

**Developing number sense for Grade 1 learners with
severe intellectual disabilities: Exploring teachers'
pedagogical content knowledge**

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DECLARATION

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

A handwritten signature in black ink, appearing to read 'Labuschane', is positioned above a horizontal line.

Signature

Date: 24/11/2023

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PREFACE

As I conclude my postgraduate studies at the North University's Potchefstroom campus, the completion of this dissertation is a significant milestone in my academic journey. This research, titled "Developing number sense for Grade 1 learners with severe intellectual disabilities: Exploring teachers' pedagogical content knowledge", delves into a crucial aspect of education for learners with severe intellectual disabilities (SID). Through this work, I strived to enhance comprehension of how teachers' pedagogical content knowledge (PCK) can have a positive impact on the development of number sense for learners with SID.

This journey has been a transformative one, marked by challenges, revelations and profound moments of learning. My wish is that the insights and findings presented in this dissertation would not only enrich the PCK knowledge of teachers but also ignite broader discussions on fostering more equitable educational experiences for all learners, particularly within the context of schools catering to learners with SID.

I would like to extend my gratitude to all those who have been part of this remarkable journey and made this dissertation possible.

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I consider myself incredibly fortunate to have been granted the opportunity to pursue my postgraduate studies at the North University's Potchefstroom campus. This journey towards earning my MEd degree has been nothing short of life-transforming, and for that, I owe a profound debt of gratitude to the exceptional individuals who provided me with unwavering support, patience and guidance. Without their dedicated assistance, this academic endeavour would have remained an unattainable dream, and it is to them that I offer my heartfelt thanks.

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Annamarie van Wyngaard, your steadfast support and willingness to listen have been invaluable to me.

To my other family and friends, thank you for believing in me and offering your support throughout this journey.

Your contributions, whether big or small, have made a significant impact on my academic and personal growth. Your unwavering belief in me has been a driving force in my pursuit of

knowledge and in the completion of this dissertation. Thank you all for your steadfast support and encouragement.

ABSTRACT

The aim of this study was to explore the interplay between teachers as learning specialists, Grade 1 learners with severe intellectual disabilities (SID), and number sense development. In the context of learners with SID, the acquisition of number sense transcends mere educational attainment – it holds the potential to foster independence and a meaningful connection to the world. Through an in-depth examination of teachers' pedagogical content knowledge (PCK), barriers to learning experienced by learners with SID, and the multifaceted world of number sense, this study uncovers the intricate dynamics that shape this essential journey. By shedding light on the pivotal role of teachers – specifically in terms of their topic-specific pedagogical content knowledge (TSPCK) – in bridging the gap between learners with SID and the intricate realm of number sense development, this research provides invaluable insights. These insights serve as a foundation to inform and refine teaching strategies and pedagogical knowledge and emphasises the necessity of cultivating TSPCK tailored for number sense development. Ultimately, this research empowers teachers to unlock the potential for a more independent and fulfilling life for learners with SID through the comprehensive development of number sense.

Research questions:

To achieve the research purpose, the main research question was formulated as follows:

- How do teachers use PCK when they teach number sense to Grade 1 learners with SID?

To explore the main research question, the secondary questions were as follows:

- What training did teachers receive to use PCK when they teach number sense to Grade 1 learners with SID?
- How do teachers apply PCK when teaching number sense to learners with SID?
- What challenges do teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID?

Theoretical framework:

The study's theoretical framework is built upon the seminal contributions of Piaget and Shulman, which offer a solid groundwork for comprehending the developmental phases of

learners and their Pedagogical Content Knowledge (PCK). Piaget's cognitive learning theory, focusing on developmental stages, equips teachers with a thorough understanding of the cognitive mechanisms that drive learning. Shulman's consensus model of PCK further enhances this understanding by emphasizing the interplay between subject matter knowledge and pedagogical skills, crucial for effective teaching.

Brief overview of the research design and methodology and summary of the study's findings:

In this study, a qualitative interpretive case study research design with a phenomenological approach was used. The study involved observing and interviewing teachers who taught number sense to Grade 1 learners with SID. The study investigates the role of PCK in supporting learners with SID. The study identifies strong teaching strategies across all data sources, with a particular focus on teaching strategies mentioned in the CAPS for Learners with SID and effective teaching strategies observed in focus group interviews and semi-structured individual interviews. Teachers' prior knowledge is discussed, linking learners' prior knowledge with training and challenges such as time constraints, learners' abilities, and assessments. The theme of learners with SID and barriers to learning is identified, alongside strategies to support number sense development and classroom organization. Lesson plans and resources are also discussed. Overall, the study emphasizes the importance of enhancing teachers' PCK to improve teaching effectiveness and prepare learners for life after school.

Keywords: learners with severe intellectual disability (SID); number sense development; pedagogical content knowledge (PCK); topic-specific pedagogical content knowledge (TSPCK); special educational needs; schools; Grade 1

OPSOMMING

Hierdie studie het ten doel gehad om die wisselwerking tussen onderwysers as leerspesialiste, graad 1-leerders met erge intellektuele gestremdhede (EIG), en getalbegripontwikkeling te verken. Binne die konteks van leerders met EIG, strek die aanleer van getalbegrip verder as blote opvoedkundige bereiking; dit kan onafhanklikheid en 'n betekenisvolle verbintenis met die wêreld bevorder. Deur 'n diepgaande ondersoek van onderwysers se pedagogiese inhoudskennis (PKK), leerhindernisse wat leerders met EIG ondervind, en die veelvlakkige wêreld van getalbegrip, ontbloom hierdie studie die ingewikkelde dinamika wat hierdie noodsaaklike reis vorm. Deur lig te werp op die deurslaggewende rol van onderwysers, spesifiek in terme van hul onderwerpspesifieke pedagogiese inhoudskennis (OSPIK) – in die oorbrugging van die gaping tussen leerders met EIG en die ingewikkelde veld van getalbegripontwikkeling – bied hierdie navorsing onskatbare insigte. Hierdie insigte dien as 'n grondslag om onderrigstrategieë en pedagogiese kennis in te lig en te verfyn, wat die noodsaaklikheid beklemtoon om OSPIK te kweek wat vir getalbegripontwikkeling aangepas is. Uiteindelik bemagtig hierdie navorsing onderwysers om die potensiaal vir 'n meer onafhanklike en vervullende lewe vir leerders met EIG te ontsluit deur die omvattende ontwikkeling van getalbegrip.

Navorsingsvrae:

Om die navorsingsdoel te bereik, is die hoofnavorsingsvraag as volg geformuleer:

- Hoe gebruik onderwysers PKK wanneer hulle getalbegrip aan Graad 1 leerders met EIG onderrig?

Om die hoofnavorsingsvraag te verken, was die sekondêre vrae soos volg:

- Watter opleiding het onderwysers ontvang om PKK te gebruik wanneer hulle getalbegrip aan Graad 1 leerders met EIG onderrig?
- Hoe pas onderwysers PKK toe wanneer hulle getalbegrip aan leerders met EIG onderrig?
- Watter uitdagings ervaar onderwysers wanneer hulle PKK toepas wanneer hulle getalbegrip aan Graad 1 leerders met EIG onderrig?

Teoretiese raamwerk:

Die teoretiese raamwerk van hierdie studie is gegrond op die baanbrekerswerk van Piaget en Shulman, wat 'n stewige grondslag bied vir die begrip van leerders se ontwikkelingsfases en PIK, onderskeidelik. Piaget se teorie, met sy klem op ontwikkelingsfases, bied onderwysers 'n omvattende begrip van die kognitiewe ontwikkeling wat leer ondersteun. Shulman se konsensusmodel van PIK versterk hierdie begrip verder deur die wisselwerking tussen vakinhoudkennis en pedagogiese vaardighede te beklemtoon, wat noodsaaklik is vir doeltreffende onderrig.

Kort oorsig van die navorsingsontwerp en -metodologie en opsomming van die studie se bevindings:

In hierdie studie is 'n kwalitatiewe interpretatiewe gevallestudie navorsingsontwerp met 'n fenomenologiese benadering gebruik. Die studie het waarneming en onderhoude met onderwysers wat getalbegrip aan Graad 1-leerders met EIG onderrig, betrek. Die studie ondersoek die rol van PIK in die ondersteuning van leerders met EIG. Die studie identifiseer sterk onderrigstrategieë regoor al die data-bronne, met 'n spesifieke fokus op onderrigstrategieë wat in die KABV vir Leerders met EIG genoem word, en effektiewe onderrigstrategieë wat in fokusgroep-onderhoude en semi-gestruktureerde individuele onderhoude waargeneem is. Onderwysers se voorafgaande kennis word bespreek, wat leerders se voorafgaande kennis koppel aan opleiding en uitdagings soos tydbepelings, leerders se vermoëns en assesserings. Die tema van leerders met EIG en hindernisse tot leer word geïdentifiseer, tesame met strategieë om getalbegrip-ontwikkeling en klaskamerorganisasie te ondersteun. Lesplanne en hulpbronne word ook bespreek. In die algemeen beklemtoon die studie die belangrikheid daarvan om onderwysers se PIK te versterk om onderrigseffektiwiteit te verbeter en leerders voor te berei vir lewe na skool.

Sleutelwoorde: leerders met erge intellektuele gestremdhede (EIG); getalbegripontwikkeling; pedagogiese inhoudskennis (PIK); onderwerpspesifieke pedagogiese inhoudskennis (OSPIK); spesiale onderwysbehoeftes; skole; Graad 1

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CHAPTER 1: ORIENTATION AND BACKGROUND

1.1 INTRODUCTION AND BACKGROUND

The essence of independent living is the ability to understand number concepts and developing a sense of numbers (Department of Basic Education [DBE], 2018). The ability to understand numbers and the skills to work with numbers plays a crucial role in an individual's daily life, enabling a person to navigate and control various aspects of it (Brown, 2018). However, learners with severe intellectual disabilities (SID) face particular challenges in developing a sense of numbers (Schnepel et al., 2020). Number sense involves various skills for daily life activities, including recognising number symbols (such as 1, 3, 5), counting objects, naming and valuing numbers (one, three, five), understanding place value (tens and ones), comparing and ordering numbers (1, 2, 3) (DBE, 2018; Naudé, 2014). It is believed that a solid understanding of numbers forms the foundation for developing mathematical abilities and skills. This involves understanding the representation of numbers according to their value. Learners using these skills can apply them to any mathematical problem (Brown, 2018; Carr et al., 2020; Yilmaz, 2017). Additionally, mastering numbers entails recognising patterns, leveraging numerical resources, and effectively manipulating them in various activities (Yaman, 2015).

In the case of learners with SID, developing a number sense presents significant challenges, as they struggle to grasp numbers as a concept. Their learning progress hinges on specific competencies such as connecting numbers to quantities (Sermier et al., 2019; Zhang & Holden, 2023). While number sense generally improves with age in typically developing learners, the same pattern does not hold true for learners with SID. Therefore, the goal of teaching numerical skills to learners with SID is to enable them to contextualise numbers and actively participate in real-world situations like cooking, counting and handling money (Cheong et al., 2017; DBE, 2018). Achieving these differentiated learning goals for learners with SID requires thoughtful and tailored instructional strategies (Nickerson & Whitacre, 2010; Thapliyal et al., 2022). To effectively implement differentiation, teaching strategies should be employed while considering learners' individual needs. Strategies may involve organising learners into groups based on their support requirements, such as high support and low support, and then implementing various approaches like learning centres, interest groups and group investigation (DBE, 2018; Gentry et al., 2013). One reoccurring individual need learners display in teaching and learning is one-to-one support.

Teaching Grade 1 learners with SID foundational concepts of mathematics in a South African setting for special educational needs is a daunting task (DBE, 2018; Eksteen, 2014; Onyishi & Sefotho, 2021). Several factors may influence the teaching of number sense to Grade 1 learners in highly specialised classroom settings such as for learners with SID (DBE, 2018). The specific

challenges experienced by individual learners with SID, teachers' knowledge, the classroom organisational strategies employed, and the teaching strategies employed influence learners' ability to develop mathematical concepts (DBE, 2011).

To understand the educational challenges experienced by learners with SID, it is vital to clarify the meaning of SID. The Diagnostic and Statistical Manual of Mental Disorders V (DSM-V) classifies SID as a significant sub-average intellectual functioning (IQ of 70 or below) or manifested deficits in cognitive, functional and adaptive skills (American Psychiatric Association [APA], 2013; Wu & Boat, 2015). *Limited cognitive functioning* refers to a learner with an intellectual limitation that influences skills such as conceptual skills, social skills and practical skills. For this study, I focused on the challenges teachers experience due to the learners' limited conceptual skills when the teachers teach number sense (Shree & Shukla, 2016). Learners' cognitive limitations are evident in their processing, thinking, memory and attention (Ribner et al., 2018; Schnepel et al., 2020).

