*

A few participants admitted to never completing the homework or task given to them as indicated by Participant 6QN041: *“Never.”* Some participants didn’t put in any effort to find answers to questions that they couldn’t answer. In question 8, Participant 8QN075 indicated just leaving questions blank or not filling in the questions when struggling with a task: *“Leave blank or fill in anything.”* For the same question (8) Participant 8QN032 indicated when not finding answers on the internet they just leave the questions blank until they see the teacher again: *“I visit the internet,*

and if I find nothing about the question, I will leave it blank and ask my teacher when I see him again.”

Never completing tasks could be a problem-solving issue as participants possibly left questions open due to not knowing the answers or not trying to solve the problem, not being motivated to complete tasks, or not having time to complete the task.

5.2.3.2 Problem solving

Various perspectives came to light regarding the effectiveness of problem solving in CAT theoretical continent. Participant QN081 felt that problem solving is mostly encouraged by scenario-based questions: *“Yes, mostly through scenarios that they give us to work with, then we have to figure out what's wrong from the information given and figure out how to solve it.”* Participant 11QN077 argued that scenarios are not the most effective way to promote problem solving: *“Yes and No. It does allow one to think of what the answers could be and if you struggle you can solve the problems by finding solutions. But it is not necessarily the most effective way to develop those things,”* while Participant 11QN099 was of the opinion that it helped him to think outside the box: *“It provides a better understand on how the world works but does not necessarily develop problem-solving skills.”*

5.2.3.3 Motivation

This section represents different factors that motivated individuals to complete their CAT theory tasks. This sections' answers emerged from question 7, 9, 10, 12 and 13. It seemed that most participants were motivated by extrinsic factors.

Extrinsic motivation includes external incentives like achieving good marks, avoiding punishments, or impressing parents and teachers. Some individuals were motivated by the prospect of leisure time activities or distractions like playing games or resting after completion of the tasks.

Participant 13QN001, like other participants, was motivated by the marks they achieved: *“To get better grades.”* While Participant 7QN052 used marks as a benchmark: *“My previous marks for the theory tests.”* Some participants felt they could easily boost their average term mark with CAT, like Participant 7QN047 claimed: *“The opportunity to get an amazing mark so easily and that it could boost my term mark by a lot.”* Participant 7QN035 reasoned that CAT could improve his average mark: *“CAT is an average booster.”*

Another prominent external motivational factor was trying to avoid negative consequences, like being afraid of punishment, falling behind or not meeting the due date. In the case of Participant 12QN014: *"So that I won't fail or get punished"*, Participant QN005 added: *"My parents scolding me"*, Participant 12QN014 continued: *"So that I won't fail or get punished"* and Participant 12QN055 stated: *"Not to get an intervention."* Intervention is similar to demerit points at most other schools. For Participant 12QN018 this was a compound answer: *"Punishment makes me do homework, I want to do well motivates me for exams."* Participants also mentioned the teacher as motivation. As Participant 12QN001 said: *"My teacher and the amount that I care about doing well and working for CAT."*

A few participants did not want to struggle. The idea of procrastinating also emerged. Participant 7QN083 said: *"I don't want to feel pressured to do my work at the last minute"* and Participant 7QN050 alleged: *"To do it the day I get it so I don't have to stress about it later on in the week."* Some participants just wanted to complete the task in order to enjoy free time, as Participant 7QN020 argued: *"When I'm done, I can rest and have a bit of downtime. I am so busy during the day; it helps to have a little downtime"* such as to play games., Participant 13QN011 declared: *"I am not someone who likes to work at home and would rather spend my time doing other stuff like playing games than doing school work"* and Participant 7QN095 agreed: *"To play Krunker"* which is an online game.

Some learners displayed intrinsic motivation and were driven by personal interest and enjoyment. Participant 12QN056 wanted to do well for himself: *"To do well for myself"*. Participant 12QN017 indicated aiming for good marks as self-motivation: *"I want good marks thus self-motivation"*. Accordingly, Participant 7QN007 was focused on self-motivation: *"I motivate myself."* Participant 7QN028 saw the success of solving the problem as motivation: *"It is enjoyable to achieve a goal after struggling with a question for hours or even days, and eventually getting it right on your own. It drives one to want to do more."*

It seemed that the length of the lesson could lead to a lack of motivation. Participant 9QN061 perceived lessons to be too long and too boring: *"No, 45 minute lessons are long and it gets boring after a while"*. Other participants indicated lack of attention span. Participant 9QN085, for example claimed to lose interest quickly: *"No, after 5-15 minutes I lose interests."*

5.2.3.4 Active engagement

The answers for this theme were derived from question 10 (se Annexure G). The active engagement theme represented different responses regarding the level of active involvement in the CAT theory class. The first category included participants who expressed active involvement,

indicating that they were consistently engaged and participated in the class. The second category represented participants who experienced variable involvement, meaning that their level of engagement and participation fluctuated depending on the content, and they were not consistently actively involved in every class session. The third theme consisted of participants who lacked involvement, suggesting that they were not actively engaged in the CAT theory class.

Actively involved

Learners felt that they were actively involved in the classroom when they participated in class discussions, as Participant 10QN090 stated: *"Yes, I take part in class discussions answers questions."* Participant 10QN048 agreed: *"Yes, because I learn best when I answer questions verbally and talk it out."* Learners also thought that taking notes made them actively involved Participant 10QN068 added: *"Yes I can follow the teacher with PowerPoints and I can Sum up the work in my workbook and do the activities"*, while Participant 10QN100 felt that by asking questions one can get a better understanding and thus stated: *"Yes, I like to make sure I understand the work fully and will enquire when uncertain."* Furthermore, Participant 10QN097 mentioned not falling asleep during the lesson as active involvement: *"yes I don't sleep."*

Variably involvement

Although some participants tried to engaged in the lesson, they sometimes wandered off daydreaming. Participant 10QN089 admitted: *"Sort of, sometimes I daydream."* Participants tried to stay focused by asking questions, like Participant 10QN001 said: *"I try my best to stay focused when teacher is explaining and I try to ask as much questions as I can"* and Participant 10QN041 remarked: *"Partly. I answer questions where I know the answers."* Asking and answering questions did not come naturally to all participants and some needed some guidance. Participant 10QN045 admitted that he was only engaged when the teacher involved the participants: *"kind of, I take part when the teacher asks me something."* Some theoretical content determined the involvement of participants, and participants tried to stay involved until the content became boring. Participant 10QN078 explained: *"Most of the time but it can become boring at times."* At times they were however interested in the topic like Participant 10QN029 indicated: *"Yes, most of the time, but my interest in the specific work will determine my involvement."*

Lack of involvement

A lack of involvement came from participants who mainly just sat and listened to the teacher such as Participant 10QN054 who admitted: *"No, because I usually just sit and listen."* Participant 10QN069 confirmed: *"No, I just listen to what the teacher says."* Participant 2QN065 felt that he

would rather do the work at home as no one listened in the classroom: *"The whole lesson is done at home when summarising, almost no one listens in class."* This could partly be because participants were not engaged in class and let other participants answer questions. Participant 10QN095 added: "no not really as there are other people doing the asking." On the other hand, Participant 10QN102 was of the opinion that they do not get the opportunity to answer questions: *"no, no one lets me join in."* Some participants struggled to focus on the theory *"No, I struggle to focus on theory"* (Participant 10QN044). This could be ascribed to boredom as indicated by Participant 10QN076: *"noit bores me sometime."* Participant 10QN055 admitted to falling asleep *"No, I am usually asleep or doing other work"* (Participant 10QN055).

5.2.4 Finding of resources

The theme resources mainly consist of answers derived from questions 5 and 8 (see Annexure G). Participants reported that they looked for online resources, made summaries from their textbooks, and asked their peers. Participants mainly used three different sources: digital resources, physical resources, and seeking external help from someone. These categories represented different types of resources utilised by individuals to complete their CAT theory activities.

Digital Resources, such as internet access, the use of electronic devices to find information, PowerPoint presentations, and software applications for typing and processing information such as MS Word and MS Excel were used.

Participants 5QN103 and 8QN036 mainly made use of the internet to search for answers and respectively claimed: *"Internet and YouTube"* and *"Use the internet to find answer."* Participant 8QN077 indicated the use of Google as a supporting resource: *"I go look in the textbook and if I require further assistance, I will Google it."* Participant 5QN072 used the internet along with the textbook and also preferred to answer the questions electronically: *"My textbook and the internet. I answer the questions on Word."* Another prominent resource used by the learners was the PowerPoints obtained from the school drive or textbook CD.

Some participants preferred the use of physical resources like summaries and books. Participant 5QN031 made use of summaries in a notebook and the textbook: *"Textbook and notebook, I learn from my summaries that I make during homework."* While Participant 5QN102 preferred not to be actively involved with the content as he preferred to read the content: *"Read from textbook."* Participant 5QN021 combined this with the use of the internet and his textbook: *"Internet, textbook, PowerPoints on the school's drive."*

When learners could not find answers to questions, they occasionally opted to seek external help, from the teacher, peers or family members. Participant 5QN094 stated: *“Textbook, teacher and Hard drive,”* while Participant 8QN035 said: *“I ask my friends or e-mail the teacher.”* Similarly, Participant 8QN005 added: *“I ask my friends, but if they don't know, I ask the teachers”* while family members assisted Participant 8QN038: *“Ask my sister or search it”* and likewise Participant 8QN030 explained: *“I go to my dad for help.”*

5.2.5 Summary of participants' experiences of CAT theory according to pre-open-ended questionnaires

Although the pre-open-ended questionnaire had multiple learners reporting CAT theory as interesting, fun and enjoyable, a large number of learners highlighted the challenges and negative aspects in terms of the theory content. Some participants expressed mixed emotions, occasionally finding it interesting, but sometimes boring or not up to modern standards. Some frustration was indicated by the participants due to the large amount of content, repetitive content and a preference for practical work. Overall, the participants' experiences regarding the enjoyability and value theme varied, reflecting various opinions and perspectives towards CAT theory. SDL components such as time management, problem solving, motivation and engagement have not fully been presented or established yet. Learners often indicated a lack of time management and problem solving.

5.3 Results of post-open-ended questionnaires

The post-open-ended questionnaire was completed by 56 participants. A summary of the raw codes, themes and categories that emerged, is given in Annexure I and are reported according to the same categories as the pre-open-ended questionnaire, namely enjoyability and value, challenges experienced, and SDL characteristics.

5.3.1 Enjoyability and value

The enjoyability and value theme mainly consisted of answers derived from question 1,3,4, and 11 in the questionnaire (see Annexure I). Overall, more participants reported a positive and enjoyable experience towards CAT theory than before the intervention. However, a number of participants still highlighted challenges and negative aspects in terms of theoretical content. Reports of neutral or mixed emotions or opinions regarding their experience of CAT theoretical content were in the minority.

5.3.1.1 Positive experiences

Enjoyment and fun emerged as strong themes and participants expressed their excitement and interest in CAT theoretical content. CAT theoretical content was described as: *"Nice, best, educational"* (Participant QM001). Participant QM021 noted: *"Exciting, educational, and fun."* *"Interesting, different, and entertaining"* (Participant QM054) and *"Fun, Interesting, Joyful"* (Participant QM043).

Promoting of critical thinking skills were more prominent than before the intervention. Almost all participants believed that critical thinking and problem-solving skills were promoted. Participant QM056 noted: *"off course"* and Participant QM002 replied: *"Yes definitely."*

5.3.1.2 Mixed perceptions

As in the pre-open-ended questionnaire, some learners still reported mixed perceptions towards CAT theoretical content. Outdated content emerged as a reason why learners were bored. *"It is very interesting and boring some times because the work is old and there should be more improved information that has improved in the Computer technology"* (Participant QM044). CAT theoretical content was also described as ranging from easy to difficult. *"Some of it is difficult to understand and some of the work is easy to understand"* (Participant QM029).

5.3.1.3 Negative perceptions of CAT theoretical content

In contrast to the pre-open-ended questionnaire, the majority of participants did not have issues with the workload or the difficulty level *"The work is quick and easy to complete"* (Participant QM042). *"There is not much work to do"* (Participants QM013 and QM028). *"I enjoy the practical work more than the theory work"* (Participant QM011). The overall negative attitudes towards CAT theoretical content were also less prominent. However, some participants still had negative perceptions of CAT theory content.

Negative perceptions involved a lack of interest in theoretical content, as opposed to practical content. Some participants reported that they are *"just not interested in theory"* (Participant QM020). Negative perceptions of three participants respectively (QM037, QM011 and QM056) stood out from the others. All found theory boring and frustrating. *"Boring, Non-exciting, Unstimulating"* and *"Boring, time-consuming and irrelevant"*, *"Frustrating educational and unbalanced."* Others just found the workload to be too much and mentioned that they preferred practical content to theoretical content. *"There is too much work that needs to get done."* (Participant QM028).

Participants lacked motivation towards CAT theory content when too much content was addressed. "*When too much is given*" (Participant QM056) and the "*Amount of work*" (Participant QM006), or "*The amount of work needed to cover and study is too much*" (Participant QM054).

5.3.2 Challenges experienced with CAT theoretical content

The neutral aspects consisted of learners who provided answers containing both positive and negative comments in terms of the theory content. The participants' comments in these categories mainly referred to the difficulty level of the content and the workload. The neutral aspects theme mainly consisted of answers derived from question 1, 2 and 11 in the questionnaire (see Annexure I).

For most participants the content was not particularly difficult or challenging it was just time consuming and required effort due to the large volume of theory work. A significant number of participants expressed opinions such as "*The work is not challenging*" Participant QM019), or "*The work is not difficult; it's just time-consuming.*" (Participant QM047). Participant QM048 affirmed: "*The work is straightforward.*"

Several participants perceived CAT theoretical content as balanced. "*CAT content is not too difficult or too hard*" (Participant QM046). Participant QM019 perceived theoretical content as reasonable: "*CAT content is not too difficult; it's reasonable.*" Accordingly, Participant QM030 perceived it as manageable. "*CAT content is not too difficult; it's manageable.*" Another participant reasoned that it just required time to complete. "*CAT is not too difficult; it just requires time*" (Participant QM001). While Participant QM005 continued with a mixed perception towards the theory by stating it was enjoyable but, clearly stated that he does not like to study. "*Enjoyable, interesting, exciting. Not enjoyable because study work. And I don't like study work.*"

5.3.3 Self-directed learning characteristics

SDL characteristics emerged from the data. Finding of own resources emerged as the strongest theme. Other characteristics were persistence, time management, problem-solving, motivation and engagement.