Learners diagnosed with SID progress and are promoted based on their age and not according to their scholastic performance or chronological age (DBE, 2018). Although the expected chronological age for Grade 1 learners with SID in a South African special educational needs school is eight to nine years old (DBE, 2018), this is not always the case. Learners' ages in special educational classrooms can vary considerably due to their varying developmental stages. A teacher may have some learners in the class who function at a Grade 1 level, while other learners may function at a higher level (e.g., Grade 2). Teachers are therefore expected to teach the same concept (e.g., numbers) to learners at different developmental stages in the same classroom. This study focuses on the developmental level of a Grade 1 learners with SID.

In the context of a learner with SID, numerical skills need to be included in the classroom activities to equip the learner to apply the knowledge, skills and values that they will use in everyday social situations (DBE, 2018), for example, managing their budgets under supervision (Cheong et al., 2017). By having numerical skills, learners with SID can become self-sustaining critical thinkers who can partake in society as capable and economically active citizens (DBE, 2018). A well-developed sense of numbers can help them with independent functioning in everyday interactions where these skills are applicable (Wu & Boat, 2015).

As mentioned earlier, the underlying fundamental concept of developing a number sense is having a solid understanding of numbers as a concept. A solid grasp of numbers is also important to learners who struggle to connect numbers and quantities. The concept "number(s)" is a sub-set of the content area "Number, Number Operations, and Relationships" and focuses specifically on the development of learners' understanding of actual numbers such as 1, 4 and 7 and includes knowing number symbols, number values and number names (DBE, 2018). This content area is derived from the learning programme CAPS for Learners with SID, Mathematics.

Teachers' practical pedagogical content knowledge (PCK) plays a crucial role in teaching number sense (Kola & Sunday, 2015). The richness of a teacher's PCK strongly influences the effectiveness of teaching mathematics (Zelkowski et al., 2013). PCK is a combination of pedagogical knowledge and content knowledge (Shing et al., 2015). A study by Anders and Rosbach (2015), which focused on mathematics teaching for lower grades, concluded that the richness of teachers' PCK in mathematics varies considerably between the different content areas. The highest levels of PCK are present in "Number, Number Operations, and Relationships", and the lowest levels of PCK in "Space and Shape". As this study focused on classrooms for learners with SID at a Grade 1 developmental level, it was important to determine whether the same richness of PCK was present in the teaching of number sense to learners with SID. This is vital because understanding the level of PCK in teaching number sense to learners with SID ensures that adaptive teaching strategies are appropriately designed to meet learners' unique needs (Mazibe et al., 2023).

1.2 PROBLEM STATEMENT

Learners with SID face unique challenges when learning about numbers. The mathematical development of learners with an intellectual disability is believed to be similar but delayed to that of typically developed learners (Geary, 2013; Kumatongo, 2019; Schnepel et al., 2020). Added to this delayed development is the individual needs of each learner with SID.

It is, however, difficult to establish whether the diminished mathematical learning development of learners with SID is a result of their limited cognitive functioning or the result of "insufficient or inappropriate support" offered by teachers due to the teachers' insufficient knowledge of the existing challenges when teaching learners with SID (Schnepel et al., 2020). The intensity of support needed by learners with SID to overcome the impact of SID on their learning is acknowledged in the Education White Paper 6 (EWP6), (DoE, 2001) alerting various stakeholders to the need for specialised knowledge of these learners' individual needs (DBE, 2018).

Schnepel and colleagues (2020) highlight the lack of successful and appropriate support offered to teachers teaching learners with SID. Allam and Martin (2021) support this argument by pointing out that these teachers do not always receive special training and may experience a sense of not being qualified to teach learners with SID. Furthermore, the study revealed a lack of different teaching strategies and a lack of an effective learning environment to support learners with SID because of insufficient budget, curriculum guidance and teacher-learner support material (TLSM). This lack of support has a direct influence on teachers' use of PCK.

In South Africa, teaching mathematics in schools for learners with SID is guided and supported by two official documents. The *Education White Paper 6, Special Education Needs – Building an*

Inclusive Education System (EWP 6) of 2001 (Department of Education [DoE], 2001) refers to the use of desired teaching strategies that will help overcome the impact of different disabilities in a differentiated setting and meet the individual special needs of learners. It does, however, not provide further guidance on the nature of these desired teaching strategies and how they should be adapted to suit different disabilities in differentiated settings. The mathematics learning programme adapted for learners with SID is captured in the “newly” developed Curriculum Assessment Policy Statement (CAPS) for learners with SID (DBE, 2018). CAPS for learners with SID advocates a developmentally appropriate teaching and learning foundation that calls for differentiated content and an adapted pedagogy (Amaro, 2022). Content differentiation should be achieved by reducing the knowledge and skills required in terms of depth and breadth to be at a more functional level. Teachers must enact the differentiation based on the general guidelines provided by the learning programme. Further differentiation at the pedagogical level should focus on activity-based learning (DBE, 2018). The DoE encourages teachers to be innovative and to create appropriate teaching strategies for responding to the unique and variable needs of learners with SID (DBE 2011).

Teaching learners with SID, therefore, requires teachers to think innovatively and creatively rather than drawing from procedural or routine teaching knowledge (Kovacs et al., 2018). The challenge for teachers who teach learners with SID is to design individualised instruction that provides the optimal amount of holistic stimulation to learners who suffer from a diverse set of cognitive and physical barriers (Donohue & Bornman, 2014; Kempen & Steyn, 2016). The purpose of this study was to explore how teachers draw on their PCK when teaching number sense to Grade 1 learners with SID (Ball et al., 2008).

The current state of scholarly work regarding the topic of teaching mathematics to learners with SID is multifaceted. Researchers have investigated the unique challenges faced by these learners, the similarities and differences in their mathematical development compared to typically developed learners, and the factors that influence their learning outcomes. Aguhayon et al. (2023) highlights the importance of specialized knowledge and support for teachers, the need for differentiated teaching strategies, and the role of the curriculum in addressing the individual needs of learners with SID. Additionally, there is a growing emphasis on the importance of innovative and creative teaching approaches that go beyond procedural or routine methods (Maass et al., 2019). The Education White Paper 6 (EWP6) and the Curriculum Assessment Policy Statement (CAPS) for Learners with SID provide guidelines for teaching mathematics to learners with SID, but there is a need for further research to explore the effectiveness of these strategies in practice. Overall, the current state of scholarly work underscores the complexity of teaching mathematics to learners with SID and the importance of ongoing research and professional development to support teachers in meeting the diverse needs of these learners.

1.3 RESEARCH QUESTIONS

To achieve the research purpose, the main research question was formulated as follows:

- How do teachers use PCK when they teach number sense to Grade 1 learners with SID?

To explore the main research question, the secondary questions were as follows:

- What training did teachers receive to use PCK when they teach number sense to Grade 1 learners with SID?
- How do teachers apply PCK when teaching number sense to learners with SID?
- What challenges do teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID?

1.4 AIM AND OBJECTIVES

The aim of the study was to explore how teachers use PCK when they teach number sense to Grade 1 learners with SID. To reach this aim, the objectives were as follows:

- to explore the training that teachers receive to use PCK when they teach number sense to Grade 1 learners with SID
- to investigate how teachers apply PCK when teaching number sense to learners with SID
- to identify and describe the challenges teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID.

1.5 CLARIFICATION OF CONCEPTS

The clarifications of the critical concepts used in this study are provided as operational definitions only. The theoretical context of the concepts is addressed in greater detail in chapter 2.

1.5.1 Number sense

As explained in the introduction, the concept “numbers” is a sub-set of the content area “Number, Number Operations, and Relationships” and focuses on developing learners’ understanding of actual numbers such as 2, 4 and 6. This development of number sense includes knowing and understanding number symbols, numerical values and number names (DBE, 2018). Number knowledge is a crucial part of the hierarchical development of number sense which results in skills that enable learners to work with numbers (DBE, 2012). Number sense incorporates the meaning and relationship of different kinds of numbers, the relative size of different numbers, the representation of numbers in various ways, the effect of operating with numbers and the ability to estimate and check solutions (Paulsen & Dednam, 2016).

1.5.2 Severe intellectual disability (SID)

The Screening, Identifying, Assessment and Support (SIAS) document (DBE, 2014) lists the following types of disabilities: multiply disabled, deaf, hard of hearing, blind, partially sighted, deaf/blind, cerebral palsy, specific learning disability, behavioural disorder, mild or moderate intellectual disability, severe intellectual disability, physical disability, autistic spectrum disorders, epilepsy, and attention deficit disorder, with/without hyperactivity. Early childhood diagnosis is based on disagreement about considerable cognitive, speech and motor development (DBE, 2012). The DSM-V (APA, 2013) classifies SID as a significant sub-average intellectual functioning (IQ of 70 or below) or a manifestation of deficits in cognitive, functional and adaptive skills (Wu & Boat, 2015) that exist concurrently with deficits in two or more adaptive behaviours such as practical skills, conceptual skills and social skills (APA, 2013).

1.5.3 Pedagogical content knowledge (PCK)

PCK is conceptualised as a unique domain of teacher knowledge that focuses on the ways of representing and formulating the subject to make it comprehensible to others (Shulman, 1986). In this study, the consensus model of PCK was employed to assess teachers' subject knowledge in mathematics teaching practices (Molefe & Stears, 2014; see Figure 2.2). This allows the teacher to teach mathematical concepts relevant to the learner (Chikiwa et al., 2019). Shulman's PCK framework has emerged as a valuable resource in educational research. PCK refers to the specialised knowledge that teachers possess, encompassing not only their content knowledge but also the strategies, skills and pedagogical approaches required to convey that content effectively to learners (Shing et al., 2015). In this study, my focus extended to the exploration of PCK within the domain of number sense development in Grade 1 learners.

1.5.4 Curriculum and Assessment Policy Statement Grade R-5 for Learners with Severe Intellectual Disability

In the South African education system, a CAPS specifically designed for learners with SID is used in schools for learners with special educational needs. While this CAPS has not been officially gazetted, the DoE mandates schools to implement an adapted learning programme aligned with its principles. This highlights the commitment of the DBE to provide educational opportunities for learners with SID even though the CAPS for this specific group may not have undergone the formal gazetting process. By instructing the adapted learning programme based on the principles of CAPS, schools strive to cater to the unique needs and abilities of learners with SID, ensuring a more inclusive and supportive educational experience (DBE, 2018).

1.6 THEORETICAL FRAMEWORK

The theoretical framework of this study is grounded in the seminal works of Piaget and Shulman, which provide a robust foundation for understanding learners' developmental stages and PCK, respectively. Jean Piaget's contributions to the field of education have been profoundly influential, providing a solid foundation for understanding how learners acquire knowledge. In this study, I recognised Piaget's central role in shaping educational theory and practice. Piaget's cognitive learning theory (Piaget 1957), particularly his developmental stages, forms the cornerstone of my exploration. Understanding these stages was vital, as they lay the groundwork for comprehending the cognitive development of learners, which, in turn, informs teaching strategies and curriculum development.

Piaget's cognitive developmental theory outlines four key stages: the sensorimotor stage; the preoperational stage; the concrete operational stage; and the formal operational stage (Babakr et al., 2019). These stages reflect the evolving cognitive capacities of typically developing learners as they progress through their educational journey. I delved into the application of these stages within the context of number sense development for Grade 1 learners with SID. Examining how these stages relate to early mathematical learning is crucial for devising effective teaching strategies, lesson planning and a learning programme for Grade 1 learners with SID. Piaget's developmental stages are a fundamental component of subject matters in education because they provide a framework for understanding how learners' cognitive abilities evolve and, therefore, influence how teachers design and deliver instruction to match the cognitive readiness of their learners.

Teachers are often referred to as learning specialists (Guerriero, 2014). The underlying idea is that teachers possess a unique knowledge base (Moje, 2015). For teachers to be effective, they need to make practical and effective use of different types of knowledge that go beyond the understanding of the subject matter (Stronge, 2018), are multifariously varied, and require a deep understanding of various knowledge bases (Diezmann & Watters, 2015). Shulman (1986, 1987) describes teacher knowledge as consisting of seven categories: content knowledge; general pedagogical knowledge; curriculum knowledge; PCK; knowledge of learners; knowledge of educational contexts; and knowledge of educational aims, purposes and values (Shulman, 1987). Although all categories of teacher knowledge are crucial, studies have revealed that the richness of a teacher's PCK strongly influences the effectiveness of teaching mathematics (Zelkowski et al., 2013). Lee et al. (2018) believe that PCK is critical to learners' understanding and achievement in mathematics.

Shulman's (1986) theory on PCK formed the conceptual framework for exploring teachers' PCK when teaching number sense to Grade 1 learners with SID (§ 2.2). This study focused on the use of PCK to teach a specific topic (number sense) and, as such, the concept topic-specific

pedagogical content knowledge (TSPCK) formed part of the conceptual framework of the study. These concepts are discussed in chapter 2 in the context of teaching number sense to learners with SID.

By investigating teachers' PCK, I aimed to gain a comprehensive understanding of how teachers could best facilitate the development of number sense for learners with SID. This includes their knowledge of the subject matter, their ability to adapt teaching methods to the developmental stage of the learners, and their understanding of potential challenges and misconceptions in number sense acquisition. This research sought to shed light on the dynamic interplay between Piaget's cognitive developmental stages and Shulman's PCK framework to enhance the teaching of number sense to Grade 1 learners. Some learners, particularly those with disabilities, may not have fully developed early mathematics skills such as number sense and counting skills when they begin Grade R. This is not solely a result of their disability; it can also be attributed to factors such as limited exposure to, experience with, or ineffective teaching of mathematics skills (Witzel et al., 2023).

Building on this foundation, a thorough examination was conducted of the strategies and techniques employed by teachers to develop number sense for their learners. Through the lens of Piaget's developmental stages and PCK framework, this study aspired to offer insights into the most effective pedagogical practices for early mathematics teaching.

In conclusion, the profound significance of comprehending Piaget's developmental stages cannot be overstated for teachers teaching Grade 1 learners with SID, as it serves as the bedrock of their PCK. This knowledge empowers teachers to provide tailored instruction, individualised support, learning programme adaptations, differentiated teaching strategies, and effective progress assessment, thereby fostering an inclusive learning environment for learners with SID. In the broader context of this theoretical framework, it is clear that the integration of Piaget's cognitive learning theory and Shulman's PCK framework is instrumental in guiding the research on number sense development among Grade 1 learners. This synthesis will be instrumental in our exploration of teaching practices and their profound influence on the cognitive development of learners with SID in the realm of developing a sense of numbers. These concepts are discussed in chapter 2 in the context of teaching number sense to learners with SID.

1.7 RESEARCH METHODOLOGY

In this study, a qualitative interpretive (§ 3.2.1) case study research design with a phenomenological approach was used. The study aimed to explore how teachers use PCK when teaching number sense to Grade 1 learners with SID. The data had to be qualitative in nature. Qualitative research aims to gather comprehensive insights into and a deeper understanding of

people's concepts, opinions and experiences (Saldaña, 2021). Qualitative research relies on people's words or non-numerical data (Eyisi, 2016) and therefore it falls within an interpretive paradigm (Nieuwenhuis, 2019a). Qualitative research is also a process of using naturalistic research methods that seek an in-depth understanding of social phenomena within a particular natural setting by investigating the meanings people ascribe to their behaviour, actions and interactions with others (Mustofa, 2019).

Case study research is effective as a methodology as it provides an in-depth understanding of complex educational problems that can inform professional practice by understanding exemplary "cases" (Yin, 2018). In case study research, the aim is to acquire an in-depth understanding of teachers' subjective experiences and meaning-making processes (Leavy, 2014). The focus on exemplary cases, as well as the focus on experiences and meaning, made the choice of a case study design relevant to this study with its focus on the presence of PCK enacted within the real-world context of teaching number sense to Grade 1 learners with SID.

Qualitative data generation involves the process of selecting, interpreting and organising information for analysis and understanding of the phenomenon by collecting data that would allow the researcher to answer the research questions (Flick, 2017). Data generation methods in this study were document analysis, semi-structured individual interviews and focus group interviews, and the data were analysed using a general qualitative analytical strategy.

Permission was obtained from the Gauteng DBE to collect data from teachers. Informed consent was sought from the 12 teachers who were invited to participate in the study. To ensure confidentiality, codes were assigned to schools (School A–E) and participants (Teacher 1–12). Six schools in a Gauteng region catering to learners aged three to 18 were initially considered for participation in the study. All of these schools offered SEN services for learners with SID. Out of these six schools, five agreed to participate, resulting in the initial invitation of 15 potential participants (i.e., teachers). Ultimately, 12 participants were successfully recruited based on specific selection criteria and their responses to the invitations. The participant selection criterion was as follows: teachers who were actively teaching learners at the Grade 1 developmental level according to CAPS for Learners with SID. It is important to note that the study was not limited to Grade 1 teachers teaching eight- and nine-year-old learners with SID.

1.8 CONTRIBUTION OF STUDY

Given the complexity of teaching learners with SID, practical knowledge around the specific PCK required by teachers is much needed in the South African context. Studying and identifying the knowledge needed to teach learners with SID and the skills and strategies teachers and learners need for the regular day-to-day demands may contribute to local knowledge in the field of number

sense development for Grade 1 learners with SID. Given the practice-based underpinning of PCK, its use as a theoretical framework enabled me to provide a more in-depth view of mathematics teaching that focuses more on learners' special educational needs (Nolan et al., 2015).

1.9 CHAPTER OUTLINE

- **Chapter 1: Orientation and background**

This chapter provides an overview of the research study, including the research problem, the phenomenon under study, knowledge gap, research questions and aims.

- **Chapter 2: Pedagogical content knowledge for number sense development**

Chapter 2 serves as the foundational framework for this study and focuses on two crucial theories that underpinned the research: Piaget's (1957) cognitive learning theory, particularly his developmental stages, and Lee Shulman's (1986) consensus model of PCK. I begin by delving into the specifics of Shulman's framework, with an emphasis on TSPCK, directly relevant to my examination of teachers' PCK and number sense development, the central theme of this study. Next, I explore the concept of teachers as learning specialists, highlighting their specialised and profound understanding of the subjects they teach, often referred to as TSPCK, and discuss the characteristics that define it.

Given my research focus on teachers' PCK, I also address a critical aspect of the study titled *Developing number sense for Grade 1 learners with severe intellectual disabilities*. I initially provide context by discussing learners with SID. Subsequently, I shift the focus to number sense development, emphasising the essential teaching strategies and the pivotal role of activity-based learning in achieving this objective (§ 1.6).

- **Chapter 3: Research methodology and design**

Chapter 3 elaborates on the research design and methodology as discussed briefly in chapter 1. The explanation for selecting a qualitative case study and positioning it within the interpretive research paradigm is provided. The case study, participant selection and the data collection and analysis process that were followed are discussed. The chapter concludes with a discussion on the ethical aspects that were applicable to study, followed by a discussion on how the trustworthiness of the findings was ensured.

- **Chapter 4: Data analysis and findings**

The fourth chapter offers a detailed description of the analysis process and presents the results and discusses the findings. The findings are discussed in the context of the conceptual framework proposed in chapter 2.

- **Chapter 5: Conclusions, contributions, limitations and recommendations for further study**

Chapter 5 discusses the conclusions drawn from this study, highlights the contributions of the study, acknowledges the limitations, and sets the stage for future research on teachers' PCK and its influence on developing number sense for Grade 1 learners with SID. The rationale behind selecting the research topic (i.e., *Developing number sense for Grade 1 learners with severe intellectual disabilities: Exploring teachers' pedagogical content knowledge*) is revisited. The research objectives, scope and theoretical foundations are discussed, alongside a reiteration of the primary research question. However, the chapter does not shy away from recognising inherent research limitations and recommendations are made for further exploration on this research topic. Chapter 5 serves as a pivotal point of reflection and as a foundation of the subsequent discussion on the study's implications and potential contributions to the exploration of teachers' PCK.

1.10 CONCLUSION

This chapter provided an overview of the crucial role of number sense for learners' lives and emphasised the challenges faced by Grade 1 learners with SID of developing a sense of numbers. It highlighted the importance of tailored teaching strategies and the need for teachers to be equipped with specialised knowledge to support these learners effectively. The chapter also discussed the unique context of teaching learners with SID, including the variation of their developmental stages within the same classroom. Additionally, it underscored the significance of numerical skills in promoting independent living for learners with SID. The chapter concluded by introducing the concept of teachers as learning specialists and the role of PCK in teaching number sense to learners with SID.

Chapter 2 delves into the theoretical framework, namely Piaget's cognitive learning theory, with a focus on developmental stages, and Lee Shulman's consensus model of PCK. The chapter also explores the concept of teachers as learning specialists and emphasises their specialised understanding and profound knowledge of the subject matter they teach (i.e., TSPCK). Additionally, it provides context on learners with SID and discusses number sense development, teaching strategies and the importance of activity-based learning in achieving this goal.

CHAPTER 2: PEDAGOGICAL CONTENT KNOWLEDGE FOR NUMBER SENSE DEVELOPMENT

“Those who can, do. Those who understand, teach.”

(Shulman, 1986:14)

2.1 INTRODUCTION

Chapter 1 provided an overview of the study, including the research problem and knowledge gap, research questions, aims and objectives, concept clarification, and a brief outline of the research methodology.

The aim of chapter 2 is to present the theoretical framework, with a focus on two foundational theories that underpinned this study, namely Piaget's (1957) cognitive learning theory, with an emphasis on developmental stages, and Lee Shulman's (1986) consensus model of PCK. First, the specifics of Shulman's framework are explored, considering TSPCK, which is relevant to my examination of number sense as the central topic of this study. Next, I delve into the concept of teachers as learning specialists, emphasising their specialised and profound understanding of the subject matter they teach, referred to as TSPCK. The characteristics that define TSPCK are then explored.

Given the primary focus of this study on teachers' PCK, I also address an essential aspect of the research titled *Developing number sense for Grade 1 learners with severe intellectual disabilities*. First, I discuss learners with SID, providing the necessary context, and then I shift the focus to number sense development, emphasising teaching strategies and the integral role of activity-based learning in achieving this goal.

2.2 THEORETICAL FRAMEWORK

The two theoretical frameworks underpinned this study, namely Piaget's cognitive learning theory, specifically focused on developmental stages, and Lee Shulman's (1986) consensus model of PCK. In cognitive learning theory (Piaget, 1957), it is argued that learning only happens when the learner completes certain developmental stages along a continuum (Lefa, 2014) known as the sensorimotor stage (0–2 years), preoperational or intuitive stage (2–7 years), concrete operational stage (7–11 years) and finally, the formal operational stage (adolescence to adulthood). The acquisition of number sense for young children is often considered to develop along the same development stages as their cognitive development. Competencies related to numbers already develop before school-going age through informal learning processes (Piaget, 1957; Yilmaz, 2017). Piaget (1957) argued the importance of these informal developmental processes in his

cognitive learning theory (Yilmaz, 2017). It is noteworthy to point out that new learning is only possible if the learner is at the stage of development that dictates the type of learning (Mupa & Chinooneka, 2015).

It is therefore important to understand the characteristics of learning in each developmental phase to set developmentally appropriate learning outcomes and select the most appropriate teaching strategies. Table 2.1 summarises the developmental stages and how they are linked to the development of number sense. The focus in this study was on the teaching of number sense to Grade 1 learners with SID. Developmentally, it can be expected that these learners may be age 8 to 9. So, the characteristics of number development in the first three developmental stages are of relevance and are discussed in more detail.

Table 2.1: Developmental stages according to Piaget’s cognitive learning theory

Stage	Age	Characteristics	Goal
Sensorimotor	Birth to 18–24 months	Motor activity without the use of symbols. All things learned are based on experiences or trial and error. Egocentric intelligence	Object permanence
Pre-operational	2–7 years	Development of language, memory and imagination. Intelligence is both egocentric and intuitive.	Symbolic thought
Concrete operational	7–11 years	More logical and methodological manipulation of symbols. More aware of the outside world and events.	Operational thought
Formal operational	Adolescence to adulthood	Use of symbols to relate to abstract concepts. Grasp abstract concepts and relationships.	Abstract concepts

(Source: Babakr et al., 2019)

- **Sensorimotor stage (birth to 18–24 months)**

In the sensorimotor stage, children develop through experiences and movements using their five senses. Their brain wants to see, hear, taste, smell and touch as much as possible. When focusing on the development of number sense, according to Piaget (1952), it is essential in the early stages of number concept development that learners establish a one-to-one correspondence. Tirosh et al. (2020) elaborate, highlighting that such correspondence entails the ability to link concrete objects to numbers, such as recognising the number “five” and being able to physically count “five” objects. According to Piaget (1952), the development of a one-to-one correspondence is crucial for learners to acquire a fundamental understanding of the concept of numbers. In other words, until a learner has established the ability to match objects or items with specific numbers in a consistent and systematic manner, they may not have the necessary foundation to grasp the concept of numerical quantities. One-to-one correspondence forms the foundation of counting. Learners must, for example, grasp the principle of using and manipulating environmental resources before they can comprehend the concept of numbers (Naudé, 2014). To nurture the mathematical capabilities of learners during this stage, it is helpful to offer them abundant opportunities to actively engage with the environment in unrestricted but safe ways. By encouraging hands-on experiences and facilitating exploration, learners can begin to construct mathematical concepts and enhance their overall mathematical abilities (Sakala et al., 2021). This happens in a setting where learners can explore, experiment and express their abilities in a range of spontaneous and unstructured learning opportunities (Barrera-Mora & Reyes-Rodriguez, 2019). Instructional strategies that incorporate counting with books that include pictorial illustrations of mathematics, for example, would enhance learners’ conceptual development of numbers, as they benefit from seeing pictures of objects and their respective numbers simultaneously. The range of opportunities should always be developmentally appropriate and enjoyable.