5.3.3.1 Time management

While some participants still struggled with time management, Participant QM011 mentioned: "*The workload is difficult to fit into the busy life of a student since there are other private activities that often interfere with the schoolwork.*" The workload remained a hurdle, for some participants, while others felt that most of the work was covered in class with little homework to be done.

Participant QM018 claimed: *"Fun, Informative, Entertaining. I think there is a good amount of work for CAT not overloading and not too little that there is nothing to learn and homework isn't dumped on us every day but given at a regular amount."*

Although they perceived the workload as high, a significant number of participants (43 out of the 56 participants) indicated completing the theory tasks *"As soon as possible"* (Participant QM001). This indicated that the learners were progressing in time management as an SDL characteristic. While the majority of the participants referred to *"As soon as possible"* (Participant QM002), Participant QM031 preferred, *"The day before the submission date"*. Others stated *"Usually over a weekend when I have time"* (Participant QM003) and *"Whenever I have time"* (Participant QM005).

It was very interesting to note that fewer participants admitted to leaving questions blank. Participant QM038 even indicated coming back to the answer later, *"leave it out and come back to that question later on."* Apart from Participant QM011 mentioning the *"busy life of a student"*, Participant QM023 also felt time constraints *"I have little time to complete my tasks."* A lack of time management skills was thus still noticed for some participants.

Multiple learners experienced CAT theory to be redundant. *"The work is a bit repetitive"* (Participant QM040). Some participants subsequently felt as if they were doing the same work over and over again. *"It feels like I am doing the same thing over and over again"* (Participant QM052). Repeating work from one grade to another could possibly be the reason for the perception of redundancy. As Participant QM010 stated: *"It can sometimes feel like a waste of time."*

5.3.3.2 Problem solving

Compared to the pre-open-ended questionnaire, problem solving was one of the most significant changes regarding participants' perceptions of CAT theoretical content and emerged as a strong theme. Participants also enjoyed problem solving activities. *"CAT requires a lot of problem-solving skills"* (Participant QM025). *"CAT involves a lot of problem-solving, which I like"* (Participant QM016). *"CAT involves a lot of problem-solving, which I find enjoyable."* (Participant QM057). *"Problem-solving in CAT is challenging but satisfying"* (Participant QM062).

Participant QM067 appreciated the problem-solving opportunities CAT theoretical content had to offer, *"I appreciate the problem-solving opportunities in CAT."* Problem solving in CAT theoretical content furthermore engaged participants in active learning. *"I find the problem-solving in CAT engaging"* (Participant QM020). confirmed:

5.3.3.3 Motivation

Motivation represented different factors that encouraged individuals to complete their CAT theory tasks. This theme also appeared to be one of the major themes as multiple answers from participants were derived from questions 7, 9, 10, 12 and 13 (see Annexure G).

Extrinsic motivation emerged as a strong theme. Participant QM018 mentioned several reasons for being extrinsically motivated: *“Not getting intervention and getting good marks for myself, parents, university.”* *“To avoid detention”* (Participant QM005), and *“The intervention system of the school”* (Participant QM028). Participants were under pressure to perform well and frequently mentioned that they did not want to disappoint their parents. Participant QM007 maintained: *“My mom”*, Participant QM055 affirmed: *“This is kind of bad but my parents because of their pressure for me to be the best.”* Participant QM033 was also worried about good grades: *“Not get bad grades and get scolded by my parents or not to disappoint my teachers and parents.”* Participant QM038 stated: *“I could get good marks for a test.”*

Aspects related to Classcraft emerged as a new theme. Extrinsic motivation after the intervention was related to rewards. *“Getting my rewards for doing so”* (Participant QM056). *“To do well and be rewarded”* (Participant QM001). Interestingly, Participant QM027 reported that an early start motivated him, which could refer to intrinsic motivation *“If I start early then it motivates me.”*

Wanting to obtain good results could refer to extrinsic motivation, but it could also be interpreted as personal achievement and intrinsic motivation: *“Good results”* (Participant QM003). *“To excel in marks”* (Participant QM019). Participant QM012 indicated enjoyment of the subject as intrinsic motivation. *“The subject itself.”* Participant QM044 continued: *“That I like the subject and I want to study the different types of computer applications.”* Participant QM053’s feelings about the subject were: *“It’s enjoyable and interesting.”* All of the participants showed intrinsic motivation by displaying interest in the subject, the desire for knowledge and the personal satisfaction when working with CAT theoretical content. All of these can be interpreted as characteristics of self-directed learners.

There were however participants who reported a lack of interest and subsequently low levels of SDL. Some participants for example Participant QM016 indicated: *“Laziness”* or *“Wanting to do other stuff instead of CAT”* (Participant QM048). This indicated the reason why they experienced a lack of motivation toward CAT theoretical content. Some were just not intrinsically motivated at all, like Participant QM031 who admitted: *“Mostly I do not have motivation to prepare for it, I feel forced.”* This could be because some experienced theoretical content as boring. Participant QM036 stated: *“It is boring”* and Participant QM052 added: *“Sometimes I am too busy or the work*

is a part of the theory which I don't have much interest in." Participant QM011 stated that he felt neglected in class: *"The fact that no attention is given to me and that the top candidates often get all the attention."*

5.3.3.4 Active engagement

The results in this category emerged from question 10 (see Annexure G). Different levels of engagement were reported. Some participants were actively involved, indicating that they were consistently engaged and participated in the class. It furthermore, seemed that levels of engagement and participation fluctuated depending on the specific content that was facilitated. There were however also participants who were not actively engaged in the CAT theory class.

Active engagement emerged as a strong theme. The majority of the participants (38 from 56 participants) reported that they were actively engaged in class. Participants, like Participant QM036 experienced that they were actively involved, claiming: *"Yes I am always in class". "Yes, I work hard in class."* (Participant QM038) and *"Yes, I try to pay attention"*(Participant QM034). On the other hand, Participant QM018 felt like only to answer questions when questions were asked: *"Yes, I listen and when sir asks questions I answer them."* Participant QM033 found that the game (Classcraft) that they played contributed greatly to paying attention: *"Yes, because we have a game we play that acquires attention and max focus."* The game forced all learners to be active participants in some kind of way. Participant QM053 mentioned: *"Yes, we make it so everyone usually has to answer at least one question."*

While some participants tried to stay involved in the lesson, they often lose their focus. Participant QM011 explained: *"I pay attention, but often get lost."* Some participants were undecided regarding active involvement. Participant QM039 mentioned that his engagement fluctuated: *"yes and no, try to answer my best I can in class"*.

A lack of engagement was reported by participants who preferred not to be noticed in class. Participant QM052 stated: *"No, I don't like having attention on me when I answer a question."* Accordingly, Participant QM055 displayed a low level of self-confidence: *"No because I for one am not the smartest kid in the class and whatever I say will most likely be wrong."* Lack of engagement, however, emerged as a weak theme.

5.3.4 Finding resources

Participants indicated different categories of resources, namely digital resources, physical resources and seeking help from someone. These categories represented different types of

resources utilised by individuals to complete their CAT theory activities. The theme resources mainly consist of answers collected from questions 5 and 8 (see Annexure G).

The digital resources used did not differ from the pre-open-ended questionnaires. Participants frequently made use of "*The internet*" according to Participant QM031. Many just answered: "*Google*" (Participant QM041), and a few referred to the "*Computer*" (Participant QM025) as a resource.

Most of the participants used their textbook, "*I use my CAT textbook*" (Participant QM009), while Participant QM037 indicated using summaries: "*my summaries*". Participant QM033 agreed and added PowerPoint Presentations: "*The CAT Textbook and the PowerPoint slides that we write down in class.*"

Compared to the pre-open-ended questionnaire, few or no participants made use of teachers as a resource. "*The textbook and what the teacher explains in class*" (Participant QM005). Some participants still asked their parents or friends for assistance "*Parents*" (Participant QM018). "*CAT book, Google and help from friends*" (Participant QM051).

5.3.5 Summary of results of the post-open-ended questionnaires

After the intervention was conducted some notable changes became emerged regarding participants' perceptions of CAT theoretical content.

There was a significant drop in negative perceptions regarding the CAT theoretical content. Improvements were noted as more participants expressed their enjoyment of CAT theory. This led to more enjoyment and value as the intervention kept learners engaged and interested. More opportunities were provided to increase their SDL skills such as better time management, problem-solving skills, intrinsic motivation, and engagement, as claimed by most of the participants in the study.

5.4 Results of post-intervention focus group interviews

A summary of the categories, themes and codes that emerged from the focus group interviews is indicated in Annexure J. Emerging themes were categorised as teaching approach, outdated content and workload, relevance of CAT theoretical content, and SDL characteristics.

5.4.1 Teaching approach

From the results, it was evident that teachers have an important role in how participants experienced CAT theoretical content. Themes that emerged were the use of humour, teaching and learning methods and attitude towards learners.

Participant IN6 remarked: *"Previously was boring before the class we were sitting and looking at you're book and trying to learn. We did nothing practical."* Interactive teaching methods kept the participants engaged: *"A new way to interpret the way of learning the content of the work. Even if the teacher just reads to you what is in the book then it won't be as interesting as if they explain it to the kids in a fun way like playing a game like a quiz or a pop- quiz or something like that, then it will be very interesting"* (Participant IN5). Participant IN8 suggested that learners should be engaged in a practical way in the theory: *"I think they can like actually take a PC apart or literally show you what it looks like, how the parts of a PC look. Like taking a PC formal display apart. Then you get taught how to put it together and how to take it apart. That's something practical."*

The participants' feedback reflected the participants' experience regarding the impact that the teaching approach had on engaging and motivating the participants in learning theoretical content.

Participants expected teachers to make lessons more interesting and enjoyable *"Boring, I think the way a teacher teaches it should be more interesting and fun"* (Participant IN1). Participants reported that they did not experience questions and answers as active learning. Participant IN6 commented: *"I feel there is not a lot of interaction so not everybody in the class at the same time can like ask questions or answer questions."* Participants valued active teaching approaches such as classroom discussions. *"So it must be a two-sided traffic not one sided"* Participant (IN5). *"It's nice to discuss certain topics with them and they then explain what it's more about and go more in-depth about certain things you don't necessarily understand"* (Participant IN3). *"He made the class part of the lesson, he asked questions to the kids in the class and made it almost a group activity instead of just someone talking to you"* (Participant IN5). Participant IN7 felt that Classcraft should be applied more to facilitate theoretical content. *"Well Sir I have a question. Going forward will these in Classcraft be done more often?"* This was reiterated by Participant IN4: *"Sir, I quite enjoy all the practical stuff we do because Sir teaches us new interesting ideas to get to know the stuff."* Interestingly, participants were experiencing CAT theoretical content as practical work, thus indicating a shift in their mindsets towards theoretical content when applying gamification as teaching approach.

The teacher's tone of voice could also play a role in learners' perceptions of theoretical content, *"Yes I think it was because of the way the Teacher taught us. He made it very interesting and unlike some other Teachers. The way they talk is very bland. One tone."* (Participant IN5). Participants also felt that teachers can motivate learners if they are friendly and willing to help and incorporate humour. *"I think a good Sir motivates you very much. So, if you have a good Sir you are motivated to stay focused at a subject. Especially if a teacher is friendly and willing to help you. I think that is a big factor in motivating someone to work"* (Participant IN3). *"Sir occasionally made jokes. The jokes make it interesting, they grab your attention and make it enjoyable to learn more"* (Participant IN1).

Some participants preferred to be kept actively busy with small assessments and visual aids. Participant IN6 remarked: *"Like just a quick 5 min test. Like at a start of a lesson. Or like if you struggle with a question you can ask questions quickly."* Participant IN2 mentioned making use of visual aids such as pictures. *"Sir, the CAT that Sir did, Sir, it's like you look at the picture then you can create like half in your head what it is, give it a shot and see if you're right."*

5.4.2 Outdated content and workload

Outdated content again emerged as a prominent theme. The answers provided by the participants regarding outdated content shed light on several factors contributing to perceived boredom in the CAT theory classes. The outdated content included irrelevant content and repetitive theoretical content. Such as old examples and textbooks and CAPS that can't keep up with the every changing technology and world.

The presence of outdated content in textbooks and homework seemed to hinder the participants: *"We got quite a bit of homework, and I must say the content we covered was rather outdated. Some of the textbooks are really outdated. Some of the things that we no longer use we still have to learn."* (Participant IN2). Furthermore, participants indicated an awareness of rapidly changing technology which intensified their feelings of disengagement with outdated material. *"A lot of theory is outdated since technology updates quite frequently. I think that's also why people might find it a bit boring because it's not what we use anymore."* (Participant IN3). Participants felt that the old content did not promote critical thinking. *"Something that we could adapt to something easy for us to adapt to like critical thinking. It only clicks in the mind for some students we need something that like a lot of students can adapt to therefore we can do critical thinking in class. But these textbooks that we have are five or six, seven years older. I feel that they are very outdated. They don't really promote critical thinking at all."* (Participant IN2).

The amount of theory that needed to be done was experienced as reasonable, but often irrelevant and not focused on real-world applications. *"I think the amount of content is reasonable but sometimes it can be overbearing"* (Participant IN5) *"Some of the theory is quite nice to learn but the others just you don't need to know it like netiquette is quite a big part and is quite simple because you only need to be respectful to others but it's like an entire chapter."* Participants didn't perceive theory as interesting, because of a lack of real-world applications. *"I think people find it boring because when it comes to CAT-like theory it's not really interesting because you don't go actually in-depth on like PC parts and on how real-life works on the internet and I think it's nothing like you do at home. I don't know how to explain it."* (Participant IN8).

Participants who had higher levels of prior knowledge of computer concepts experienced boredom with CAT theoretical content. The current theoretical content did not stimulate their curiosity and they subsequently did not experience a learning need. *"I think some people already know quite a bit about CAT theory, which is probably why they find it boring, because they're not learning anything new"* (Participant IN4). Thus, familiarity with certain theoretical concepts might lead to some learners finding the theory repetitive or unstimulating. *"Many people already know what to do in CAT; they already know the theory, and other people find it interesting because it's the first time they're dealing with computers and programming."* (Participant IN4).

Overall the participants felt if teachers could address these concerns by incorporating more up-to-date and interactive content that focused on real-world examples, it could help mitigate boredom and enhance learner interest in CAT theory classes.

5.4.3 Practical application and relevance of theoretical content

By addressing the interactive needs of the participants, it could lead to more engagement of theoretical content for the participants. The feedback provided by the participants highlighted their preference for practical content over theoretical content. *"I basically just took CAT to learn about practical work not any theory. It doesn't really interest me, the theory. I just want to learn how to use the computer and get Excel and Word, that's all."* (Participant IN4). Many learners expressed a preference for practical work over theory, citing the hands-on nature of practical tasks as more engaging and beneficial. Participant IN7 remarked: *"I think our practical are much better because you can physically interact with what you're doing. Like later when you have a job and you're working with Excel, it will help a lot with the theory behind it."*

Multiple participants believed that spending more time working on practical tasks would better to prepare them for the future as stated by Participant IN7: *"Well Sir I think we should spend more time (and that's my opinion obviously) on practical because let's say if we were to use CAT in real*

world it would not necessarily only be the theory part it would be the majority would be practical actually physical doing something we were taught in CAT that's way it would be better if you do more practical." Participant IN4 added: *"Because I'm not really interested in what the computers are made of and all of that I just want to learn about Excel and that."*

Participants however recognised that theory is essential and cannot be entirely disregarded, as it provides a foundational understanding necessary for success in the subject. Participant IN7 explained: *"I think many people chose CAT as a subject for the practical part and not the theoretical part. But with all subjects you take, there's going to be a bit more writing and a bit more book work than just computers. But overall, theory isn't as bad as I expected it to be. Obviously, the practical part is a bit better, but theory isn't too bad."*

The participants enjoyed the practical theory tasks that gamification incorporated, as it provided opportunities to learn new concepts in an interactive and engaging manner, fostering a deeper understanding of the material. Participant IN7 continued: *"Yes, I think when the teacher says we're going to do theory today, it's a bit like, 'Oh, okay, theory.' But as soon as he says it's practical, everyone's excited. But theory is part of it; you need it to get through the year. We can't just do practical, we need to write theory."* Participant IN5 commented: *"The ratio of theory to practical is a bit overwhelming because there is so little practical stuff that we can actually use compared to the theory that we have to sit and learn, which is too much."*

The participants valued the practical component of CAT classes more than the theory. Mainly because they felt that the practical content is relevant and engaging.

5.4.4 Self-directed learning characteristics

A few SDL characteristics emerged from the data. For the post-intervention focus group interviews, engagement and motivation emerged as a strong theme.

5.4.4.1 Finding resources

Multiple participants mentioned the use of resources and enjoyability.

Suggestions regarding physical resources emphasised the importance of regularly updating textbooks to ensure relevance and accessibility. *"Regulate the textbooks, as in every day like every two, three years. Create new textbooks, maybe e-books could be useful, they are easy to update and don't cost as much and you don't have to print."* (Participant IN2).

Additionally, participants mentioned seeking assistance from family members such as parents and/or siblings: *"I usually ask my dad because he works a lot with Excel and Word; he took IT courses around 1990."* (Participant IN4). IN4 continued: *"I usually ask my dad because he does IT; if I struggle, I'll ask him how to do it."* *"Sir, I usually ask my brother because he's very good with these kinds of things; if I'm unsure about something, I usually go straight to him."* (Participant IN4).

Online research and leveraging newer technologies were also suggested as ways to supplement learning outside the classroom. Participant IN3 advised: *"Go online and research the newer technology if you really want to know more about it."* Participant IN4 accordingly suggested acquiring help from classmates: *"We usually do our theory in class then we ask each other. If one maybe knows something the other one doesn't, then we can work it out."*

5.4.4.2 Engagement

One participant indicated that interaction and competition between learners, and using online resources and devices helped the participants to enjoy theoretical content more: *"Yes. I enjoy it a lot more Sir because you know we interact a lot more, and it's almost like a competition and everybody obviously likes a competition and competing. So that is another big factor which encourages you to obviously do well and try to perform better. And it's a lot more interesting than just clicking thru slides and stuff about theory. Like today most stuff happens online and on devices. So as soon as you tell learners we will be doing theory in a more practical way everyone will start enjoying it more."* (Participant IN7).

Participant IN2 further emphasised the challenge for learners to concentrate and pay attention when direct instruction is applied. *"I think not much can make me concentrate for 50 minutes."* *"As it is, sometimes it's difficult to pay attention in class because the periods are long, especially when you're learning theory from the board and the teacher is standing there in front and walking around."* (Participant IN2).

Learners experienced gamification as engaging, motivating, creating a sense of anticipation, and resulting in higher retention of knowledge. *"...before having theory be more online or having some sort of goal or motivation in a way it becomes quite boring and repetitive so it starts to get overwhelming in a way and after Classcraft it changing every week, its different so you don't know what is going to happen. And the way that you get thought everything just helps you stick in your mind a lot more."* (Participant IN7).

5.4.4.3 Motivation

Participants' feedback on motivational aspects, provided insights into the way they engage with CAT theoretical content. Participant IN5 mentioned that good grades and success were the strongest motivators for the participants *"Good marks."* *"To get good grades. I want to do well in the subject."* *"You get good results from the tests and that is what motivates you to study"* (Participant IN3). With multiple participants indicating a desire for academic achievement and recognition, Participant IN4 added: *"Yes, Sir, I am usually very motivated by the fact that I know if I do my work in class and I focus in class I will do much better in my tests and my practical tests and yes, that is my motivation."*

Participants highlighted the influence of external factors on their engagement. While motivation could emerge from the school's disciplinary system (intervention) Participant IN1 declared: *"It motivates me more to do it because the teacher gives interventions if you don't do it."* Participant IN7 admitted to doing homework to avoid unpleasant consequences: *"The fact that the school gives interventions if your homework isn't done and I only need a few more before I get detention."*

Additionally, the level of interest in the subject matter played a significant role in motivating learners. *"I think it's about your interest, what you are interested in. Everyone is interested in different parts of computer science, and what you find interesting may not be interesting to someone else"* according to Participant IN3. Some participants admitted to rather doing something else than homework. *"I just think that when I get home, I'm not really in the mood to do any more schoolwork, or just what I'm trying to say is there are better things to do than schoolwork"* (Participant IN7).

In contrast to motivation, factors emerged that demotivated participants. These were identified as a lack of understanding, heavy work load and outdated content. Learners expressed frustration when they struggled to comprehend the material. Participant IN1 explained: *"What demotivates me, Sir, is if like they give a topic and I don't understand the work, I won't enjoy it."* Frustration also became evident when participants lacked understanding because they missed classes. *"If you weren't in class and you have to do homework and you don't know what's going on, then it's quite difficult"* (Participant IN6).

Concurring with the results of the pre- and post-open-ended questionnaires, heavy workload, particularly when coupled with long and time-consuming activities, and outdated content and repetition of content, emerged as strong themes. *"Especially when the homework is quite a lot and you've worked on all the questions beforehand, but you still don't really know how it is, and you have to keep going back and forth, especially for each question, especially if there are many*

questions." (Participant IN8). This could also contribute to demotivation, resulting in participants to feel overwhelmed and disengaged. *"The thing that demotivates, me is that if you focus on one thing the entire time. Like you can say its and old program and we keep on learning about old programs instead of new one each two or three years, then it starts demotivating me."* (Participant IN2).

The intervention helped to foster intrinsic motivation. Some participants specifically stated that the implementation of the intervention (Classcraft) was interactive and an enjoyable learning experience. IN6 remarked: *"The new way that we tried with the Classcraft, it was really interesting and was a fun way of learning because in the new day and age everybody plays games and the way we learned was, I didn't find it boring because really, I really enjoyed it, it was a fun and easier way to learn in class."* *"I enjoyed the Classcraft way of teaching more than the traditional, old, just-to-the-book way"* (Participant IN6).

5.5 Conclusion

In the above sections, the results of pre- and post-open-ended questionnaires, and of the post-intervention focus group interviews were discussed. The results confirmed that learners find it challenging to concentrate and to learn when teacher-centred teaching methods are applied. Moreover, the results indicated that participants were more intrinsically motivated by the application of gamification and expressed a need for updated content and active teaching and learning strategies. An interesting finding was that with the application of gamification, participants viewed theoretical content as practical work.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The main purpose of this study was to determine how gamification can be used to facilitate CAT theoretical content to enhance GenZ-L' SDL. This chapter focuses on drawing a conclusion of the research questions by considering the theoretical foundation that was laid by Chapters 1, 2 and 3, and the discussion of results from the empirical research described in Chapters 4 and 5.

Chapter 2 focussed on the characteristics of GenZ-L (research aim 1), the essence of CAT theoretical content, and applicable teaching-learning approaches, -strategies, and -methods for facilitating CAT theoretical content (research aim 2).

Chapter 3 focussed on SDL models (research aim 3), gamification in the context of teaching and learning (research aim 4) and suggested an intervention that applies gamification to enhance SDL when facilitating theoretical content in the CAT classroom.

Chapter 4 focussed on the research design and methodology that were followed for the empirical research. A qualitative research approach from an interpretive paradigm was used to investigate the significance of the participants' experiences.

The focus of Chapter 5 was on discussing the results of the data analysis for the pre- and post-open-ended questionnaires, and focus group interviews. Chapter 5 laid the foundation for the discussion of GenZ-L experiences in terms of the teaching and learning of CAT theoretical content (research aim 5), and to what extent the use of gamification in the teaching and learning of CAT theoretical content contributed to the enhancement of SDL (research aim 6).

In this chapter, the results will be integrated and discussed, and conclusions will be drawn. Recommendations for the main research question regarding how gamification can be used to facilitate CAT theoretical content in order to enhance GenZ-L' self-directed learning will be made.

Lastly, limitations and recommendations for further research will be discussed.

6.2 Conclusions with regard to research question 1: What are the characteristics of Generation Z learners?

The characteristics of Generation Z, were explored through the lens of 21st century skills that learners need to effectively face the challenges of a rapidly changing world. Education must prepare learners to adapt to change and to be lifelong learners and therefore develop SDL (Knowles, 1975). GenZ-L need to acquire skills such as digital literacy, problem solving, critical thinking, communication and collaboration (Chu et al., 2017).

Developing these 21st century skills are crucial for GenZ-L, who are furthermore characterised by unique attributes.

6.2.1 The characteristics of Generation Z learners

GenZ-L refer to learners who were born between 1995 and 2010 (Moore, Jones, & Frazier, 2017) and display favouritism for the digital world due to their upbringing in the digital world compared to their predecessors. The prominent characteristics that define GenZ-L are indicated in Table 6-1. GenZ-L crave instant gratification, prefer hands-on interactive learning experiences, are goal-orientated and are passionate about topics of interest.

However, some of these characteristics indicated areas that had to be addressed or improved especially when the aim is to promote SDL (see Table 3-2). These included a short attention span, lack of social skills and collaboration, requiring instant gratification, likelihood of information overload and the lack of critical evaluation of online content.

When teachers tailor instruction methods for their classrooms, GenZ-L' preference for active, learner-centred teaching approach should be kept in mind. Teachers should therefore explore and apply innovative strategies and methods in the classroom, especially when focussing on theoretical content.

Table 6-1: Characteristics of Generation Z

Characteristic	Description
Crave technology	One of the most striking characteristics of GenZ-L is that they crave the digital world (Chicca & Shellenbarger, 2018) and technology (McKibben, 2017).
Lack of critical evaluation	Despite all the information at their disposal, GenZ-L lack the ability to effectively assess information (Aharon, 2021). Seemiller and Grace (2016) believe that GenZ-L accept online sources without much critical evaluation due to the large amount of information available.
Short attention span	Lohman (2016) also believes GenZ-L has a shorter attention span, especially with less stimulating presentations and delivering of content (Redmer et al., 2021).
Instant gratification	The constant crave towards technology for GenZ-L could be because they seek constant feedback and instant gratification (McKibben, 2017). This leaves them wanting instant gratification (Redmer et al., 2021).
High expectation/competitive	GenZ-L feel they are more creative, and more passionate about making things better than all the past generations before them (Adobe, 2016), they are goal-orientated and driven (Merriman, 2016) with high expectations (McKibben, 2017).
Low self-motivation	Monster (2016) identified various motivating factors for GenZ-L, emphasising their commitment to achieving goals. Merriman (2015) underscores their innate innovativeness, productivity, goal orientation, and realism. Despite these qualities, the issue of self-motivation remains ambiguous.
Pragmatic/hands-on/active	GenZ-L are active learners, they prefer to be engaged and “learn by doing” (Thomas, 2019) and not by sitting passively. They prefer to be hands-on and interactive with the content.
Lack of collaboration skills	Chicca and Shellenbarger (2018) identified that GenZ-L are high consumers of technology and cravers of the digital world, however they have underdeveloped social and relationship skills because of this craving.
Independent learning	Monster (2016) argues that because of this “always on” technology, GenZ-L wants to determine their own schedules, create their own career paths and introduce their own personal preference for completing tasks (Merriman, 2015).
Visual learning	GenZ-L prefer visuals, they want to be interactive and hands-on, they are curious and love challenges (McKibben, 2017).

Before proposing relevant teaching and learning strategies for GenZ-L, the essence of CAT theoretical content will first be discussed.