- **Preoperational stage (2–7 years)**

The preoperational stage involves the ability to attribute meaning to objects using language, enabling learners to engage in symbolic thought. Symbolic thought involves the use of words or objects to represent something beyond their literal form, extending beyond the association of sensory information and physical actions (Sakala et al., 2021). In this stage, learners can comprehend that words, images and gestures serve as symbols for other things (Kurniawan et al., 2018). According to Bashrin (2015), to facilitate the development of mathematical understanding in learners during the preoperational stage, it is important to utilise concrete objects, pictures, actions and symbols. When teaching number sense to learners in this stage, it is recommended that one capitalises on their ability to grasp the connection between objects and the symbols that represent them (Vatavu et al., 2015). One effective approach is to design hands-on activities where groups of toys or other objects represent specific numbers, such as five toy cars, three apples, or seven pieces of chalk. This approach allows numbers to be treated as quantities rather than mere

symbols (Skinner & Stevens, 2013). Subsequently, instruction can progress to the utilisation of pictorial representations for the same mathematical problems (Robertson, 2017).

Concrete operational stage (7–11 years)

Learners acquire an understanding of logic and begin to develop tangible cognitive processes, such as arranging objects in a specific sequence (Saxena et al., 2020). This phase is characterised by an improvement in language skills, sometimes accompanied by over-generalisations, as well as the emergence of symbolic thinking, an egocentric perspective and limited logical reasoning. During this stage, learners are encouraged to participate in problem-solving activities that involve the utilisation of various materials like blocks, sand and water (Agustina & Ahmad, 2020). Their perceptions in this developmental stage typically focus on one aspect or dimension of an object, neglecting other aspects.

The concept of developmental stages, particularly as delineated by Piaget's cognitive learning theory, is highly pertinent to the study's objectives. However, it is essential to acknowledge the controversy surrounding this concept (Rochat, 2023). Much of this controversy revolves around the responses that have been given to the following five central questions: (1) Do developmental stages exist? (2) If they exist, where are they or where should we look first for them? (3) What features define a developmental sequence as a sequence of developmental stages? (4) What psychological factors and processes underlie developmental change, be it qualitative, discontinuous, and stage-like, quantitative, continuous and gradual, or even continuous and discontinuous? (5) Should we abandon the concept of developmental stages (Lourenço, 2016)? This controversy underscores the complexity of understanding cognitive development and the challenges in applying a universal framework to diverse learners, including those with SID. Despite the controversy, Piaget's theory remains a valuable theoretical framework for understanding cognitive development and informing teaching practices (Oogarah-Pratap et al., 2020). The fact that diverse developmental theories rely on developmental stages in different fields lends support to the idea that developmental stages exist, even though the concept is used with varying meanings (Newman & Newman, 2022). By acknowledging the controversy and engaging with these questions, teachers can navigate the complexities of cognitive development and tailor their instructional strategies to meet the diverse needs of learners with SID.

This discussion, which primarily focused on the initial three developmental stages according to Piaget's cognitive learning theory in the context of Grade 1 learners with SID, now transitions to an exploration of PCK. To understand how PCK is applied in teaching number sense to these learners, we must first establish a foundation by examining the development of number sense in early mathematical stages, considering the specific challenges faced by learners with SID and identifying the pedagogical strategies necessary to support number sense development. In line with Shulman's recognition of PCK as a vital facet of a teacher's professional knowledge, I dissect the concept further. This concept involves a profound understanding of subject matter for teaching tailored to diverse learners' abilities and interests.

Shulman identified PCK as one of the domains of a teacher's professional knowledge (§ 2.3). PCK is characterised as consisting of content knowledge (the knowledge of representation subjects); the ability to understand how learners conceptualise a subject, and teaching and learning related to the content knowledge (Shulman, 1987). Shulman (1986) defined PCK as knowledge of subject matter for teaching which consists of an understanding of how to represent specific subject matter topics and issues appropriate to the diverse abilities and interests of learners. PCK is described as a specialised form of knowledge used by teachers to enable them to transfer subject matter or content knowledge to a learner in the context of facilitating learner understanding in such a manner that would render the content personal and meaningful for the learner (Chan & Yung, 2018). In other words, PCK includes an awareness of ways of conceptualising subject matter that would bring about effective teaching of the content (Shulman, 1986, 1987) resulting from knowledge of the most useful forms of representation of the subject concepts, the most powerful analogies, illustrations, examples, explanations and demonstrations, and an understanding of what makes the learning of specific concepts easy or difficult (Shulman, 1986). Therefore, as teachers develop their expertise, PCK emerges and gradually becomes a central component of their teaching practice (Kind & Chan, 2019). PCK of varying qualities emerges at different stages of a teacher's professional trajectory. Initially, teachers rely on canonical PCK, which is planned knowledge developed by colleagues. However, over time, they develop their own personal PCK by generating instructional strategies tailored to their individual teaching contexts.

Following the original definition of PCK by Shulman, many researchers have worked on describing its nature. Veal and Makinster (1999) considered PCK as a combination of knowledge of learners, knowledge of content and knowledge of instructional strategies. Grossman (1990) included knowledge of the curriculum and knowledge of teaching purposes, while Hashweh (2013) included knowledge of assessment and knowledge of the context. The central thread in all the models stayed the transformation of subject matter knowledge for teaching and offering a richer learning experience. In the context of mathematics teaching, Ball and Bass (2000) modified and empirically

validated Shulman's (1987) concept of PCK, introducing the concept of "specialised" mathematical knowledge needed by teachers only.

As the concept of PCK matured, the need arose to reach a consensus on what PCK entailed. This resulted in the PCK consensus model (illustrated in Figure 2.1) described by Gess-Newsome (2015). The model combines earlier PCK configurations in a multilayered flow-chart structure (Figure 2.2) depicting student outcomes to flow from classroom practice, topic-specific professional knowledge (TSPK) and ultimately from the professional teacher knowledge bases at the top, which include pedagogical knowledge, curricular knowledge and assessment knowledge (Gess-Newsome, 2015). The knowledge needed to teach a specific topic is illustrated with the domain called TSPK. TSPK is conceptualised as a knowledge base teachers can draw on that is also available for study (Gess-Newsome, 2015) as it is prepared by curriculum developers, for example. The teacher professional knowledge bases described as knowledge for teachers (Gess-Newsome, 2015) developed through formal education. The conceptualisation of TSPK extends to include canonical knowledge, which refers to the collective knowledge agreed upon and used by a group of teachers within a school. This is demonstrated through shared or common practices (Smith & Banilower, 2015). Canonical knowledge encompasses various aspects, such as instructional strategies, content representations, learner understandings, discipline-specific practices, and the mindset and thinking patterns employed by teachers (Gess-Newsome, 2015:36).

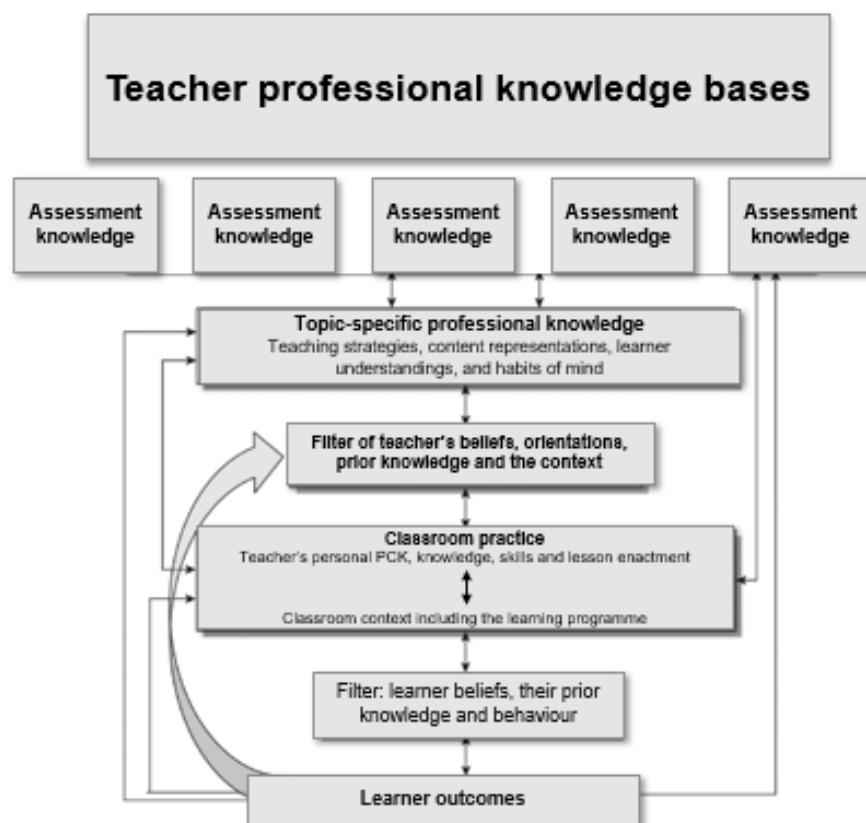


Figure 2.1: Consensus model of PCK (Molefe & Stears, 2014:132)

Figure 2.1 adapted by L. Labuschagne (2024) for the purposes of this study.

PCK is placed in the context of classroom practice (Figure 2.2). TSPK is depicted as pre-filtered/pre-amplified PCK, as the position of TSPK (consensus model, line 2) precedes the “filter” of teacher beliefs and orientations (consensus model, line 3) (Kind & Chan, 2019). TSPK filtered by teachers’ beliefs, their motivation, or other affective dispositions can influence which develops over time (Gess-Newsome, 2015), resulting in personal PCK. While TSPK is positioned as knowledge generated by research or best practice and is necessary for effective teaching of a specific topic (having a normative function), personal PCK is viewed as implicit, person- and situation-specific and happening during classroom practice (Stender et al., 2017). Personal PCK is “the knowledge of, reasoning behind, planning for, and enactment of teaching a particular topic in a particular way for a particular reason to particular learners for enhanced student outcomes (reflection-on-action)” (Gess-Newsome, 2015). To conclude, PCK is indicated as teachers’ personal knowledge that drives their planning for, implementation of and reflection on instruction (Neumann et al., 2019). A criticism of this model of PCK is the vagueness around the description of what PCK may comprise (Neumann et al., 2019) or, as argued by Mavhunga and Rollick (2016), failing to recognise PCK in topics as a version of PCK that is content-specific.

Given the argument above on the value of PCK within teaching and specific the teaching of a specific topic, there is a need to operationalise PCK specific to a topic. This shifted the interest to the topic-specific PCK model of Mavhunga and Rollick (2013) where the focus is on content-specific PCK elements as central concept to the planning and execution of a planned lesson for a specific topic. In contrast to the consensus model described above (Figure 2.2), Mavhunga and Rollick (2013) presented a model where the focus is on TSPCK which is personal and specifically focused on the teaching of a specific topic. Mavhunga and Rollick (2013) identified five components that are content-specific in nature – namely learner prior knowledge, curricular saliency, what is difficult to understand, representations, and conceptual teaching strategies – which work together to establish a measurable theoretical construct.

TSPCK is defined at the topic level, focusing on the transformation of specific content knowledge into transformed specific content knowledge that represents the topic content in a form that is accessible to all learners (O’Brien, 2017). TSPCK is therefore a precursor to PCK and underpinned by knowledge of learners, content knowledge and pedagogical knowledge. The transformation of specific content knowledge into transformed specific content knowledge requires the use of pedagogical reasoning and is not transferable across topics. TSPCK is consequently very specific, as each topic would require precise PCK distinct from that used to teach any other topic or any other group of learners.