6.3 Conclusions with regard to research question 2: What is the essence of the teaching and learning of CAT theoretical content?

The NCS stipulated certain skills that should be developed in each learner who is enrolled for subjects in the South African School Curriculum. General aims apply to all school subjects and are linked to 21st century skills of problem solving, critical and creative thinking, the ability to communicate and collaborate effectively, and sound organisational skills (DBE, 2011).

According to the CAPS, the purpose of the subject CAT is to develop “digitally enabled learners” who can apply the integrated components of computer systems to solve real-life problems (DBE, 2011). The subject content of CAT comprises practical and theoretical content, which is divided into six overarching main topics. The main topics are: Solution Development, Systems Technologies, Network Technologies, Internet Technologies, Information Management, and Social Implications (DBE, 2011).

Table 1-1 in Chapter 2 briefly describes and explains the six main topics in CAT and indicates that theoretical content covers 50% of the CAT curriculum. This information underscores the importance of following a balanced approach when facilitating both theoretical and practical content of the subject. Learners however struggle to find the relevance of theoretical content (McQuail, 2010) and subsequently lack motivation and engagement with theoretical content. When facilitating theoretical content, relevant teaching strategies should thus be applied to foster intrinsic motivation amongst GenZ-L.

Data analysis revealed that multiple participants believed that spending more time working on practical tasks would better prepare them for the future, as stated by IN7: *“Well Sir I think we should spend more time (and that’s my opinion obviously) on practical because let’s say if we were to use CAT in real world it would not necessarily only be the theory part it would be the majority would be practical actually physical doing something we were taught in CAT that’s way it would be better if you do more practical.”* IN4 added: *“Because I’m not really interested in what the computers are made of and all of that I just want to learn about Excel and that.”* A common misconception from participants’ side therefore was that they do not see the relevance of the theoretical content.

This is indicated by another participant about the amount of theory that needed to be done: *“I think the amount of content is reasonable but sometimes it can be overbearing”* (IN5) and added the inclusion of irrelevant chapters: *“Some of the theory is quite nice to learn but the others just you don’t need to know it like netiquette is quite a big part and is quite simple because you only need to be respectful to others but it’s like an entire chapter.”* Learners need to understand the relevance of the content and they prefer real-world scenarios.

Apart from participants seeking relevant content, they have a need for current content, which is not outdated, as IN2 explained: *“The thing that demotivates, me is that if you focus on one thing the entire time. Like you can say its and old program and we keep on learning about old programs instead of new one each two or three years then it starts demotivating me.”*

6.3.1 Teacher-centred approach vs learner-centred approach

In a teacher-centred approach the teacher takes the role as the sole knowledge provider, while the learners assume the role of “passive recipients of information” (Muganga & Ssenkusu, 2009, p. 17).

Traditional teacher-centred approaches subsequently do not leave space for learners to feel part of the process of learning, to collaborate, to be curious about the content or even to be challenged by the content (Anuradha, 2021). This all indicate that teacher-centred approaches, strategies and methods are not suitable for GenZ-L, as they are pragmatic and want to be part of the process (McKibben, 2017).

On the other hand, learner-centred approaches place a strong emphasis on the learner’s role in the learning process (Gill & Kusum, 2016). Both learners and teachers have equal focus in the learning process (Anuradha, 2021). The learner-centred approach focuses more on how learners learn in the classroom instead of how teachers teach (Wohlfarth et al., 2008). The learners are actively busy learning and have a greater input into their learning, how they learn it, and when they learn it (Wohlfarth et al., 2008).

Using learner-centred approaches such as gamification, helps to promote a more in-depth learning experience, which will develop learner autonomy (Darsih, 2018). Furthermore, a learner-centred approach will also foster curiosity, creativity, and collaboration – all of these being skills that are needed to thrive in the 21st century (Sudderth, 2022) and that can be linked to SDL (Guglielmino, 1977).

6.4 Conclusions with regard to research question 3: What is SDL about?

Self-directed learners possess skills that includes determining their learning needs, time management and pace setting, developing a plan to finish work, assessing one's own progress, accepting and utilising criticism, coming up with novel solutions to problems, creating learning objectives, and knowing how to choose and apply a variety of learning strategies and possible learning resources (Knowles, 1975).

From the literature, it was learned that GenZ-L lack some SDL characteristics such as a high degree of self-motivation, self-confidence, a strong desire to learn and collaboration. Teachers subsequently need to adapt their teaching approaches, teaching strategies and teaching methods to appeal to GenZ-L and to address the lack of certain SDL characteristics. As a result, gamification was identified as a teaching strategy that can be applied to facilitate theoretical content in CAT and promote SDL (see Table 3-2 and Table 3-3).

Table 3-2 indicated strengths and weaknesses regarding SDL characteristics among GenZ-L. Addressing their weaknesses and focussing on their strengths, to promote SDL emerges as a valuable strategy for GenZ-L. SDL will offer a platform to acquire crucial skills in a manner aligned with their distinctive characteristics.

Table 3-3 showed a brief summary of how Oswald's SDL model can be compared to gamification with the nine SDL dimensions he identified. Although all these SDL dimensions that have been identified, appears in gamification to some degree, it cannot be assumed that gamification on its own will develop SDL, as there is a strong focus on extrinsic motivation. GenZ-L characteristics showed strengths and weaknesses when compared with SDL characteristics (see Table 3-2), that had to be addressed with gamification.

6.5 Conclusions with regard to research question 4: What is gamification in the context of teaching and learning?

Gamification was defined as “the use of design (rather than game-based technology or other game-related practices) elements (rather than fully developed games) characteristic for games (rather than play or playfulness) in non-game contexts (regardless of specific usage intentions, contexts, or implementation media),” Hernández-Prados, et al. (2021) described gamification as a “*ground breaking methodology*” within innovative education that is here to stay. Moreover, the use of games in general and gamification in particular, is considered one of the most prominent instructional strategies to motivate learners and to increase their engagement.

The use of gamification is not new to learning. As we have used games to learn by playing since we were small on the playground. Gamified systems such as competition, points scoring, collecting, player reputation, theming, medals, etcetera are all transferable between different types of games and are effective in different combinations, even in non-gaming settings. Most gamification systems use reinforcement for example points, levels, badges, leader boards, etcetera to promote engagement and motivation in users (Dicheva et al., 2015).

The integration of gamification emerged as a promising strategy to facilitate CAT theoretical content for GenZ-L. By leveraging game elements such as interactivity, rewards, and progress tracking, educators can create immersive learning experiences that align with GenZ-L preferences. However, gamification cannot only be designed to accommodate the preferences of GenZ-L, but should also be specifically designed to foster SDL.

Teachers should subsequently consider the characteristics of learners (Miranda, 2020) when choosing their teaching strategies. Not only should teaching strategies address the

preferences of a specific generation and satisfy their learning needs, but teaching strategies should also develop the necessary skills and characteristics that learners need to address the challenges of society.

6.6 Conclusions with regard to research question 5: What are the experiences of Generation Z Learners in terms of the teaching and learning of CAT theoretical content?

When looking at ways to innovate your classroom, gamification stands out as a promising intervention to enhance SDL. Particularly in this study, Classcraft was used as an online resource to enhance the teaching of CAT theoretical content. As the participants unravelled and navigated through the dynamic elements of levelling up and working with their team, teachers could incorporate updated and current resources with collaborative teams or groups to ensure a more effective and engaging learning experience for all learners.

6.6.1 Gamification intervention to enhance SDL

For this study gamification was used as an intervention to facilitate theoretical content. The intervention was compiled by considering the characteristics of Gen Z and model of SDL.

This intervention used Classcraft as a free online educational RPG for gamification. Classcraft transforms the classroom into an adventure (Boggan, 2020). Classcraft uses game-based elements like levelling up, working in teams, and earning powers that can be used and have real-life consequences in the classroom. These game-based elements can be assigned by the teacher to any existing topic. Teachers can use Classcraft throughout the year to track learners' progress when learners perform any tasks like helping another learner to study, receive a high score on assessment, or even as simple as answering a question in the classroom.

6.6.2 Participants' experiences of the gamification intervention

While the pre-open-ended questionnaire had multiple learners reporting CAT theory as interesting, fun and enjoyable, a large number of learners highlighted the challenges and negative aspects regarding the theory content. Some participants expressed mixed emotions, occasionally finding it interesting, but sometimes boring or not up to modern standards. Some frustration was indicated by the participants due to the amount of content, repetitive content and their preference for practical work. Overall, the participants' experiences regarding the enjoyability and value theme varied, reflecting various opinions and perspectives towards CAT theory.

In terms of task completion, learners exhibited diverse approaches, with some preferring to complete tasks immediately, while others waited until closer to the deadline. Motivation emerged as a key factor influencing participants' engagement with both intrinsic and extrinsic factors. Examples of these are rewards and personal interest playing a significant role in engagement. Some participants, although in the minority still stayed motivated for various reasons, such as being lazy, uninterested, or feeling that their classmates were better/smarter than them. Despite the difficulties that some participants faced, most of the participants participated actively in the classroom discussions and activities. Participants demonstrated a high level of engagement with the teaching of CAT theory. Overall this section highlighted how crucial it is to meet a range of learner needs in order to successfully teach and promote the learning outcomes in CAT theoretical content.

A number of learners expressed difficulty in maintaining focus during extended periods of theory instruction, indicating a need for more engagement and interactive teaching approaches to sustain attention. *“I’d say before having theory be more online or having some sort of goal or motivation in a way it becomes quite boring and repetitive so it starts to get overwhelming in a way and after Classcraft it changing every week, its different so you don’t know what is going to happen. And the way that you get thought everything just helps you stick in your mind a lot more.”* (Participant IN7).

In summary, addressing these suggestions and challenges by incorporating updated and recent resources, promoting collaborative learning, and implementing interactive teaching methods could contribute to a more effective and engaging learning environment when facilitating CAT theoretical content, ultimately enhancing learners' SDL.

6.7 Final conclusion of the study

In this study the potential of how gamification can be used to facilitate CAT theoretical content, in order to enhance GenZ-L' SDL was researched. This was performed through a comprehensive examination of the literature, establishing theoretical foundations and through the empirical findings.

Several characteristics were identified for GenZ-L (see Table 3-2). The most notable characteristics throughout the study for GenZ-L were their unique traits shaped by a digital background in their upbringing. The strengths of technology, proficiency and goal orientation were identified. Several shortcomings of GenZ-L were also identified. GenZ-L have a short attention span, they need instant gratification and lack collaboration skills. To incorporate

these strengths and address weaknesses, a tailored and effective teaching strategy needs to be used to promote SDL.

In CAT, theoretical and practical content both play an equal role in the subject. Learners often struggle to see the relevance of theoretical content. Additionally, the use of teacher-centred approaches is not suitable for GenZ-L and learners expressed frustration with this approach. There needs to be shift to learner-centred approaches to foster interactive classrooms, in order to promote active and engaged classroom practices to facilitate theoretical content to GenZ-L. Learners also indicated the importance of varied methods of instruction to cater to the diverse needs of GenZ-L.

SDL has been identified as a fundamental skill set in the 21st century. Learners need to be lifelong learners to be successful in the modern workforce. Although GenZ-L do display certain SDL skills they lack self-motivation, critical thinking and collaboration due to their constant online interactions. These were addressed with Classcraft creating an interactive group situation where learners had to collaborate with other learners and hand in tasks earlier, which they would traditionally not have done so quickly.

When looking at gamification itself, the use of game-based elements into a non-gaming context improved the motivation and engagement of the participants. When using these game-based elements such as levelling up and rewards, the teacher could entice the learners to experience theoretical content in a more engaging and enjoyable experience.

This study underlined the potential of gamification as an important tool to transform the teaching and learning of theoretical content for GenZ-L to promote SDL. However, instructional approaches should continuously be evaluated and adapted to find the best approach for the current generation.

6.8 Limitations of the study

The gamification intervention was only implemented at one school with male learners, and with a relatively small population considering the number of learners taking CAT as an elective subject in South Africa. The researcher was also the facilitator of the intervention, and there was no control group to compare the results with.

The last limitation of the study is partially due to COVID-19, limiting the study to its full potential as learners were partially kept away from school to combat the virus. This led to very little time for the interviews of the study. COVID-19 also contributed to the low number of learners not answering or participating in all three data collection tools.

6.9 Recommendations for further study

Research regarding gamification to enhance SDL when facilitating theoretical content in other subjects is recommended to confirm the results found in this study. Other gamification platforms can also be incorporated to improve and enrich the possibilities for education in other learners' contexts. Studies can also compare the experiences of female participants with those of male participants, to explore the various preferences between genders. More research needs to be carried out in schools with limited resources, to determine how gamification can be made more accessible to under-privileged communities. Regardless, of cultural background and resources, inclusive strategies to apply gamification to enhance SDL should be researched. Participants with SDL skills wanted to adapt to a changing world, but were frustrated by outdated subject content, subsequently opening up new avenues for research on learning and teaching support material and problem-based scenarios

6.10 Final remarks

When looking at how gamification can be used to facilitate CAT theoretical content in order to enhance GenZ-L' SDL it has been evident that teachers should understand the characteristics of GenZ-L. GenZ-L have very unique traits which are being shaped by technology and instant gratification every day, with just a swipe away from the next content to consume.

With the short attention span of GenZ-L, they need tailored instructional approaches to keep them engaged, motivated and interested in theoretical content. Traditional, teacher-centred approaches are not adequate enough to satisfy the needs of GenZ-L. The necessity for learner-centred approaches like gamification with the ability to transform the theoretical classroom into a game-like environment is crucial to leverage the abilities of game-based elements to foster engagement and SDL.

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ANNEXURES

Annexure A: Language editor

TO WHOM IT MAY CONCERN

This is to certify that the undersigned has done the language editing of an MEd dissertation for the following candidate:

SURNAME and INITIALS: STOLTZ JH

TITLE: Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning.



DR RHELDA KRÜGEL

08 May 2024

DATE

NOTE WELL: The language editor does not accept any responsibility for post-editing, re-typing or re-computerising of the content.

Residential address: 48 Arcon Villas
Lee Avenue
Arcon Park
Vereeniging
1939
Cell no.: 082 664 2296

Annexure B: Ethics approval



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Web: <http://www.nwu.ac.za/>

North-West University Education, Management
and Economic Sciences, Law, Theology,
Engineering and Natural Sciences Research
Ethics Office (NWU-EMELTEN-REC)

Tel: +2718 299 4707
Email: lukas.meyer@nwu.ac.za

27 October 2020

Dear Dr Lubbe

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU-EMELTEN-REC) on 26 October 2020, the NWU-EMELTEN-REC hereby approves your study as indicated below. This implies that the NWU-EMELTEN-REC grants its permission that, provided the general and specific conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning																														
Principal Investigator/Study Supervisor/Researcher: Dr E Lubbe																														
Student: Mr JH Stoltz																														
Ethics number:	<table border="1"><tr><td>N</td><td>W</td><td>U</td><td>-</td><td>0</td><td>1</td><td>1</td><td>1</td><td>6</td><td>-</td><td>2</td><td>0</td><td>-</td><td>A</td><td>2</td></tr><tr><td colspan="3">Institution</td><td colspan="3">Study Number</td><td colspan="3">Year</td><td colspan="3">Status</td></tr></table>			N	W	U	-	0	1	1	1	6	-	2	0	-	A	2	Institution			Study Number			Year			Status		
N	W	U	-	0	1	1	1	6	-	2	0	-	A	2																
Institution			Study Number			Year			Status																					
Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation																														
Application Type: Single study	Commencement date: 09.10.2020		Risk:																											
Expiry date: 08.10.2021			Greater than minimal but provides the prospect of direct benefit.																											
Approval of the study is provided for a year, after which continuation of the study is dependent on the receipt and review of a twelve-monthly monitoring report and the concomitant issuing of a letter of continuation.																														

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- The principal investigator/study supervisor/researcher must report in the prescribed format to the NWU-EMELTEN-REC:
 - twelve-monthly on the monitoring of the study, whereby a letter of continuation will be provided annually, and upon completion of the study; and
 - without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.
- The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the principal investigator/study supervisor/researcher must apply for approval of these amendments at the NWU-EMELTEN-REC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.

- *Annually a number of studies may be randomly selected for active monitoring.*
- *The date of approval indicates the first date that the study may be started.*
- *In the interest of ethical responsibility, the NWU-EMELTEN-REC reserves the right to:*
 - *request access to any information or data at any time during the course or after completion of the study;*
 - *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
 - *withdraw or postpone approval if:*
 - *any unethical principles or practices of the study are revealed or suspected;*
 - *it becomes apparent that any relevant information was withheld from the NWU-EMELTEN-REC or that information has been false or misrepresented;*
 - *submission of the twelve-monthly monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and/or*
 - *new institutional rules, national legislation or international conventions deem it necessary.*
- *NWU-EMELTEN-REC can be contacted for further information via Ethics-EMELTEN-apply@nwu.ac.za or 018 299 4707*

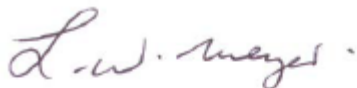
Specific conditions:

1. The commencement and execution of the study are subject to COVID-19 restrictions and regulations and strict adherence to the prevailing COVID-19 research procedures and protocols.

The NWU-EMELTEN-REC would like to remain at your service and wishes you well with your study.

Please do not hesitate to contact the NWU-EMELTEN-REC for any further enquiries or requests for assistance.

Yours sincerely,



Prof Lukas Meyer
Chairperson NWU-EMELTEN-REC

Annexure C: Gatekeeper approval



Western Cape
Government

Education

Directorate: Research

Audrey.wyngaard@westerncape.gov.za

tel: +27 021 467 9272

Fax: 0865902282

Private Bag x9114, Cape Town, 8000

www.westerncape.gov.za

REFERENCE: 20210414-2204

ENQUIRIES: Dr A T Wyngaard

Mr Johannes Stoltz
Education Faculty
North West University
Private Bag X8001
Potchefstroom
2520

Dear Mr Johannes Stoltz

RESEARCH PROPOSAL: THE FACILITATION OF COMPUTER APPLICATIONS TECHNOLOGY THEORETICAL CONTENT IN ORDER TO ENHANCE SELF-DIRECTED LEARNING

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **03 May 2021 till 30 September 2021**.
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number.
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:
The Director: Research Services
Western Cape Education Department
Private Bag X9114
CAPE TOWN
8000

We wish you success in your research.

Kind regards.

Signed: Dr Audrey T Wyngaard

Directorate: Research

DATE: 15 April 2021

Lower Parliament Street, Cape Town, 8001
tel: +27 21 467 9272 fax: 0865902282
Safe Schools: 0800 45 46 47

Private Bag X9114, Cape Town, 8000
Employment and salary enquiries: 0861 92 33 22
www.westerncape.gov.za

Annexure D: Permission letter parent



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Fax: +2718 299-4910
Web: <http://www.nwu.ac.za>

CONCENT LETTER FOR GRADE 10 AND GRADE 11 COMPUTER APPLICATIONS TECHNOLOGY LEARNERS.

TITLE OF THE RESEARCH STUDY: Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning

ETHICS REFERENCE NUMBERS: NWU-01116-20-S2

PRINCIPAL INVESTIGATOR: DR EES Lubbe
E-MAIL ADDRESS: elsie.lubbe@nwu.ac.za
CONTACT NUMBER: 018 299 1462

POST GRADUATE STUDENT: MR JH Stoltz

You are invited to take part in a **research study** that forms part of a master's study in Computer Science Education.

Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher, or person explaining the research to you, any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about in which you might be involved. Your participation is **entirely voluntary** and you are free to say no to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you did agree to participation at first.

This study has been approved by the **Ethics Committee of Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences (NWU-EMELTEN-REC)** of the **North-West University (NWU-01116-20-S2)** and will be conducted according to the ethical guidelines and principles of Ethics in Health Research: Principles, Processes and Structures (DoH, 2015) and other international ethical guidelines applicable to this study.

What is this research study all about?

- *We plan to research how gamification can be used to facilitate Computer Applications Technology (CAT) theoretical content to Generation Z learners in order to improve their self-directed learning.*
- *This study will be conducted at your child's school and will be done by experienced researchers, trained in Computer Applications Technology. Approximately 80 participants (grade 10 and 11 CAT learners) will be included in this study.*

What will be expected of you?

You will be asked to complete two open-ended questionnaires (narratives) about your experiences of teaching and learning of CAT theoretical content. The questionnaires

will include no more than 10 questions and will take no longer than 30 minutes to complete. You will be asked to complete the questionnaire in the CAT class at a convenient time for example during break. I will abide to the COVID-19 regulations, depending on the ruling COVID-19 level at that stage.

You will also be asked to participate in two semi-structured focus group interviews that will take about 20 minutes to complete. The interviews will be held at a convenient location and time, such as the CAT classroom during a break. I will abide to the COVID-19 regulations, depending on the ruling COVID-19 level at that stage.

The following are **proposed** for data collection activities:

Date	Time	Activity	Role of participant
Term 2 Week 3 (Learners can attend one session)	14:15-14:45	Open-ended questionnaires (narratives)	Learner will fill in a questionnaire on the date that suites them best. The open-ended questionnaires (narratives) will take no longer than 30 mins to complete
	14:15-14:45		
Term 2 Week 4 (Learners can attend one session)	14:15-15:45	Semi-structured focus group interviews	Learners will participate in small semi-structured focus group interviews. Where learners will be expected to answer a few questions concerning the topic. An interview will take no longer than 20 mins to complete.
	14:15-15:45		
Term 3 Week 8 (Learners can attend one session)	14:15-14:45	Open-ended questionnaires (narratives)	Learner will fill in a post questionnaire on the date that suites them best. The open-ended questionnaires (narratives) will take no longer than 30 mins to complete
	14:15-14:45		
Term 3 Week 9 (Learners can attend one session)	14:15-15:45	Semi-structured focus group interviews	Learners will participate in small post semi-structured focus group interviews. Where learners will be expected to answer a few questions concerning the topic. An interview will take no longer than 20 mins to complete.
	14:15-15:45		

*If there are learners rather wanting to use break time rather than staying after school arrangements can be made to accommodate these learners.

How will we protect your confidentiality and who will see the findings?

Confidentiality and anonymity will be applied. Your name and the school's name will not be mentioned anywhere in the research. Only the researchers and the study leaders will be able to view the data. Data will be kept safe by locking hard copies in a secure location and electronic data will be password protected on the researchers and the study leaders' computers. Data will be stored for the duration of the study and five year after the study has been completed and will then be deleted and discarded by the study leader.

Kind regards
Dr EES Lubbe
Study leader

Is there anything else that you should know or do?

- You feel free to contact the independent recruitment person, Karlo de Villiers at kdevilliers@paulroos.co.za if you have any queries.
- Please feel free to contact the researcher JH Stoltz, student number 22811648, at 076 359 4031 or stoltzjh@gmail.com should you have any further questions. You are also welcome to contact Dr Elsie Lubbe who is the study leader for further information.
- Your child may also contact the ethics committee of Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences (EMELTEN-REC) through Mrs Villera le Roux at 018 299 4707 or Villera.leroux@nwu.ac.za should you or your child have any concerns that were not answered about the research or if you or your child have complaints about the research.
- Thank you for considering requesting research at your school. Would you please be so kind as to email me your decision? My email address is: elsie.lubbe@nwu.ac.za.

Declaration by learner

By signing below, I (NAME and SURNAME of the learner)
agree that I will take part in the research study titled: *Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning.*

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been 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 handled in a negative way if I do so.

Signed at (place) on (date) 20....

.....
Signature of participant

.....
Signature of witness

Annexure E: Informed consent learner



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CONCENT LETTER FOR GRADE 10 AND GRADE 11 COMPUTER APPLICATIONS TECHNOLOGY LEARNERS.

TITLE OF THE RESEARCH STUDY: Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning

ETHICS REFERENCE NUMBERS: NWU-01116-20-S2

PRINCIPAL INVESTIGATOR: DR EES Lubbe
E-MAIL ADDRESS: elsie.lubbe@nwu.ac.za
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You are invited to take part in a **research study** that forms part of a master's study in Computer Science Education.

Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher, or person explaining the research to you, any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about in which you might be involved. Your participation is **entirely voluntary** and you are free to say no to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you did agree to participation at first.

This study has been approved by the **Ethics Committee of Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences (NWU-EMELTEN-REC)** of the North-West University (NWU-01116-20-S2) and will be conducted according to the ethical guidelines and principles of Ethics in Health Research: Principles, Processes and Structures (DoH, 2015) and other international ethical guidelines applicable to this study.

What is this research study all about?

- *We plan to research how gamification can be used to facilitate Computer Applications Technology (CAT) theoretical content to Generation Z learners in order to improve their self-directed learning.*
- *This study will be conducted at your child's school and will be done by experienced researchers, trained in Computer Applications Technology. Approximately 80 participants (grade 10 and 11 CAT learners) will be included in this study.*

What will be expected of you?

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will include no more than 10 questions and will take no longer than 30 minutes to complete. You will be asked to complete the questionnaire in the CAT class at a convenient time for example during break. I will abide to the COVID-19 regulations, depending on the ruling COVID-19 level at that stage.

You will also be asked to participate in two semi-structured focus group interviews that will take about 20 minutes to complete. The interviews will be held at a convenient location and time, such as the CAT classroom during a break. I will abide to the COVID-19 regulations, depending on the ruling COVID-19 level at that stage.

The following are **proposed** for data collection activities:

Date	Time	Activity	Role of participant
Term 2 Week 3 (Learners can attend one session)	14:15-14:45	Open-ended questionnaires (narratives)	Learner will fill in a questionnaire on the date that suites them best. The open-ended questionnaires (narratives) will take no longer than 30 mins to complete
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	14:15-15:45		
Term 3 Week 8 (Learners can attend one session)	14:15-14:45	Open-ended questionnaires (narratives)	Learner will fill in a post questionnaire on the date that suites them best. The open-ended questionnaires (narratives) will take no longer than 30 mins to complete
	14:15-14:45		
Term 3 Week 9 (Learners can attend one session)	14:15-15:45	Semi-structured focus group interviews	Learners will participate in small post semi-structured focus group interviews. Where learners will be expected to answer a few questions concerning the topic. An interview will take no longer than 20 mins to complete.
	14:15-15:45		

**If there are learners rather wanting to use break time rather than staying after school arrangements can be made to accommodate these learners.*

How will we protect your confidentiality and who will see the findings?

Confidentiality and anonymity will be applied. Your name and the school's name will not be mentioned anywhere in the research. Only the researchers and the study leaders will be able to view the data. Data will be kept safe by locking hard copies in a secure location and electronic data will be password protected on the researchers and the study leaders' computers. Data will be stored for the duration of the study and five year after the study has been completed and will then be deleted and discarded by the study leader.

Kind regards
Dr EES Lubbe
Study leader

Is there anything else that you should know or do?

- You feel free to contact the independent recruitment person, Karlo de Villiers at kdevilliers@paulroos.co.za if you have any queries.
- Please feel free to contact the researcher JH Stoltz, student number 22811648, at 076 359 4031 or stoltzjh@gmail.com should you have any further questions. You are also welcome to contact Dr Elsie Lubbe who is the study leader for further information.
- Your child may also contact the ethics committee of Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences (EMELTEN-REC) through Mrs Villera le Roux at 018 299 4707 or Villera.leroux@nwu.ac.za should you or your child have any concerns that were not answered about the research or if you or your child have complaints about the research.
- Thank you for considering requesting research at your school. Would you please be so kind as to email me your decision? My email address is: elsie.lubbe@nwu.ac.za.

Declaration by learner

By signing below, I (NAME and SURNAME of the learner)
agree that I will take part in the research study titled: *Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning*.

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been 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 handled in a negative way if I do so.

Signed at (place) on (date) 20....