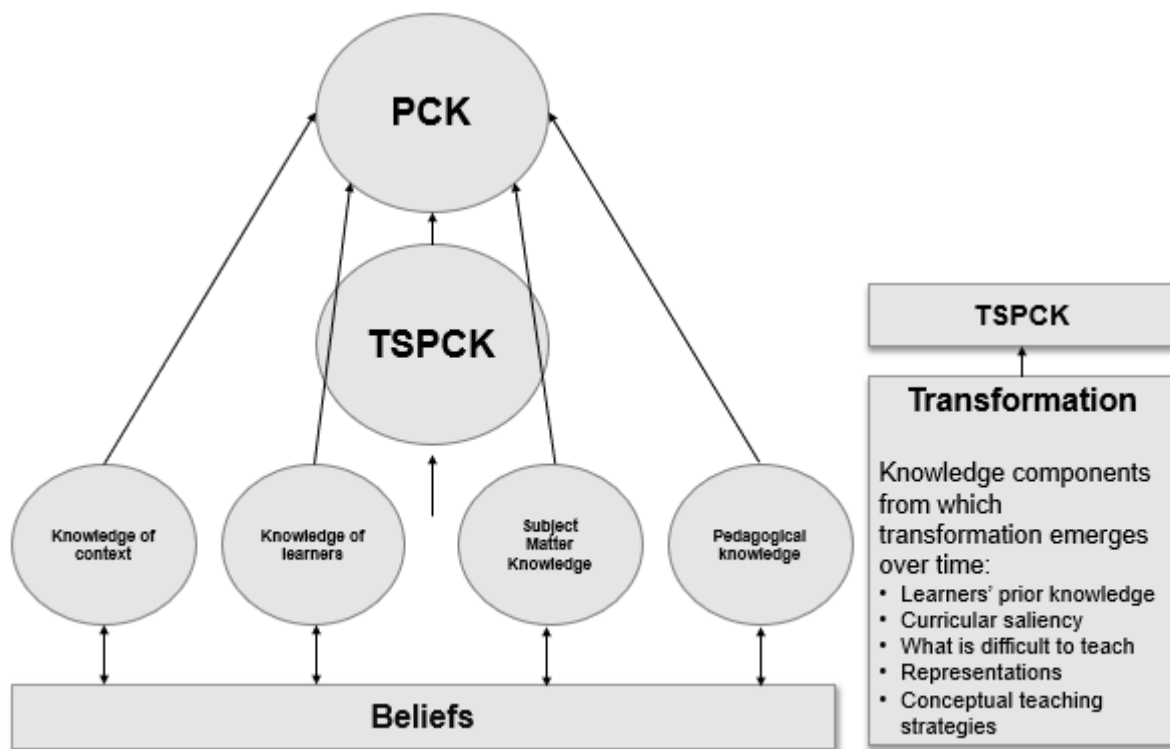


Figure 2.2: A model of TSPCK (Mavhunga & Rollick, 2013)

Figure 2.2 adapted by L. Labuschagne (2024) for the purposes of this study.

In the TSPCK model, knowledge components from which transformation emerges have been identified, namely learners' prior knowledge, conceptual teaching strategies, curricular saliency, knowledge of what makes a topic easy or challenging to teach, and knowledge of representations and analogies, models, examples or illustrations (Mavhunga & Rollick, 2013). These five knowledge components help teachers to think and transform the specific topic content for teaching purposes. As illustrated in Figure 2.2, all the components are collectively needed to enable the pedagogical transformation of content knowledge into specialised knowledge that assists teachers to transform their unique understanding and knowledge of the content of a specific topic into a teaching and learning opportunity (their PCK). The five components of TSPCK depicted in Figure 2.2 are extensively examined in the key characteristics of TSPCK, solely for the purpose of discussion rather than their direct application to this study.

Lee Shulman, a distinguished scholar in the realm of education, has made significant contributions to our understanding of effective teaching practices and teacher education. His work has provided valuable insights into the complex interplay between content knowledge and pedagogy. In this dissertation, I draw upon Shulman's pioneering concept of PCK as a foundational framework. Shulman's concept that teachers have a knowledge base for teaching links the understanding of teachers' unique knowledge required to develop number sense to a very specific group of learners (Chikiwa et al., 2019). The content knowledge required to achieve this is well defined by the DBE

(2018) in their learning programme *CAPS for Learners with SID, Mathematics, Grade 1*. The concept of “number(s)” forms part of the sub-set of the content area “Number, Number Operations, and Relationships”. The latter topic focuses on the development of learners’ understanding of actual numbers, such as 1, 4 and 7, and includes knowing number symbols, number values and number names (DBE, 2018) (§ 2.4.3).

To build an understanding of numbers in a teaching and learning situation, teachers need the most appropriate PCK to choose suitable content representations and explanations that emphasise topic-specific concepts in a meaningful way for learners. This PCK is evident in the practical and suitable examples that teachers choose to illustrate the concepts and for learners to work with the new concept while grasping the new knowledge. Based on Shulman's (1987) concept that teachers have a knowledge base for teaching, one can argue that for teachers to use their PCK and to develop learners with SID's understanding of numbers, they need to understand the unique knowledge required to develop number sense for a very specific group of learners (Chikiwa et al., 2019). In pursuit of effective teaching strategies for Grade 1 learners with SID and teachers' PCK, my exploration now turns to the implementation of activity-based learning approaches.

The theoretical frameworks of Piaget's cognitive learning theory and Shulman's consensus model of PCK are foundational for understanding the cognitive development and instructional needs of learners SID. Piaget's theory, with its emphasis on developmental stages, provides teachers with a comprehensive understanding of the cognitive processes that underpin learning. This knowledge is crucial for tailoring instructional strategies and materials to align with the learners' cognitive abilities, ensuring that they are developmentally appropriate and engaging. Furthermore, Shulman's consensus model of PCK highlights the importance of teachers' collective understanding and shared expertise in effective teaching strategies. In the context of learners with SID, this model emphasizes the need for collaborative lesson planning, peer observation, and ongoing professional development to ensure that teachers are equipped with the most effective instructional practices. By integrating these theoretical frameworks into classroom practices, teachers can create an inclusive learning environment that supports the holistic development of learners with SID.

In concluding this section on the theoretical framework, I have synthesised Shulman's consensus model of PCK with the TSPCK model of Mavhunga and Rollick (2013). Shulman's theory highlights the significance of teachers' collective understanding of and consensus on effective pedagogical strategies in each subject – a pivotal facet of teacher expertise, especially for teachers teaching learners with SID. Concurrently, Mavhunga and Rollick's TSPCK model delves into the intricate, context-specific nature of PCK, offering valuable insights into how teachers should adapt their knowledge for subject-specific instruction, namely how to develop number sense for learners with SID. Further, to enrich this framework, I integrated Piaget's cognitive learning theory according to

learners' developmental stages, providing a developmental lens to understand how learners' mathematical cognition evolves over time. By amalgamating these perspectives, my research aimed to offer a comprehensive understanding of the dynamic interplay between pedagogical expertise, subject-specific knowledge and learners' cognitive development in the field of number sense development in the specific context of teaching Grade 1 learners with SID.

Transitioning from the theoretical framework, which incorporates Shulman and Piaget's theories, to the concept of teachers as learning specialists, it is crucial to understand that teachers, often referred to as learning specialists (Guerriero, 2014), need knowledge and a deep understanding of various knowledge bases to excel in their teaching role (Diezmann & Watters, 2015).

2.3 TEACHERS AS LEARNING SPECIALISTS

Teachers often get referred to as learning specialists (Guerriero, 2014). For teachers to be learning specialists with acquired professional expertise, they need knowledge that is multifarious or varied and should have a deep understanding of different knowledge bases (Diezmann & Watters, 2015). The underlying idea is that teachers have a unique knowledge base that distinguishes discipline teachers from discipline experts (Moje, 2015). Possessing expertise in a specific subject matter is one aspect, while possessing the knowledge and skills to effectively teach it is an entirely separate matter (Moradkhani et al., 2013). For teachers to be effective, they must make practical and effective use of different types of knowledge that go beyond knowledge of the subject matter (Stronge, 2018). This requires understanding how the teacher's "knowledge base" functions in the teaching and learning environment when teaching a specific topic to a particular group of learners in a specific context (Hume et al., 2019).

In the past 30 years, great strides have been made to explore the different domains of teacher knowledge when teaching a particular topic in a subject and in a particular context (Guerriero, 2014). Shulman (1986, 1987) initially introduced the concept of teacher knowledge and described three categories: subject matter content knowledge; PCK; and curriculum knowledge. Shulman refined the model, adding a fourth component, namely knowledge of social and contextual dimensions (Shulman, 1987).

Although all categories of teacher knowledge are crucial, studies have revealed that the richness of a teacher's PCK strongly influences the effectiveness of teaching mathematics (Zelkowski et al., 2013). Furthermore, the richness of PCK predicts the educational level, professional experience and teaching strategies in the mathematics classroom. Lee et al. (2018) went as far as to argue that PCK has a critical influence on learners' understanding and achievement in mathematics. The focus of this study falls on PCK as one of the knowledge bases of teachers.

Teachers as learning specialists have a specialised, in-depth understanding of the subject matter they teach, referred to as TSPCK. TSPCK transcends superficial knowledge, involving a profound grasp of the underlying principles, concepts and relationships within a particular domain. It integrates pedagogical knowledge, enabling teachers to skilfully structure lessons, select appropriate resources, design assessments and adapt teaching strategies to cater to the diverse learning needs of their learners. Moreover, TSPCK equips teachers with the insight to anticipate and address common learner misconceptions, difficulties and preconceived notions specific to the subject matter, allowing for tailored teaching strategies. TSPCK emphasises adaptability, prompting teachers to employ context-specific instructional techniques, examples and analogies that best suit the topic at hand. It recognises that the teaching of a subject can vary based on grade level, classroom dynamics and learner demographics, empowering teachers to adeptly adjust their instruction to align with these contextual factors. Developing TSPCK is an ongoing, dynamic process that requires continuous learning and reflection, motivating effective teachers to actively engage in professional development opportunities to refine their expertise in teaching specific topics. Next, the key characteristics of TSPCK, with a specific focus on the development of number sense, are discussed.

2.3.1 Key characteristics of TSPCK

2.3.1.1 *In-depth content knowledge*

In-depth content knowledge involves teachers recognising the significance of key concepts in a topic and understanding how these concepts interrelate with other aspects of the subject (McNeill & Knight, 2013). This includes identifying the big ideas, which are interconnected networks of concepts that facilitate comprehensive skill and knowledge acquisition (Chalmers et al., 2017). Organising educational content around these central concepts enhances learner learning. This component addresses questions such as the intended learning outcomes, the importance of the concept, prerequisite concepts, and additional information that may not be taught at the current stage (Nilsson & Vikström, 2015).

Proficiency in identifying big ideas equips teachers with the ability to determine the optimal sequence for teaching specific topics and to assess learners' prerequisite knowledge (Mavhunga & Rollnick, 2016). It is crucial for teachers to grasp the developmental progression of number sense, which emphasises the progression from concrete experiences to abstract understanding and fosters the connection between numbers and their representations (Peucker & Weißhaupt, 2013). To effectively cultivate number sense, teachers can employ three strategies: providing concrete and physical learning experiences; focusing on mastery of skills; and establishing connections between spoken language and mathematics (Witzel et al., 2012).

According to the DBE's Guidelines for Responding to Learner Diversity in the Classroom (DBE, 2011), differentiation takes place in learning programme content, learning environment and teaching methods. While teachers differentiate the learning programme, they must plan according to the cognitive developmental levels of the learners. Differentiation is to provide quality teaching and learning opportunities by organising, implementing and modifying the teaching content while addressing the individual learner's needs (Nel et al., 2016). Many teachers see differentiation as complex and overwhelming. Teachers differentiate by adjusting the learning programme and activities, the content of the subjects and how they assess while adjusting the classroom climate for all learners (Nel et al., 2016).

In a class for learners with SID, the content still needs to be relevant and challenging while taking differentiated learning styles into account and focusing on the strengths of the learners (Nel & Nel, 2016). In doing so, it creates room for the multiplicity of skills that can be developed.