.....
Signature of participant

.....
Signature of witness

Declaration by person obtaining consent

I (NAME and SURNAME) declare that:

- The information in this document was explained to the him/her clearly and in detail by myself.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that him/her adequately understands all aspects of the research.
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (*place*) on (*date*) 20....

.....
Signature of person obtaining consent

Declaration by researcher

I *JH Stoltz* declare that:

- I explained the information in this document to the person obtaining consent.
- I did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them I was available should he/she want to ask any further questions.
- The informed consent was obtained by an independent person.
- I am satisfied that him/her adequately understands all aspects of the research, as described above.

Signed at (*place*) on (*date*) 20....

.....
Signature of researcher

Annexure F: Data collection tool

No	Questions from the open-ended questionnaire	Reason for the question (Gamification, Gen Z, SDL)
1	Write down at least three adjectives that describe your experience of CAT theory class.	Engagement (Gamification): To test the learner's level of interest and involvement in CAT theory homework and class activities. Feedback Systems (Gamification): Reflection of the learner's perception of their learning experience in CAT theory classrooms. Motivation (Self-directed learning): Describing the emotional response and drive towards participating in CAT theory class activities.
2	What is your opinion about CAT theory regarding: (a) The amount of content to be done for homework, tests and examination sessions. (b) The difficulty level of the content? (c) Your level of interest in terms of the content?	Engagement (Gamification): Impact of workload on learner's motivation and interest in CAT theory. Reflection on learner's interest and engagement with CAT theory topics. Progression Paths (Gen Z): Perception of the pacing and structure of CAT theory curriculum. Challenge (Gamification): Assessment of the complexity and difficulty of CAT theory concepts.
3	Name the resources you use to complete your CAT theory activities.	Resourcefulness (SDL): Demonstration of learner's ability to seek and utilise various learning resources. Autonomy (SDL): Illustration of learner's independence in selecting and utilising resources for CAT theory tasks.
4	When are you most likely to complete your theory tasks? As soon as possible, the day before the submission date, or any other relevant answer?	Time Management (SDL): Reflection on learner's time management skills and habits regarding completion of CAT theory tasks. Autonomy (SDL): Illustration of learner's ability to schedule and manage their own learning tasks.
5	Explain what motivates you the most to complete theory tasks.	Goals and Objectives (Gamification): Clearly defined objectives that users aim to achieve through the gamified experience. Motivation (SDL): Exploration of intrinsic and extrinsic factors driving learner's motivation towards completing CAT theory tasks. Feedback Systems (Gamification): Understanding the impact of feedback and rewards on students' motivation.

6	What do you do when you do not know the answer to a question in a CAT theory assignment?	Resourcefulness (SDL): Seeking out and utilising various resources for learning, including books, online courses, videos, etcetera Curiosity and Inquiry (SDL): Cultivating a curious mindset and asking questions to deepen understanding. Problem-solving Skills: Reflection on learner's strategies for addressing gaps in knowledge and understanding. Resourcefulness (SDL): Demonstration of learner's ability to seek additional resources or assistance when faced with challenges.
7	Were you motivated to pay attention during CAT theory lessons?	Gen Z: Engagement: Strategies to capture and maintain the interest of users through gameplay elements. Engagement: Reflection on learner's level of interest and motivation during CAT theory lessons. Feedback Systems: Understanding the impact of instructional methods and materials on learner engagement.
8	Were you actively involved in the CAT theory class?	Autonomy (SDL): Illustration of learner's initiative and involvement in CAT theory class activities. Social Interaction (Applicable to Gen Z): Reflection on learner's collaboration and participation within the CAT theory class environment.
9	Do you think the way theoretical content is taught gives you the opportunity to develop critical thinking and problem-solving skills?	Social Interaction (Gamification): Integration of social features like collaboration, competition, and sharing within the game environment. Skill Development (SDL): Assessment of the effectiveness of CAT theory instruction in fostering critical thinking and problem-solving skills. Engagement (Gamification): Evaluation of the engagement and interactivity of CAT theory teaching methods in promoting skill development.
10	What (a) motivates or (b) demotivates you to do CAT class activities or homework or to study for a test/exam?	Motivation (SDL): Exploration of factors influencing learner's motivation towards CAT class activities, homework, and test preparation. Feedback Systems (Gamification): Understanding the impact of feedback, rewards, and assessment methods on learner motivation and engagement.

Annexure G: Pre- and post-open-ended questionnaire.

P1



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This is the English version of the questionnaire for the study: *Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning*. The Afrikaans version is on the backside of this page.

Dear learner

In this questionnaire we aim to collect data to improve the teaching and learning of CAT theoretical content.

Your participation is non-obligatory and will be kept anonymous. You should not write your name on the questionnaire. It will not reflect negatively upon you, whether you decide to participate or not. If you do complete the questionnaire, you give your permission that the data may be used for research purposes.

Instructions

Fill in the questions as honestly as possible. There are no right or wrong answers. None of the answers will be held against you. If you do need more space for an answer, please use the space provided after question 10. Please remember to indicate the question number in this case.

No	Question	Write your answer in this box
1	Write down at least 3 adjectives that describe your experience of CAT theory lessons.	
2	What is your opinion about CAT theory regarding: (a) The amount of content to be done for homework, tests and examination sessions. (b) The difficulty level of the content? (c) Your level of interest on behalf of the content?	a b c

3	Name the resources you use to complete your CAT theory activities.	
4	When are you most likely to complete your theory tasks? As soon as possible, the day before the submission date, or any other relevant answer?	
5	Explain what motivates you the most to complete your CAT theory tasks.	
6	What do you do when you do not know the answer to a question in a CAT theory assignment?	

7	Are you generally motivated to pay attention during CAT theory lessons?	
8	Are you actively involved in the CAT theory class?	
9	Do you think the way theoretical content is taught gives you the opportunity to develop critical thinking and problem-solving skills?	
10	What (a) motivates or (b) demotivates you to do CAT theory activities or homework, or to study for a CAT theory test/exam?	a b

Annexure H: Categories, themes and codes of the pre-open-ended questionnaire.

Categories	Themes	Codes	Participant
1. Enjoyability and value	Positive experience	• Fun • Enjoyable • Exciting • Understandable • Intuitive • Helpful • Informative • Educational	1QN034: "Interesting, fun, enjoyable" 1QN051: "good, fun, enjoying" 1QN064: "enjoyable, relaxing and fun" 1QN066: "enjoyable, fun, exciting" 1QN082: "Fun, informative, enjoyable" 11 QN027: "Yes. A lesson can be presented in an interesting way, making it more enjoyable for me to be a part of it."
	Perceived importance	• Important • Value	1QN033: "It's enjoyable, very useful, it's important." 1QN062: "Fun, Easy, Important, Helpful"
	Level of interest	• Interesting	1QN027: "Fun, interesting, important" 4QN081: "In terms of interest, most of the theory I'm not that interested in, mostly I'm only interested in theory that contains content related to "normal" computers and network, the rest of it is quite boring." 4QN019: "I am very interested in CAT. It is enjoyable for me to learn new skills on the computer." 4QN030: "I have medium interest in the subject." 4QN037: "I have a lot of interest towards the subject that why I chose it."
2. Challenging Aspects	Homework load	• Too little homework • Too much homework • Fair amount of homework • No homework	2QN042: "We never get homework which is very nice. For tests and exams, I think the amount of content given is not too much and is a realistic amount." 2QN052: "I feel like more homework needs to be set out for learners to excel in the subject, tests are too hard due to the lack of knowledge that is obtained and I have no examination experience so I cannot comment."

Categories	Themes	Codes	Participant
			2QN036: "The workload is too much. So many information to keep in mind that are important. I know all of the information will help but tests should be broken down into multiple tests; each focusing on separate sections and group of contents." 2QN087: "CAT theory is not very interesting when discussing it in class. We get flooded with a large amount of homework and study work for theory when only half of it is asked. As a result, I lose interest in studying for it and paying attention." 2QN047: "If you keep up with the work given each day it really doesn't become a lot of work to do. We are given time in class to complete the work and ask questions. By doing these little amounts of work each day it really helped me be prepared for the test series." 2QN100: "It isn't that much work as long as you listen in class." 4QN029: "I think it's unnecessary work that I have to know, but the practical aspect is understandable." 2QN021: "I think the workload is very reasonable for all the above."
	Negative experience	• Boring • Repetitive • Hard work • Difficult • Long • Waste of time • Unproductive • Insufficient • Exhausting • Mediocre • Clueless • Redundant	1QN010: "Boring, minimal interaction, a lot." 13QN009: "The work is boring and I do not have a lot of interest in it." 1QN053: "Exhausting, Long, Boring." 1QN054: "Boring, Waste of time, long." 1QN102: "Boring difficult to understand complicated." 1QN052: "Unproductive, insufficient and mediocre." 4QN016: "I am more interested in the practical aspects." 11QN019 "No. The questions are just textbook questions and can only be answered if you have learned it directly from the textbook." 11QN049 "No, you have to learn it without understanding." 3QN007 "Quite difficult if you don't pay attention." 3QN043 "The work is not very hard to study, just not as interesting as practical work."
	Study workload	• Too little to study • Too much study work	2QN002: "The amount of homework we get is entirely right and not too much, but we receive a lot of information to study for exams and tests."

Categories	Themes	Codes	Participant
		Fair amount to study	2QN036: "The workload is too much, with so much information to keep in mind that is important. I know all the information will help, but tests should be broken down into multiple tests, each focussing on separate sections and groups of contents." 2QN082: "The amount of theory and detail that we have to learn is a considerably large and difficult amount."
	Time constraints	- Too little time - Amount of work - My phone/computer games	2QN007: "limited time to go through everything thoroughly." 1QN037: "Long, a lot of information quickly, not exciting." 1QN061: "Boring, Long and waste of time."
	Teaching approach	- Practical based and not theory based - Mainly for practical - Everything at home no one listens in class	2QN016: "I think CAT should be more practically based because I believe one will only use the practical knowledge and not the theory." 2QN054: "It is a lot of work seeing that the reason I take the subject is mainly for the practical knowledge." 2QN065: "The hole lesson is done at home when summarizing, almost no one listens in class." 2QN074: "Too much theory just wants to do the practical work."
	Redundancy	Redundant as IT	2QN055: "It's redundant to me, since I take IT."
3. Neutral Aspect	Not challenging	- Easy - Not so hard - Hard in the beginning - Hard when not paying attention	3QN026: "The theory is not really difficult; it's just a lot." 3QN034: "Not that hard but challenging to remember all theory." 3QN087: "The theory isn't very difficult. Most of the time, it is easy, but there are some things that need more explaining." 3QN088: "Not too hard if you have some knowledge about computers."
	Normal	Perfect	3QN021: "The difficulty level of CAT theory is not too high or too low. I have learned a lot about computers in the short time I have had CAT as a subject." 3QN031: "I think the difficulty level is just right." 3QN050: "It's not too difficult or too easy." 3QN090: "I think it is the perfect difficulty, not too hard, not too easy."

Categories	Themes	Codes	Participant
	Mixed perception	• Quick • Plain • Average	1QN005 "fun, interesting, difficult." 1QN011 "Boring, enjoyable, easily understandable." 1QN044 "Interesting, cool, boring: CAT theory is not bad to learn compared to other subjects because it is easy to learn and remember. But sometimes the lessons can get boring I still like the way it is taught." 1QN085 "Boring, interesting, informative." 1QN104 "long, tiring, interesting." 11QN062 "Not quite it's not up to modern standards." 11QN077 "Yes and No. It does allow one to think of what the answers could be and if you struggle you can solve the problems by finding solutions. But it is not necessarily the most effective way to develop those things." 11QN099 "It provides a better understand on how the world works but does not necessarily develop problem-solving skills."
4. Resources	Digital resources	• Internet/Google/Network • Phone/PC • Word/Excel	5QN071: "My textbook as well as the internet." 5QN072: "My textbook and the internet. I answer the questions on word." 5QN070: "CAT textbook, YouTube, internet." 5QN103: "Internet and YouTube." 8QN036: "Use the internet to find answer." 8 QN077: "I go look in the text book and if I require further assistance, I will Google it."
	Physical resources	• Textbook • Slideshow	5QN021: "Internet, textbook, PowerPoints on the school's drive." 5QN031: "Textbook and notebook, I learn from my summaries that I make during homework." 5QN102: "Read from textbook."
	Seek external help	• Ask a friend • Ask teacher • Parents/ Family	5QN094: "Textbook, teacher and Hard drive." 8QN038: "Ask my sister or search it." 8QN030: "I go to my dad for help." 8QN035: "I ask my friends or e-mail the teacher." 8QN005: "I ask my friends, but if they don't know, I ask the teachers."

Categories	Themes	Codes	Participant
	Problem solving	- Write the best answer I can - Guess	8QN006: "Write the best possible answer that I can think of and elaborate on it." 8QN029: "I write down another answer that I think is correct because I might get a mark." 8QN067: "I think out of the box. And try and figure out the answer." 8QN033: "Guess the closest possible answer." 11QN081: "Yes, mostly through scenarios that they give us to work with, then we have to figure out what's wrong from the information given and figure out how to solve it."
5. Task Completion	Immediate completion	AS soon as possible	6QN001: "As soon as possible." 6QN030: "As soon as possible." 6QN083: "As soon as possible." 6QN103: "As soon as possible."
	Proximity to the deadline	- More than 2 days before - The day before submission	6QN087: "About 2-4 days before the submission date." 6QN096: "Before it is given by at least a week." 6QN029: "Several days before the submission date." 6QN066: "Slowly each day."
	Flexible approaches	When I have time	6QN063: "When I have to." 6QN098: "Whenever the time suits me." 6QN007: "When I have time to do it." 6QN021: "When I don't have to study for tests or have sports commitments. (Over open weekends)."
	No attempt	- Never - Leave blank	8QN032: "I visit the internet, and if I find nothing about the question, I will leave it blank and ask my teacher when I see him again." 8QN075: "Leave blank or fill in anything." 6QN041: "Never."
6. Motivation	Extrinsic motivation	- Good marks - No demerits/ Punishments	13QN001: "To get better grades." 13QN011: "I am not someone who likes to work at home and would rather spend my time doing other stuff like playing games than doing school work." 12QN001: "My teacher and the amount that I care about doing well and working for CAT."