2.3.1.2 Pedagogical knowledge

TSPCK requires the transformation of knowledge of learners, content knowledge and pedagogical knowledge into transformed specialised content knowledge geared towards a specific topic. Furthermore, PCK can be differentiated into knowledge and practice, resulting in enacted and static PCK. Teachers come to personal decisions during lesson planning based on their TSPCK. This pedagogical transformation manifests through lesson plans, as well as what the teachers say and do during the lessons of the specific topic (dynamic PCK). Lesson plans, therefore, emerge as products from the transformation process of TSPCK (Stender et al., 2017), while the enactment of TSPCK happens in the classroom. Static TSPCK involves thinking and planning the teaching of a specific topic, while dynamic TSPCK is associated with classroom enactment (Mavhunga & Miheso, 2021).

Instruction materials as representations include the different ways in which to visually present the subject matter information, including illustrations, analogies, metaphors, diagrams, tables and models (Eames, 2016). When teachers use content representations, it indicates their ability to understand the learners' background experiences and misconceptions, and this would assist them to use the correct form of representation to convey and teach the topic according to the learners' understanding. Teachers need to use different forms of content representations to explain the content of the specific topic.

2.3.1.3 Awareness of learner thinking

Knowledge about what makes a topic difficult or easy to teach relates to learning difficulties but also contextual factors that could hinder learners from grasping the topic. The focus should be on

identifying the actual issues that make understanding difficult. It should move to more than settling on the abstractness of concepts to pinpointing the actual difficulty.

The “what” of teaching includes the content (Nel et al., 2016) and is considered equally important to all the other components of TSPCK. Content knowledge is the body of knowledge teachers need for a specific subject to create effective teaching and learning opportunities. Content knowledge includes the difficulties and knowledge limitations that teachers experience when teaching a specific topic (Nilsson & Elm, 2017).

Learners’ prior knowledge is the knowledge teachers have about the way learners think and their understanding of the concept. This influences the way teachers teach a specific topic (Mazibe et al., 2020). Knowledge and skills related to this component of TSPCK include identifying variations in learner learning and eliciting and assessing learner difficulties and misconceptions.

2.3.1.4 Adaptive teaching strategies

Conceptual teaching strategies are rooted in the subject matter and involve determining the most effective discussions and actions to address challenging areas and further develop conceptual understanding. These strategies extend beyond mere pedagogical approaches, encompassing a deeper focus on the content itself.

Teaching approaches and strategies combine teachers’ understanding of the content and how they teach it (Barendsen & Henze, 2019). While discussing the different strategies and approaches, it is important to keep in mind that no single teaching strategy and approach is effective all the time for all the learners, especially when teaching learners with SID (Killen, 2019). Teaching strategies are a combination of behaviours and actions that lead to learners’ growth and development (Blazar & Kraft, 2017). Over time, teachers with a pedagogical attitude would experiment with teaching strategies to create their innovative teaching strategies (DBE, 2011; Nel et al., 2016).

Teaching approaches can be divided into two main approaches: teacher-centred and learner-centred approaches (Kemp, 2013). The teacher-centred strategy is also known as direct instruction. In classrooms where teachers make use of the teacher-centred teaching strategy, there is little to no creativity or self-exploration and these classrooms are organised in a rigid and very structured manner (Polly et al., 2014). Some teachers prefer the teacher-centred teaching strategy because of the control they have over their learners’ learning and it provides guidance to their learners to construct meaning in the unique learning opportunity (Killen, 2019). According to Flores (2014), a more teacher-centred approach provides learners with SID more opportunities for learning.

While the teacher-centred approach focuses on teachers as the centre of all learning, the learner-centred teaching strategy focuses on what learners can explore for themselves. Learners are

responsible for their own learning (Li & Lam, 2013). The Education Whitepaper 6 (EWP6) argued that in the context of teaching learners with SID, a learner-centred approach addresses barriers to learning. This approach enables learners to overcome the causes of barriers to learning while they participate actively and critically in the learning process (DoE, 2001). According to Muema et al. (2018), this strategy can improve learners' performance. This improvement is because of learners who can embrace a new concept while discovering learning. This teaching strategy creates a more positive attitude towards learning. This enables the teacher to accommodate all learners and target specific barriers to learning in the learner with SID. This teaching strategy facilitates the holistic development of these learners (Robinson-Madden, 2021).

2.3.1.5 Contextual understanding

It is well documented that teaching learners with SID is demanding as far as education, support and development are concerned (Wehmeyer & Shogren, 2017). In general, society conceptualises education as a teaching and learning process, while in reality, effective teaching and learning strategies are influenced by various pertinent factors (Zaščerinska et al., 2013). To understand how teachers teach the concept of numbers to learners with SID, it is vital to understand the factors that influence the teaching and learning process. Various factors have been identified to influence employing PCK when teaching number sense for a Grade 1 classroom for learners with SID (Papadakis, 2017). Allam and Martin (2021) argue that the teaching and learning of Foundation Phase learners with SID can be influenced by the following:

- a lack of preparation and planning. Teachers complain about insufficient training and a lack of knowledge about dealing with behaviours they perceive as difficult in day-to-day school life (Savolainen et al., 2012).
- limited experience
- insufficient training
- limited knowledge on the learning programme
- the teachers' attitude
- limited resources, and insufficient instruction materials or equipment
- a lack of infrastructure
- limited support from collaborators
- a lack of clear policies also influences the quality of teaching (Allam & Martin, 2021).

In the case of number sense development, there are specific challenges that teachers experience. Vinner (2018) argued that teachers employ their knowledge base when teaching, but their knowledge can be restricted because of the presence of cognitive barriers in learners.

2.3.1.6 Ongoing professional development

When teachers implement these topic-specific lesson plans followed by a reflection, it leads to pedagogical improvement (O'Brien, 2017). Over time, teachers remember successfully planned and enacted lessons, and these can be retrieved during teaching and learning opportunities. PCK develops over time. PCK is thus not static in nature. A static model of teacher education may mean ensuring teachers learn a prescriptive set of techniques and develop fixed professional knowledge from these. PCK is a flexible, highly adaptive and fluid construct with a range of components that deepens over time. Greater knowledge of instructional strategies and classroom management, compared to the other components of PCK, can be acquired from various sources. These include prior experiences as learners; imitating a more experienced teacher; canonical practices acquired through discussion with and instruction by colleagues; and idiosyncratic practices that a teacher creates alone (Kind & Chan, 2019). Teachers are conditioned by their experiences as learners of mathematics, their professional development training and subsequent career opportunities to address number sense development in learners with SID.

Having examined the role of the teacher as a learning specialist and delving into the characteristics of TSPCK, the next section shifts the focus towards exploring the vital aspect of number sense development for learners with SID.

2.4 NUMBER SENSE DEVELOPMENT FOR LEARNERS WITH SID

Within the realm of education, the significance of teachers' PCK is well-established, yet when it comes to learners with SID, the need for a deeper and more nuanced form of TSPCK becomes increasingly imperative. In this context, the research delves into the domain of number sense development, specifically in CAPS for Learners with SID. To understand the unique requirements of these learners, it is essential to first explore the distinct characteristics and needs of learners with SID before delving into the intricate dynamics of fostering number sense within this specialised educational context.

2.4.1 Definition of severe intellectual disabilities (SID)

SID, also referred to as "cognitive impairment or intellectual disability" (De Ligt et al., 2012:1922), encompasses various mental and developmental disorders, including attention-deficit/hyperactivity disorder (ADHD), cerebral palsy, autism, Down syndrome, intellectual disability, and epilepsy

(Scott et al., 2016). Early childhood diagnosis is established through the observation of significant delays in cognitive, speech and motor development (DBE, 2012). SID is classified as a significant sub-average intellectual functioning (IQ of 70 or below) or a manifestation of deficits in cognitive, functional and adaptive skills (Wu & Boat, 2015) that exist concurrently with deficits in two or more adaptive behaviours such as practical skills, conceptual skills and social skills (APA, 2013). For this study, the influence of SID on cognitive skills was important, as this directly impacts a learner's number sense development.

2.4.2 Barriers to learning for learners with SID

The barriers to learning that learners with SID experience directly relates to the deficits explained in the diagnostic criteria.

Concerning intellectual deficit, it should be noted that some learners can experience a five-year developmental delay compared to a typical learner because of their disability (Piazza et al., 2010). The implication is that many learners with SID in Grade 1 may be at a preoperational or intuitive development stage (2–7-year age norm) compared to their expected age norm of the concrete operational stage (7–11 years). Learners with SID learn at a slower pace and process information differently, even with appropriate differentiation (Lewis, 2017). Each learner is unique, and the severity and range of difficulties and needs they experience differ (Nel & Grosser, 2016). Learners with SID have medical and health needs that form part of medical barriers, but these learners often experience barriers to learning too (Sari & Olkun, 2020). Learners who experience medical barriers can experience the development of number sense, learning, reasoning, problem-solving, memory and thinking negatively (Jooste & Jooste, 2016; Mazibuko et al., 2019; Nel & Grosser, 2016). Specific learning difficulties affect one or more aspects of learning. There are a range of conditions in mathematical learning difficulties, such as dyslexia, dyscalculia and dyspraxia (DoE, 2015). To support all areas of the learning programme, teachers' PCK should support activity-based learning (DBE, 2018).

When examining the challenges faced by learners with SID in terms of conceptual and practical aspects, it becomes apparent that there are inherent barriers to their learning. These barriers encompass difficulties with abstract symbolic thinking, reading, emotional regulation, attention deficit-related difficulties, and physical skills (APA, 2013; Paulsen & Dednam, 2016; Shogren & Turnbull, 2010).

The specific criteria for the different needs and difficulties learners with SID experience because of their barriers to learning include the following: difficulty using problem-solving techniques; short attention span and short-term memory; barriers to holistic motor integrational skills (auditory- and

visual perceptual, fine and gross motor); and poor sensory integration (APA, 2013; Cavendish, 2013; Van Niekerk et al., 2014).

Furthermore, studies have shown that people with intellectual disabilities have difficulties in transferring knowledge and skills already acquired to new situations (Algahtani, 2017). Therefore, transferring knowledge acquired during the teaching process to real-life situations should be the focus when educational activities are projected for learners with intellectual disabilities (Agheana & Folostina, 2015).

As explained in section 1.6.1, the concept “numbers” is a sub-set of the content area “Number, Number Operations, and Relationships” in the National Curriculum Statement: Grade R-5 for learners with Severe Intellectual Disability, Mathematics, Grade 1 (CAPS for Learners with SID) (DBE, 2018). The learning programme focuses on the development of learners’ understanding of actual numbers, for example, 1, 4, and 7, knowing number symbols, number values, and knowing number names (DBE, 2018). Knowledge of numbers is a crucial part of the hierarchical development of number sense (DBE, 2012). A well-developed sense of numbers can assist learners with SID with their independent functioning in everyday interactions where these skills are applicable (Wu & Boat, 2015).

2.4.3 The nature of number sense

Number sense is a skill that learners acquire through their early experiences with mathematics. It begins with the recognition of numbers (e.g., number names and how the number looks) and the ability to represent numbers (e.g., a picture or a set of concrete objects to show the quantity of the recognised number) in a meaningful way, leading to an understanding of how numbers are used in everyday life for independent living (§ 1.1). The development of this skill is most effective when learning experiences are meaningful. In essence, number sense is having a strong intuitive grasp of numbers (Maghfirah & Mahmudi, 2018). Kayhan et al. (2013) provide a more inclusive definition, stating that number sense involves the flexible use of numbers, practical thinking when dealing with numerical operations, selecting the most efficient and convenient solutions, sometimes finding unconventional approaches to problems, and utilising a simplified reference point to tackle complex problems. For learners to develop a sense of numbers, there are clearly identified number sense developmental stages: counting all; counting on; and breaking down and building up numbers (decomposing, rearranging and recomposing) (Sharma, 2014).

To determine which aspects of number sense are reasonably expected to be present in a Grade 1 learner with SID, it is necessary to describe the development of number sense within the specific context of learners with SID.

2.5 TEACHING NUMBER SENSE TO LEARNERS WITH SID

In this specific study, I focused on learners with SID and their learning of numbers, considering their unique teaching context. This section begins by defining SID and then discusses these learners' typical cognitive development levels in Grade 1.

This study centred on learning, specifically the development of number sense. Learning occurs at three levels, as outlined by Vygotsky (1978): interaction with others; interaction with a knowledgeable individual (such as a teacher); and interaction with external resources like calculators or counters. These interactions are crucial for acquiring three types of knowledge – namely physical knowledge, social knowledge, and conceptual knowledge – which are vital for successful number sense learning (Piaget, 1957). Physical knowledge involves hands-on experiences and understanding of the environment through touch and interaction with concrete resources, making it suitable for play-based learning (DBE, 2012). Piaget (1957) emphasises the importance of a hands-on teaching and learning environment for brain development through object manipulation. Social knowledge, on the other hand, is acquired through interaction with a teacher and involves understanding what is shared in a social context. Conceptual knowledge, which is constructed internally by each learner, also plays a crucial role (DBE, 2009).