Categories	Themes	Codes	Participant
		• Impress parent/ Teacher • Rather spend time on other subjects/ on something else • To play games/ rest	QN005: "My parents scolding me." 12QN014: "So that I won't fail or get punished." 12QN018: "Punishment makes me do homework; I want to do well motivates me for exams." 12QN055: "Not to get an intervention." 7QN020: "When I'm done, I can rest and have a bit of downtime. I am so busy during the day; it helps to have a little downtime." 7QN095: "To play Krunker (online game)." 7QN052: "My previous marks for the theory tests."
	Intrinsic motivation	• Self-motivation • Like subject • Better knowledge • Nothing • I'm lazy	12QN017: "I want good marks thus self-motivation." 12QN056: "To do well for myself." 7QN007: "I motivate myself." 7QN028: "It is enjoyable to achieve a goal after struggling with a question for hours or even days, and eventually getting it right on your own. It drives one to want to do more."
	Avoiding consequences	• Due date • Fall behind	12QN014: "So that I won't fail or get punished." 7QN083: "I don't want to feel pressured to do my work at the last minute." 7QN050: "To do it the day I get it so I don't have to stress about it later on in the week."
	Lack of motivation	• nothing • only if work Interesting • I have to	13QN015: "The amount of work and how uninteresting it is at times." 13QN012: "When the work isn't captivating or interesting to me. It could possibly make me less interested or focussed." 13QN083: "Procrastination." 9QN026: "No, not really, I don't really connect with the work." 9QN061: "No, 45 Min Lessons are long and it gets boring after a while." 9QN070: "Not really but if the theory is taught in a fun or interesting way then I will pay better attention." 9QN085: "No, after 5-15 minutes I lose interests." 7QN077: "It is partially because it interests me but mostly because I have to do it because it counts marks. I want good marks."

Categories	Themes	Codes	Participant
	Academic achievement	- Better marks - Average booster - To get the work done	7QN047: "The opportunity to get an amazing mark so easily and that it could boost my term mark by a lot." 7QN098: "not getting a low mark." 7QN035: "CAT is an average booster."
7. Involvement	Active involvement		10QN068: "Yes I can follow the teacher with PowerPoints and I can Sum up the work in my workbook and do the activities." 10QN048: "Yes, because I learn best when I answer questions verbally and talk it out." 10QN090: "Yes, I take part in class discussions." 10QN097: "yes I don't sleep." 10QN100: "Yes, I like to make sure I understand the work fully and will enquire when uncertain."
	Variable involvement		10QN001: "I try my best to stay focused when teacher is explaining and I try to ask as much questions as I can." 10QN041: "Partly. I answer questions where I know the answers." 10QN045: "kind of, I take part when the teacher asks me something." 10QN078: "Most of the time but it can become boring at times." 10QN089: "Sort of, sometimes I daydream." 10QN029: "Yes, most of the time, but my interest in the specific work will determine my involvement."
	Lack of involvement		10QN054: "No, because I usually just sit and listen." 10QN055: "No, I am usually asleep or doing other work." 10QN095: "no not really as there are other people doing the asking." 10QN102: "no, no one lets me join in." 10QN069: "No, I just listen to what the teacher says." 10QN044: "No, I struggle to focus on theory." 10QN076: "noit bores me sometime."

Annexure I: Categories, themes and codes of the post-open-ended questionnaire

Categories	Themes	Codes	Participant
Enjoyability and value	Positive perception	• Enjoyable • Exciting • Fun • Interesting • Entertaining • Informative • Intellectual • Creative • Educational • Enjoyable • Enthusiastic • Rewarding • Awesome • Inspiring	QM001: Nice, best, educational QM005: Nice, interesting, exciting QM010: Exciting, lots of work and interesting QM016: Fun, exciting, educational QM021: Exciting, educational, and fun QM054: Interesting, different, and entertaining QM056: Getting my rewards for doing so (Classcraft) QM026: Yes, it is interesting work and the gamification makes it fun.

	Perceived importance	• Educational • Productive • Intellectual • Informative • Useful • Valuable	QM001: Nice, best, educational QM016: Fun, exciting, educational QM021: Exciting, educational, and fun
	Level of interest	• High interest • Very interested • Interested • Interesting • Intriguing	QM026: Yes, it is interesting work and the gamification makes it fun. QM054: Interesting, different, and entertaining
Challenging aspects	Homework load	• Too much work • Time consuming • Overwhelming workload	
	Negative perception	• Boring • Not enjoyable • Frustrating • Confusing • Irrelevant	QM028: "Long, Boring, not exciting" - "There is too much work that needs to get done." QM056: "Frustrating educational and unbalanced" - "A lot to analyse and remember in our daily lives" QM020: "not interested in theory"
	Study workload	• Study pressure • Difficult to manage workload • Heavy workload	QM011: "The workload is difficult to fit into the busy life of a student since there are other private activities that often interfere with the schoolwork." QM031: "It is too much and unnecessary. Most of the work is not important and would not be used in future. Outdated. In the modern world, most of the facts can be obtained on internet."

	Time constraints	• Proximity to the deadline • Pressure due to deadlines • Limited time	QM003: " Usually over a weekend when I have time" QM005: "Whenever I have time" QM010: "Whenever I have time" QM011: "The day before the submission date"
	Teaching approach	• Chaotic teaching • Lack of engagement • Lack of passion from the teacher	
	Redundancy	• Outdated content • Unnecessary information	QM010: "It can sometimes feel like a waste of time." QM025: "It feels like I am doing the same thing over and over again." QM036: "The work can be repetitive and boring." QM037: "It feels like I am doing the same thing over and over again." QM040: "The work is a bit repetitive." QM043: "The work can be repetitive at times." QM052: "It feels like I am doing the same thing over and over again." QM054: "The work feels repetitive and monotonous."
Neutral aspect	Not challenging	• Not too difficult • Semi-easy	QM016: "I feel like the work is repetitive and doesn't challenge me." QM019: "The work is not challenging." QM048: "The work is straightforward." QM042: "The work is easy, but there's a lot of it." QM051: "The work is easy, but there's a lot of it." QM024: "CAT content is not too difficult or too hard."

	Normal	• Decent amount of work • Standard workload • Manageable	QM019: "CAT content is not too difficult; it's reasonable." QM030: "CAT content is not too difficult; it's manageable."
	Mixed perception	• Half enjoyable, half difficult • Enjoyable but sometimes boring	QM056: "Sometimes but not also" QM044: "It is very interesting and boring some times because the work is old and there should be more improved information that has improved in the computer technology." QM029: "Some of it is difficult to understand and some of the work is easy to understand."
Resources	Digital resources	• Google • Internet • Online research	QM015: "google" QM031: "The internet" QM024: "google" QM025: "Computer" QM041: "Google" QM042: "google"
	Physical resources	• Textbook • Workbook • Stationery	QM008: " the textbook" QM009: " I use my CAT textbook" QM026: "Computer, textbook, stationaries." QM037: "my summaries"
	Seek external help	• Asking the teacher • Asking friends or classmates	QM005: "The textbook and what the teacher explains in class" QM018: "Parents" QM051: "CAT book, Google and help from friends"

	Problem solving	• Google search • Consulting textbooks	QM016: "CAT involves a lot of problem-solving, which I like." QM020: "I find the problem-solving in CAT engaging." QM025: "CAT requires a lot of problem-solving skills." QM057: "CAT involves a lot of problem-solving, which I find enjoyable." QM062: "Problem-solving in CAT is challenging but satisfying." QM067: "I appreciate the problem-solving opportunities in CAT."
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Task completion	Immediate completion	• As soon as possible • Quick completion • Timely completion	QM014: "As soon as possible" QM045: "As soon as possible"
	Proximity to the deadline	• Last minute completion • Day before the submission date • Time pressed	QM011: "The day before the submission date" QM052: "The day before the submission date"
	Flexible approaches	• Completion based on availability • Completing when not feeling lazy	QM003: " Usually over a weekend when I have time" QM018: "The class time we have to do it"
	No attempt	• Ignoring the task • Leaving it	
Motivation	Extrinsic motivation	• Rewards for completion • Avoiding interventions • Parental pressure	QM001: "To do well and be rewarded." QM007: "My mom" QM018: "Not getting intervention and getting good marks for myself, parents, university." QM027: "If I start early then it motivates me." QM033: "Not get bad grades and get scolded by my parents or not to disappoint my teachers and parents." QM055: "This is kind of bad but my parents because of their pressure for me to be the best." QM056: "Getting my rewards for doing so."

	Intrinsic motivation	• Interest in the subject • Desire for knowledge • Personal satisfaction	QM012: "The subject itself." QM044: "That I like the subject and I want to study the different types of computer applications." QM053: "It's enjoyable and interesting."
	Avoiding consequences	• Avoiding detentions • Avoiding trouble	QM005: "To avoid detention." QM028: "The intervention system of the school"
	Lack of motivation	• Demotivated • Laziness • Lack of interest	QM011: "I enjoy the practical work more than the theory work." QM006: "Amount of work." QM011: "The fact that no attention is given to me and that the top candidates often get all the attention." QM016: "Laziness" QM020: "If the work is not interesting to me." QM026: "It takes a lot of time and dedication." QM031: "Mostly I do not have motivation to prepare for it, I feel forced." QM036: "It is boring." QM048: "Wanting to do other stuff instead of CAT." QM052: "Sometimes I am too busy or the work is a part of the theory which I don't have much interest in." QM054: "The amount of work needed to cover and study." QM056: "When too much is given."
	Academic achievement	• Wanting good grades • Striving for excellence	QM003: "Good results." QM019: "To excel in marks." QM038: "I could get good marks for a test."

Involvement	Active involvement	- Engaging in class - Participating actively - Answering questions	QM018: "Yes, I listen and when sir asks questions, I answer them." QM033: "Yes, because we have a game, we play that acquires attention and max focus." QM034: "yes, I try to pay attention" QM036: "Yes I am always in class" QM038: "Yes, I work hard in class." QM053: "Yes, we make it so everyone usually has to answer at least one question"
	Variable involvement	- Sometimes involved, sometimes not - Attention fluctuates	QM011: "I pay attention, but often get lost." QM027: "not really" QM039: "yes and no, try to answer my best I can in class" QM052: "No, I don't like having attention on me when I answer a question."
	Lack of involvement	- Not paying attention - Not actively participating	QM032: "no" QM055: "No because I for one am not the smartest kid in the class and whatever I say will most likely be wrong."

Annexure J: Post-intervention focus group interviews



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Structure for focus group interviews

After the respondents have completed the open-ended questionnaire, follow up questions will be asked during focus group interviews. The purpose of the interviews is to obtain rich information/motivations/experiences from the respondents regarding answers they provided during the completion of the questionnaire. The focus group interviews will be scheduled for 20 minutes with groups no bigger than five participants. There will be at least 5 questions discussed in the focus group interviews.

Introduction

Thank you for agreeing to participate in this interview for the topic *Facilitation of the theoretical content of Computer Applications Technology to enhance self-directed learning*. The following questions will help us to investigate your lived experiences of the teaching and learning of CAT theoretical content. This interview will be no longer than 20 minutes. The interview will be recorded by two devices for transcription purposes. Please feel comfortable to answers questions in English or Afrikaans and be as honest as possible. None of the answers will be disclosed or held against you.

Date and time of the focus group interview	2021/xx/xx	Number of learners attending	e.g. 5
Question number and question (Questions from the open-ended questionnaire)	Participants' remarks during the completion of the questionnaire	Follow-up questions	Notes on Participants' remarks during the focus group interview
(1) How do you experience CAT theory lessons?	Example: 'I feel theory is boring'	Example: Why do you think learners mentioned that...?	Example: Participants laugh / are reluctant to answer.
Write down at least 3 adjectives that describe your experience of CAT theory class.			
What is your opinion about CAT theory regarding: (a) The amount of content to be done for homework, tests and examination sessions. (b) The difficulty level of the content? (c) Your level of interest on behalf of the content?			
Name the resources you use to complete your CAT theory activities.			
When are you most likely to complete your theory tasks? As soon as possible, the day before the submission date, or any other relevant answer?			
Explain what motivates you the most to complete theory tasks.			
What do you do when you do not know the answer to a question in a CAT theory assignment?			

Date and time of the focus group interview	2021/xx/xx	Number of learners attending	e.g. 5
Question number and question (Questions from the open-ended questionnaire)	Participants' remarks during the completion of the questionnaire	Follow-up questions	Notes on Participants' remarks during the focus group interview
Were you motivated to pay attention during CAT theory lessons?			
Were you actively involved in the CAT theory class?			
Do you think the way theoretical content is taught gives you the opportunity to develop critical thinking and problem-solving skills?			
What (a) motivates or (b) demotivates you to do CAT class activities or homework or to study for a test/exam?			
Questions arising from the interview		Notes on respondent's remarks during the focus group interview	

Annexure K: Categories, themes and codes of the post-intervention focus group interviews

Theme	Categories	Codes	Participant
Teacher Influence	Instruction approach/methods	- Teacher's approach influences interest	IN1: "Boring, I think the way a Teacher teaches it should be more interesting and fun." IN5: "Yes I think it was because of the way the Teacher taught us. He made it very interesting and unlike some other Teachers. The way they talk is very bland. One tone." IN2: "Sir, the CAT that Sir did, Sir, it's like you look at the picture then you can create like half in your head what it is, give it a shot and see if you're right." IN7: "Well Sir I have a question. Going forward will these in Classcraft more often. Depending on this one. Ok but currently like at the moment where we sat now your recon we will use it more often?" IN8: "I'd say yes. I mean it's a switch of since we had Miss Elaine and she left and then You. I don't want to like take any sides but are a better Teacher than Miss Elaine. It definitely motivated me actually to do my work." IN8: "Well I think I don't know you were just more certain we were supposed to do actual work or when you actually taught us instead of another teacher just providing us. You taught it to us." IN6: "Like just a quick 5 min test. Like at a start of a lesson. Or like if you struggle with a question you can ask questions quickly."
		Traditional teaching methods and lack of interest	IN5: "So it must be a two-sided traffic not one sided." IN6: "I feel there is not a lot of interaction so not everybody in the class at the same time can like ask questions or answer questions. I feel there could be more interaction between the teacher and the students."