In the South African context, learners with SID are promoted to the next grade based on their age and not according to their scholastic performance (DBE, 2018). Consequently, teachers are expected to deliver a learning programme at the level of functioning of each learner in their class and might deliver the Grade 1 learning programme as set out in CAPS for Learners with SID to only some of their learners. All three Piaget's (1936) cognitive developmental stages, as discussed earlier – namely the sensorimotor stage (0–2 years), the preoperational or intuitive stage (2–7 years), and the concrete operations stage (7–11 years) – can be encountered in a Grade 1 classroom for learners with SID (Simatwa, 2010).

The role of a teacher is to have appropriate expectations of all learners in the classroom (Uys, 2016). As these learners experience various challenges and limitations, they need assistance in all areas of the learning programme. The challenge to teachers is to design individualised teaching and learning opportunities that provide the perfect amount of holistic cognitive stimulation (Lamport et al., 2012; Simatwa, 2010; Uys, 2016). It is thus imperative for teachers to integrate each cognitive growth into the teaching strategies used for number sense development in learners with SID. The challenge to teachers is to design individualised teaching and learning opportunities that provide the perfect amount of holistic cognitive stimulation (Lamport et al., 2012; Simatwa, 2010) while having relatively little guidance from the relevant DBE policy documents.

This suggests that teaching learners with SID while considering each learner's unique level of development (Table 2.1) requires a deep understanding of the developmental levels of learners

with SID combined with mindful teaching strategies that build on each learner's developmental profile (Peterson-Ahmad et al., 2018). For a teacher to use and adapt to the correct teaching strategies and approaches, they should understand their learners and plan teaching strategies and approaches based on the learners' abilities and disabilities (Buli-Holmberg & Jeyaprabhan, 2016). Implementing individualised and differentiated teaching for each learner is theoretically possible, but it poses significant challenges in a highly diverse classroom. Differentiated instruction requires flexibility in both teaching approaches and curriculum adaptations to cater to learners' specific needs. This necessitates the availability of multiple sets of materials (Tomlinson, 2017). Considering teachers' PCK and using appropriate materials, along with suitable learning activities, become crucial to address the cognitive developmental stages outlined by Piaget (1936). These considerations are particularly relevant to a Grade 1 classroom where learners with SID may be encountered.

Relevant professional development for teaching mathematics in schools for learners with special educational needs is necessary. Udoba (2014) highlights that teachers often do not know how to accommodate and address the special needs of learners with SID. It is argued that there is a need for teachers to have specific knowledge, including personal knowledge, knowledge of initial and continuous training, knowledge of the curriculum, and knowledge of professional practice when teaching learners with SID (Fernandez, 2014). Teachers' PCK for teaching in the classroom setting shows what teachers are taught during their training and whether they will be able to apply what they have been taught in the classroom setting (Chikiwa, 2019).

It is acknowledged that teachers acquire a foundational knowledge base and skillset during their formal training and throughout their teaching careers. Within the educational context, there is a prevailing notion that additional skills and knowledge – particularly regarding the specific content required to comprehend how learners with SID develop a sense of numbers – are often deemed unnecessary during formal training (Fernandez, 2014). One notable challenge arises from the fact that teachers often find themselves instructing subjects and grade levels for which they may not have received specific training, leading to inherent difficulties in effectively addressing the unique needs of these diverse learners (Hobbs & Porsch, 2021).

Acknowledging that teachers often lack specific training in addressing the unique needs of learners with SID, it is crucial to explore the strategies and approaches employed in this distinctive educational process. Effective teaching typically encompasses various strategies, including multisensory instruction, which enables learners to engage multiple senses simultaneously, optimising their capacity to form cognitive patterns and enhancing information retention (DBE, 2018). This exploration of teaching strategies and their alignment with the intricate needs of learners with SID shed light on the importance of bridging the gap between conventional training and the distinctive requirement of learner demographics.

It is important to investigate what teaching strategies and approaches teachers use in this unique process. Effective teaching usually combines several teaching approaches or multisensory instruction. This allows learners the opportunity to use more than one sense at a time while learning. This approach works well because of the way the brain forms patterns. By using more than one sense, the brain receives new information in multiple ways (Bear et al., 2020). As a result, new information is retained better. The three strategies commonly involved in multisensory instruction approach are as follows (DBE, 2018):

- Kinesthetic-tactile teaching: Learners experience concept with their body and five senses (see, hear, taste, smell and touch).
- Concrete teaching: Learners grasp a concept by using concrete objects such as three-dimensional shapes in the environment.
- Semi-concrete teaching: This stage involves paper-and-pencil representations. Learners use drawings, cards, and matching activities.

Teaching number sense to learners with SID requires a multifaceted teaching strategy to cater to their diverse learning needs. To overcome barriers to learning, it is imperative to employ a range of teaching strategies that align with learners' individual learning styles, cognitive levels and participation levels. The Education White Paper 6 – Implementing White Paper 6 Inclusive Learning Programmes Participant's Manual (EWP 6) (2007) – suggested the following teaching strategies: (1) broadcast, where media like YouTube, radio, television, video, or film are used to extend the educational experience beyond the classroom, making it accessible to all learners. Additionally, (2) drill teaching strategies are used for repeated practise of knowledge or skills until mastery is achieved. (3) Exposition as a strategy is used for explanation, questioning and discussion to facilitate meaningful transmission of knowledge. (4) Explicit teaching, in which case concepts and skills are broken down into manageable steps, would allow learners to practise after each step to ensure they grasp the basics. (5) Teachers use demonstration to explain and demonstrate a skill or concept, followed by learners practising it until they achieve mastery, promoting skill acquisition through observation and imitation. (6) Structured group discussions would encourage learners to actively participate in group discussions, fostering communication skills. (7) Guided discovery involves setting problems and guiding learners through the investigative process, allowing them to develop problem-solving skills and a deeper understanding of concepts. (8) Small group cooperative learning would group learners to collaborate on common goals, encouraging peer-to-peer interaction and cooperative learning. (9) Roleplay strategies, utilising roleplay to explore authentic problems through discussion or action, enable learners to explore and clarify their thoughts, feelings, attitudes and values. (10) Open discussions encourage open dialogue between the teacher and learners to address areas of uncertainty, promote critical thinking and stimulate curiosity while developing problem-solving skills. (11) Imaginative strategies

encourage learners to express themselves through creative means such as art, drama and music, fostering creative thought and self-expression. (12) Interest-based teaching strategies would allow learners to select topics of personal interest. These teaching strategies, designed to cater to the diverse needs of learners with SID, emphasise the critical aspect of addressing learners' need for support through one-to-one assistance from a teacher, as suggested by Buli-Holmberg and Jeyaprabhan (2016). This approach ensures that CAPS for Learners with SID is inclusive and effective in promoting number sense development.

In conclusion, when considering the specific teaching context of learners with SID, it becomes crucial to explore effective teaching strategies and approaches, such as multisensory instruction, to enhance the development of number sense for these learners.

2.5.1 Teachers' strategies for addressing learners' challenges in developing a sense of numbers

Learners with SID experience challenges to develop numbers as a concept and, therefore, logical and carefully designed instructional strategies are essential to achieving the differentiated learning goals (Depaepe et al., 2013). Learners with SID have difficulty processing numbers and visual representations of discrete quantity (Lewis, 2014; Mazzocco et al., 2013).

Piaget (1952) argues that development is a precursor of learning. The learner, therefore, needs to reach a particular level of development before certain learning can take place. If teachers expect learners to accomplish a form of learning before they have reached the cognitive-developmental stage, they would not progress in the specific form of learning (Saxe, 2015).

Teachers must plan and differentiate their teaching and learning strategies. It is teachers' responsibility to select appropriate activities and materials for individual learners based on differentiated learning goals (Schnepel et al., 2020). It would be beneficial to examine the statements made by Schnepel et al. (2020) concerning the mathematical progress of learners with an intellectual disability in inclusive classrooms when considering various strategies for teaching number sense to learners with SID. These statements are that learners with SID demonstrate progress in mathematics throughout the course of a school year, and they make advancements in various mathematics skills as they continue their educational journey. Hattie et al. (2016) argue that teachers should consider the mathematical process of how learners progress during a school year when planning and developing mathematical resources. This is also echoed by Dyson et al. (2013), who state that teachers should consider what it means to promote understanding of number sense and the teaching outcomes they want to achieve when teaching "numbers".

2.5.2 Activity-based learning

The focus on activity-based learning is the *how* learners learn and not just the *what* they learn, and therefore it is a learner-centred approach. Activity-based learning encourages an active approach to teaching in a multisensory manner. Learners are not passive listeners in this approach but rather active participants in the learning opportunity. Activity-based learning is achieved through three ways, namely experimentation, exploration and expression (Nwoke, 2021). Teaching and learning should revolve around engaging in hands-on, minds-on, or hearts-on experiments and activities. The concept of an activity-based learning approach is fundamentally grounded in the widely accepted belief that children are not passive recipients of information but are active learners (Celik, 2018).

In the context of learners with SID, it is crucial to establish environments that enable these learners to actively participate in mathematical activities. By providing them with opportunities to engage with mathematical problems using various strategies and encouraging them to create their mathematical challenges, learners with SID can become deeply involved in their exploration. This involvement not only enhances motivation but also prompts learners with SID to investigate, make informed decisions, seek out patterns and connections, generate generalisations, engage in effective communication, discuss their ideas, and explore alternative solutions. In this way, the approach tailored to learners with SID fosters an active and inclusive learning environment, enabling them to play a central role in developing number sense (Vale & Barbosa, 2015).

If teachers employ their PCK correctly and differentiate their activities accordingly, they guide their learners from the known to the unknown. Teachers can use concrete, visual and auditory resources for teaching and learning. Number sense development must be introduced from the concrete, semi-concrete to the abstract. Concepts should adhere to the three-step instructional approach in Mathematics.

2.6 CONCLUSION

This chapter presented the theoretical framework that underpinned this study. I delved into two foundational theories, namely Piaget's (1957) cognitive learning theory, focusing on developmental stages, and Lee Shulman's (1986) consensus model of PCK. The exploration included a detailed examination of Shulman's framework, specifically highlighting TSPCK, crucial in the context of the central theme – number sense. Additionally, I discussed the concept of teachers as learning specialists, emphasising their specialised understanding, known as TSPCK, and outlined the key characteristics that define it. Given the study's primary focus on teachers' PCK, I also addressed a critical aspect of the research centred on the title *Developing number sense for Grade 1 learners with severe intellectual disabilities*. I provided initial context by discussing learners with SID and

shifted the focus to number sense development, underscoring the importance of teaching strategies and the integral role of activity-based learning in achieving the objectives.

Next, chapter 3 discusses the research approach and methodology. A qualitative research design, aligned with the interpretive paradigm, was selected for this study. I adopted a phenomenological approach; I collected data and generated insights through exploration. Specifically, I employed a qualitative case study methodology, which allowed me to conduct an in-depth investigation on the research topic. Chapter 3 details the case study selection process, participant recruitment, data collection methods and the data analysis techniques that were used. Lastly, the ethical considerations applicable to this study and the measures that were taken to ensure the trustworthiness of the findings are discussed.

CHAPTER 3: RESEARCH METHODOLOGY AND DESIGN

3.1 INTRODUCTION

Building upon the foundational framework laid in chapter 2, chapter 3 delves into the research methodology and design that guided the study. Having explored the essential theories underpinning the research – that is, Piaget’s cognitive learning theory and Shulman’s consensus model of PCK – and having focused on TSPCK as it relates to number sense, I now turn my attention to the practical aspects of the investigation.

In chapter 2, I thoroughly examined teachers’ PCK, with an emphasis on the TSPCK of number sense, to provide a solid foundation for the research. Furthermore, I delved into the context of learners with SID, which is central to the study and a vital topic of number sense development. Chapter 3 continues this journey by providing a comprehensive explanation of the research approach and methodology focusing on a qualitative case study within the interpretive research paradigm. The research design was qualitative, closely aligned with the interpretive paradigm. Using a phenomenological approach, I collected data and generated insights through exploration. Specifically, I adopted a qualitative case study methodology, allowing for an in-depth examination of the research subject. In this chapter, I outline the case study selection process, describe participant recruitment methods, detail data collection procedures, and elucidate the data analysis techniques employed. Moreover, this chapter addresses the ethical considerations that had to be borne in mind throughout the study and discusses the measures taken to ensure the trustworthiness and reliability of the research findings.