		Interactive teaching methods enhance engagement	IN5: "A new way to interpret the way of learning the content of the work. Even if the teacher just reads to you what is in the book then it won't be as interesting as if they explain it to the kids in a fun way like playing a game-like a quiz or a pop quiz or something like that then it will be very interesting." IN5: "He made the class part of the lesson, he asked questions to the kids in the class and made it almost a group activity instead of just someone talking to you." IN6: "Previously was boring before the class we were sitting and looking at you're book and trying to learn. We did nothing practical." IN8: "I think they can like actually take a PC apart or literally show you what it looks like, how the parts of a PC look. Like taking a PC formal display apart. Then you get taught how to put it together and how to take it apart. That's something practical."
		Discussion and clarification enhance Understanding	IN3: "I think if you have questions then well it all depends on how good your teacher is so it's nice to discuss certain topics with them and they then explain what it's more about and go more in depth about certain thing you don't necessarily understand."
	Attitude towards the learners	Friendly and supportive teachers motivate learners	IN3: "I think a good Sir motivates you very much. So, if you have a good Sir you are motivated to stay focussed at a subject. Especially if a Teacher is friendly and willing to help you. I think that is a big factor in motivating someone to work."
		Humour and jokes make theory lessons interesting	IN1: "Sir occasionally made jokes. The jokes make it interesting, they grab your attention and make it enjoyable to learn more."

CAT theoretical content		Perceived boredom due to outdated content	IN1: "I think what people meant the work that we do is from the years before but the technology that we learn now has improved." IN1: "I think to improve is to improve the technology and the work and technology that is now in 2021, that we should do the theory that was back in the day. It has improved more so we can improve theory more." IN2: "We got quite a bit of homework, and I must say the content we covered was rather outdated. Some of the textbooks are really outdated. Some of the things that we no longer use in speeches we still have to learn." IN2: "Something that we could adapt to something easy for us to adapt to like critical thinking it only clicks in the mind for some students we need something that like a lot of students can adapt to therefore we can do critical thinking in class. But these textbooks that we have on five or six seven year older. I feel that they are very outdated. They don't really promote critical thinking at all." IN3: "A lot of theory is outdated since technology updates quite frequently. I think that's also why people might find it a bit boring because it's not what we use anymore."
		Boredom due to irrelevant chapter/workload	IN3: "Some of the theory is quite nice to learn but the others just you don't need to know it like netiquette is quite a big part and is quite simple because you only need to be respectful to others but it's like an entire chapter." IN5: "I think the amount of content is reasonable but sometimes it can be overbearing." IN8: "I think people find it boring because when it comes to CAT like theory it's not really interesting because you go actually in depth on like PC parts and on how real life works on the internet and I think it's nothing like you do at home. I don't know how to explain it." IN8: "Sir it's not that much like there could be a lot more work but obviously a lot of people don't want it like that." IN8: "I must say, it's quite difficult to learn all the key words basically, like 'pharming,' 'phishing,' and all that, for one test."
		Prior knowledge makes theory boring	IN4: "I think some people already know quite a bit about CAT theory, which is probably why they find it boring, because they're not learning anything new." IN4: "Many people already know what to do in CAT; they already know the theory, and other people find it interesting because it's the first time they're dealing with computers and programming."

		Perception of frequent technology updates	IN1: "I think nowadays, you have a phone, so you see most of your new technology on your phone as it changes." IN2: "Sir, what I always do is, when a new phone comes out, I always Google its specs, and I like to stay ahead with technology. If you fall behind, it's difficult, like my Dad, he can't keep up anymore."
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Practical Application		Practical part of CAT	IN2: "Because I want to know more about certain components for example you can say you have to study like the practical using interphase you have to explain how it works. That is one of the best examples I can give at the moment." IN4: "I basically just took CAT to learn about practical work not any theory it doesn't really interest me the theory I just want to learn how to use the computer and get excel and word that's all." IN4: "Because I'm not really interested in what the computers are made of and all of that I just want to learn about excel and that." IN4: "I find the practical part I enjoy the practical more than the theory it's a lot of work and sometimes it's more difficult if I understand the practical I work the computer better." IN7: "Yes, I think when the Teacher says we're going to do theory today, it's a bit like, 'Oh, okay, theory.' But as soon as he says it's practical, everyone's excited. But theory is part of it; you need it to get through the year. We can't just do practical; we need to write theory." IN7: "I think many people chose CAT as a subject for the practical part and not the theoretical part. But with all subjects you take, there's going to be a bit more writing and a bit more book work than just computers. But overall, theory isn't as bad as I expected it to be. Obviously, the practical part is a bit better, but theory isn't too bad." IN7: "I think our practical are much better because you can physically interact with what you're doing. Like later when you have a job and you're working with Excel, it will help a lot with the theory behind it." IN8: "They probably say it's boring because you're not literally physically working with the computer, but you learn more about computers." IN8: "I said it's boring because CAT theory isn't as much fun as like when you practically do it on a PC. I find it easier." IN8: "Sir, I would say that most people prefer practical. Like they've all said they want to physically work on the PC. But I would also say that theory can get boring too because they go through every detail with you about the computer and what does what and how it works, and many people think it's useless and a waste. Uh, just a bunch of bull, you know."
		Motivation from personal use outside school	IN6: "But it's interesting because with CAT, I find it interesting not just because it's my best subject, but because I find more benefit in it in real life, in what I'm going to study, than if I had just done Maths now." IN7: "Well Sir I think we should spend more time (and that's my opinion obviously) on practical because let's say if we were to use CAT in real world it would not necessarily only be the theory part it would be the majority would be practical actually physical doing something we were taught in CAT that's way it would be better if you do more practical."

Motivation and Demotivation		Balance between theory and practical work	IN2: "I think for practical. They should split it up practical need more time for practical than you would for theory. I know obviously it won't fit into this Schools program." IN5: "The ratio of theory to practical is a bit overwhelming because there is so little practical stuff that we can actually use compared to the theory that we have to sit and learn, which is too much."
		Practical tasks enhance understanding	IN4: "Sir, I quite enjoy all the practical stuff we do because Sir teaches us new interesting ideas to get to know the stuff."
	Motivation	Good marks as strong motivation	IN2: "I would say maybe hold challenges and whether you are determent or not you get a good mark." IN5: "Good marks." IN5: "To get good grades. I want to do well in the subject." IN5: "Good results." IN7: "Probably getting it done gets you probably high opportunity to get better marks." IN7: "Good marks." IN8: "Just to pass. You get good grades on test. Good marks." IN6: "I would say it is actually a decent amount of work but like the difficulty of the work is if you don't study you will struggle if you study hard enough you will get good grades."
		Motivation from exam/test preparation	IN2: "What motivated me is when they say you should pay attention 70% in class and 30% you study. So, I always pay attention." IN3: "You get good results from the tests and that is what motivates you to study." IN4: "I feel you understand the work better it motivates you in the exam. It is easier when a test or exam comes." IN4: "Yes, Sir, I am usually very motivated by the fact that I know if I do my work in class and I focus in class I will do much better in my tests and my practical tests and yes that is my motivation." IN4: "Yes, I am always motivated in class and if I listen then I know I don't have to study too much for a test to know it and then I know it is in my memory. But I also understand why people wouldn't want to study or concentrate because they think there is always time to study because it's just easy."

		Intervention	IN1: "It motivates me more to do it because the teacher gives interventions if you don't do it." IN2: "Interventions" IN3: "I say good marks and not getting an intervention." IN5: "Getting interventions." IN7: "The fact that the school gives interventions if your homework isn't done and I only need a few more before I get detention."
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	• Level of interest	IN3: "I think it's about your interest, what you are interested in. Everyone is interested in different parts of computer science, and what you find interesting may not be interesting to someone else." IN4: "I find it very interesting because I'm learning a lot of new things that I didn't know before." IN4: "Sir I like to basically do my work in class so it gets done in class so if there is something I don't know so that I can always ask the Teacher so I don't have to struggle at home I can always ask the Teacher and do it in class." IN5: "I want to learn more about the subject." IN7: "Sir I feel that am the marks will at time reflect what people's opinion are on the subject. So, if you have a lot of people with good marks you have a lot more am I say positive adjectives but then if you have more people who do a little bit worse in the subject they probably negatively reflect on the subject far more." IN7: "I just think that when I get home, I'm not really in the mood to do any more schoolwork or just what I'm trying to say is there are better things to do than schoolwork." IN8: "Especially when we're busy with our task in class and everyone's like there's nothing else to do, then you just finish it as quickly as you can." IN8: "I would say theory is interesting to me because, as I know, even though if you know what's going on in theory, you will also understand better what happens with a computer and what's what." IN4: "Well, usually what I'll do is I'll do a CAT thing and then I'll also get other work done during the day. I know CAT is easy but it takes time to process an Excel spreadsheet or a Word document so yeah." IN4: "I think the theory is a lot but I find it easy to do because I really like the theory and the practical aspect of CAT. So, I don't find it challenging to learn."
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	Demotivation	Lack of understanding demotivates	IN1: "What demotivates me Sir is if like they give a topic and I don't understand the work I won't enjoy it." IN6: "If you weren't in class and you have to do homework and you don't know what's going on, then it's quite difficult."
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		• Demotivation from outdated programs	IN2: “The thing that demotivates me is that if you focus on one thing the entire time. Like you can say its and old program and we keep on learning about old programs instead of new one each two or three years then it starts demotivating me.”
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		• Demotivation from long activities and heavy workload	IN4: "I guess the workload. Sometimes the theory work is a lot and sometime it takes a lot of time." IN8: "I think the amount of work that we were given and the time that is needed to like do it, it's quite a lot so I don't really now." IN8: "Especially when the homework is quite a lot and you've worked on all the questions beforehand but you still don't really know how it is, and you have to keep going back and forth, especially for each question, especially if there are many questions."
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		Demotivation from overwhelming workload	IN4: "Basically, just consume time. Very time consuming." IN4: "I don't know I have studied it for a test and that it's a lot of work sometimes." IN5: "Because of the amount of homework that we get. You don't think sometimes it's necessary but it is." IN8: "If it's mostly like summaries and it's just about learning those key words. If you have to learn everything like a parrot or even just read, it's not really boring because yeah, I don't know how to explain it but yeah."
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		Boring	IN3: "Mainly like I get like a lot of amount of like homework. Or it's like stuff that I really don't find interesting or that I don't want to use after School or so on. Or it's not something that is in my interest then I don't want to do it." IN1: "It wasn't boring." IN5: "I think it's because most people focus on the theory part and some people want to focus on the gaming part. So, people that probably said it was boring they just focussed on the theory on how boring that was and people that said it was interesting they just thought about gaming and how fun that was." IN7: "Some people probably don't have the perseverance like the others, that's why they find it boring and some others find it interesting." IN3: "Some of the work we doing like with computers I find people find more interesting like some of the other stuff not involving the like main computer parts. Like some people find that a little bit boring."
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General	Resources	Physical resources	IN2: "Regulate the textbooks, as in every say like every two, three years. Create new textbooks maybe e-books could be use full, they are easy to update and don't cost as much and you don't have to print." IN3: "You can research it."
		Family Members	IN4: "I usually ask my dad because he works a lot with Excel and Word; he took IT courses around 1990." IN4: "I usually ask my dad because he does IT; if I struggle, I'll ask him how to do it." IN4: "Sir, I usually ask my brother because he's very good with these kinds of things; if I'm unsure about something, I usually go straight to him."
		Collaborative learning	IN4: "We usually do our theory in class then we ask among each other. If one maybe knows something the other one doesn't then we can work it out." IN5: "Maybe help from others."
		Learner activities	IN3: "Go online and research the newer technology if you really want to know more about it." IN6: "Listen in class." IN6: "Summarise it." IN6: "Sometimes I'll just go through it at home."

		• Enjoyability	IN1: "I think I found it (Theory content) interesting to do the work" IN1: "I think it was interesting because you can learn and do things as you progress." IN5: "I think people who said it's boring are the ones who just took CAT because they think it's an easy subject, and people who say it's exciting are the ones who took CAT because they wanted to." IN6: "The new way that we tried with the Classcraft it was really interesting and was a fun way of learning because in the new day in age everybody plays games and the way we learned was I didn't find it boring because really, I really enjoyed it, it was a fun and easier way to learn in class." IN6: "As I said I really enjoy the subject and if I just sit and don't listen I'm not going to do well in my test so obviously good grades motivates you to listen in class" IN6: "I enjoyed the Classcraft way of teaching more than to the traditional old just to the book way." IN7: "Sir I think it's just varies like some people may find one topic particularly interesting and the other one not at all so it just varies between what they doing at the moment in theory Sir." IN7: "I'd say before having theory be more online or having some sort of goal or motivation in a way it becomes quite boring and repetitive so it starts to get overwhelming in a way and after Classcraft it changing every week, its different so you don't know what is going to happen. And the way that you get thought everything just helps you stick in your mind a lot more." IN7: "Yes. I enjoy it lot more Sir because you know we interact a lot more and it's almost like a competition and everybody obviously likes a competition and competing. So that is another big factor which encourages you to obviously do well and try to perform better. And it's a lot more interesting than just clicking thru slides and stuff above theory. Like today most stuff happens online and on devices. So as soon as you tell Students we will be doing theory in a more practical way everyone will start enjoying it more." IN3: "Some part of the theory is fine that what we use we find is interesting. Other parts I don't find exciting to do."
		• Attention span	IN2: "As it is, sometimes it's difficult to pay attention in class because the periods are long, especially when you're learning theory from the board and the teacher is standing there in front and walking around." IN2: "I think not much can make me concentrate for 50 minutes. "

Annexure L: Turnitin similarity index

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