The aim was achieved by answering the following research question: How do teachers use PCK when they teach number sense to Grade 1 learners with SID? The sub-questions that provided the pieces of the puzzle that allowed the main research question to be answered were formulated as follows:

- What training did teachers receive to use PCK when they teach number sense to Grade 1 learners with SID?
- How do teachers apply PCK when teaching number sense to learners with SID?
- What challenges do teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID?

3.2 QUALITATIVE RESEARCH DESIGN

The research methodology serves as a fundamental framework that shapes the entire research process (Leavy, 2017). It represents the confluence of the philosophical underpinnings of the study and the practical research methods employed (Antwi & Hamza, 2015). By establishing the groundwork for data collection, analysis, description and the explanation of the phenomenon, it delineates the procedures utilised in the study (Nieuwenhuis, 2019a). Moreover, the research methodology equips researchers with the necessary techniques to uncover answers to the research questions at hand (Kumar, 2019) (§ 1.7).

3.2.1 Research paradigm: Interpretive paradigm

A paradigm is a set of guidelines for navigating the assumptions about reality embedded in the research paradigm chosen to solve a problem (Rehman & Alharthi, 2016). The strength of a paradigm is that it allows the researcher to act, but the reasons for action are hidden in the unquestioned assumptions underpinning the paradigm or set of guidelines. This study was positioned in an interpretive paradigm based on its focus on understanding a complex social phenomenon, namely teachers' PCK when teaching number sense to Grade 1 learners with SID.

An interpretive paradigm explores shared meanings to develop insights into situations and understand how people construct meaning through observations of how people react to individual experiences (Nieuwenhuis, 2019a; Thanh & Thanh, 2015). The most important role of a researcher is that of an interpreter through offering descriptions and explanations of the phenomenon under study (Kivunja & Kuyini, 2017) and in the process of gaining insight into the phenomenon. At the time of the study, as a member of the Grade R–3 department at a school for learners with SID, I was in the position to act as an interpreter by offering interpretive descriptions and insight regarding the practices of my colleagues who taught Grade 1 learners at different schools for learners with SID (Nieuwenhuis, 2019a). To control for researcher bias and encourage open sharing of thoughts from colleagues, the researcher employed several measures. Firstly, the researcher maintained a reflexive journal to document personal thoughts, reflections, and any potential biases that might influence data collection and interpretation. Additionally, regular discussions were held with a supervisor to critically evaluate the researcher's own perspectives and ensure objectivity in data analysis. Furthermore, the researcher established a comfortable and non-judgmental atmosphere during interviews, emphasizing confidentiality and the importance of honest feedback. This approach aimed to minimize any potential biases and foster open communication among colleagues, ultimately enhancing the trustworthiness and validity of the study's findings.

3.2.2 Research approach: Phenomenology

The nature of the research question required a qualitative research design. Qualitative research is an iterative process that aims to improve the understanding of the scholarly community related to a natural phenomenon or action (Aspers & Corte, 2019). This process happens by making new significant distinctions resulting from getting closer to the phenomenon. Qualitative researchers are most interested in how people arrange themselves and their social settings or reality and how they make sense of their surroundings (Nieuwenhuis, 2019b). In this study, teachers' PCK in the setting of a classroom for Grade 1 learners with SID was explored, with a specific focus on developing number sense.

A qualitative research design is socially constructed by individuals interacting with their world (Merriam & Grenier, 2019). Qualitative researchers are gripped by knowing how people understand, interact and experience their world. This includes information about the people's contradictory behaviour, their belief systems, their emotions, and their relationships with others (Hilal & Alabri, 2013). Researchers are also interested in the specific point in time and the context of the social phenomenon under study. The phenomenon in qualitative research is investigated in a natural setting, implying researchers make sense of and interpret things the way they are (Rossman & Rallis, 2016). The strength of a qualitative research design is the resultant thick descriptions of how people experience a social issue or problem (Chowdhury, 2015).

Phenomenology was pivotal in this study, offering a nuanced understanding of Grade 1 teachers' lived experiences in teaching number sense to learners with SID. Employing phenomenological interviews and observations, I delved deeply into teachers' subjective experiences, perceptions, and decision-making processes, identifying unique challenges like adapting teaching strategies, addressing misconceptions, and managing diverse learning needs. Phenomenology also illuminated successful strategies that teachers found effective. By understanding how teachers perceived their role, learners' abilities, and teaching strategies, I gained insights into factors influencing teachers' PCK development. This informed targeted interventions, professional development workshops, and resources tailored to teachers working with learners with SID, contributing to improved teaching practices. Phenomenology provided a rich exploration of teachers' experiences, offering insights into challenges and successes of teaching number sense to Grade 1 learners with SID, enhancing the understanding of special education settings. The phenomenological approach allowed for a deeper exploration of teachers' rich, subjective experiences as they employed their PCK to facilitate number sense development in learners with SID, providing insights into unique perspectives, challenges, and successes within this special educational needs context.

3.2.3 Research methodology: Case study

Based on the nature of the research problem discussed in section 1.2, with the specific focus on teachers' PCK when teaching number sense to Grade 1 learners with SID, a qualitative intrinsic case study positioned within the interpretive research paradigm was identified as a suitable research methodology. The strength of case study research lies in its usefulness in studies when contextual conditions of the phenomenon under study must be considered (teaching for learners with SID) (Lucas et al., 2018). Case study research is therefore employed when the aim of the study is to gain an understanding of the complex phenomenon within the real-life context in which it occurs (Yin, 2018). A qualitative case study was considered valuable for answering the complex real-world question, namely how PCK is applied by teachers when teaching number sense to Grade 1 learners with SID.

The intrinsic case study approach was particularly appropriate for investigations seeking an in-depth understanding of a specific phenomenon within its real-life context, making it a suitable choice for exploring teachers' PCK in the context of teaching number sense to Grade 1 learners with SID. The focus was on gaining rich insights into the intricacies of PCK as it pertained to this specific group of learners. The study delved deeply into the complexities of the phenomenon within its natural setting, emphasizing the qualitative nuances that were vital for a comprehensive understanding of the research problem (Kekeya, 2021). This choice aligned with the methodological rigor required for academic inquiry, allowing for a thorough exploration of the unique aspects associated with the teaching of number sense to Grade 1 learners with SID.

It is imperative to establish the boundaries of the case to ensure the study's scope is reasonable and to indicate the breadth and depth of the study. The boundaries for the unit of analysis of this study were drawn based on the recommendations of Yin (2018), who recommended that time and activity can be limited (focusing on the teaching of the concept "number sense") as well as the context of the unit of analysis (teaching number sense to Grade 1 learners with SID). Miles et al. (2014) define a case as "a phenomenon of some sort occurring in a bounded context" and basically the unit of analysis – based on the research questions for this study, the presence of teachers' PCK in classrooms for learners with SID. Grade 1 teachers were the unit of analysis for the study.

Case study research further permits the prior development of conceptual propositions captured in a conceptual framework to direct data collection and analysis (Yin, 2012). Case studies are therefore useful in supporting or expanding previously developed theories. In this study, the theory of TSPCK (Mavhunga & Rollick, 2013) was examined in the context of mathematics teaching to learners with SID. The TSPCK model was applied with the aim to expand the model based on the insights gained in the context of schools for learners with SID.

Case study research is considered both a research approach and methodology (Yin, 2018). Case study research has been recognised as a practical methodology for providing a comprehensive, in-depth understanding of complex educational problems that can inform professional practice by understanding exemplary “cases” (Yin, 2018). In this case study research, a social phenomenon was investigated to acquire an in-depth understanding of the teachers’ subjective experiences and meaning-making processes (Leavy, 2014). The flexibility of the case study design allowed me to study the presence of PCK as it was displayed within the real-world context of teaching number sense to Grade 1 learners experiencing SID. This methodology helped me to give teachers teaching Grade 1 learners with SID in public schools in a Gauteng region a chance to express their opinions and thoughts on their PCK. In this study, I explored how teachers experienced and interacted with their social world based on an interpretive perspective (Merriam & Grenier, 2019).

Using the research questions and methodology as starting point, a series of decisions around the data collection, analysis and ethical practices are described in the following sections. The research design was guided by a focus on the teachers’ PCK in teaching number sense to Grade 1 learners with SID in SEN schools to gain in-depth understanding. In the next section, I discuss the selection of the research site and the participants.

3.2.4 Sampling

Sampling is considered one of the most important aspects of a research design. Sampling in a qualitative research study aims to acquire useful data to understand the complexity and context of a social phenomenon (Gentles et al., 2015). The research questions provide the focus for site and sample selection.

Sampling is divided into two methods: probability (or random) sampling and non-probability (or non-random) sampling. Non-probability sampling techniques rely on researcher judgement and are used in qualitative studies (Buckler & Walliman, 2016). Convenience sampling, a non-probability sampling method, was used to select the research site, while the participants were purposively selected (§ 1.7 & 3.2.4.2), allowing for easier data collection (Wolf et al., 2016). Both sampling strategies were an information-oriented choice, as the case and participants were selected based upon expectations about the information they held and the presence of knowledgeable people (Yin, 2018).

3.2.4.1 Site selection

The sites (schools for learners with SID) were chosen by means of convenience sampling (Etikan et al., 2016). Convenience sampling (§ 3.2.4) is a type of non-probability sampling where participants meet specific criteria decided on before the study begins. The criteria used were

accessibility, geographical proximity, and availability or willingness to participate (Etikan et al., 2016). The research question required participants at schools that have learners with SID enrolled. In the South African context, these learners are enrolled in dedicated schools for learners with SID.

The six schools identified to be selected to participate were in the geographical area where I was located (Gauteng region) at the time of the study. The schools catered to learners from the age of three to 18 years of age, who represent the total spectrum of learners with SID in the South African context. Learners are screened for admittance to these schools based on the level of intellectual ability they present. The schools follow the CAPS for Learners with SID learning programme. Although CAPS for learners with SID has not been gazetted yet, the DoE enquires their schools to instruct the adapted learning programme.

After seeking and receiving permission from the Gauteng DoE (GDE) to conduct research in their schools (Appendix A), the next step in the recruitment process was to contact the school principals by invitation and obtain permission for their school to be used as a site for data collection. Six public schools in a Gauteng region offering special educational needs services to learners with SID were initially approached and invited to participate as study sites. Five of the schools accepted the invitation, while the sixth school did not respond or provide a reason despite follow-up phone calls (Appendices B & C). The second step in the research process involved recruiting teachers as participants at the schools that agreed to participate in the study.

3.2.4.2 Participant selection

The participants for this study were purposively selected based on a set of pre-defined criteria. Purposive sampling allowed me to select teachers who could be considered a “typical” sample and knowledgeable enough to provide in-depth information on the phenomenon (Buckler & Walliman, 2016; Schoch, 2016), namely the teachers’ PCK applied when teaching number sense to learners with SID. The following inclusion criteria were applied in this study:

- Teaching learners at Grade 1 developmental level according to CAPS for Learners with SID. The study was not limited to Grade 1 teachers teaching eight- and nine-year-old learners with SID.
- Teaching at a school for learners with SID in the selected Gauteng region.
- Qualified and knowledgeable teachers (having at least a BEd Foundation Phase degree or an equivalent qualification in education).
- All participants with one year or more experience in teaching learners with SID.
- Informed participants who participated voluntarily in the study.

The recruitment process for the study involved several steps, which were executed in the following order:

Firstly, initially, an independent recruiter was selected to assist with presenting and recruiting potential participants for the research, aligning with the ethical considerations. However, it was later decided that the school principals should act as recruiters because of their existing trust-based relationships with the teachers and their familiarity with the study criteria.

Secondly, an email containing important information, including the study's objectives, research questions, and data collection methods, was sent to the school principals. This was followed by a phone call to arrange a meeting.

Next, a meeting was scheduled with the individual school principals, during which a short presentation was delivered, clarifying the role of the recruiter. All principals agreed to assume the role, given their knowledge of the staff and their suitability for the study.

Following the principals' agreement, a meeting was organised by the principals themselves with the potential participants in their respective schools. In this meeting, the study was explained to the teachers, ensuring them that both the GDE and their school's governing bodies approved the research. The principals, after the meeting, signed the consent forms on behalf of their schools (Appendix B).

Next, a meeting with all eligible teachers was arranged by the researcher to provide a more detailed explanation of the research process. A presentation was prepared for this meeting. I was present to answer any potential questions raised by the participants and members of the school management teams, such as principals, deputy principals or departmental heads.

After the meetings, the consent forms were collected from the participants, indicating their voluntary agreement to participate in the study. In total, 15 potential participants from the six schools were initially invited, but ultimately, 12 participants were successfully recruited based on the participant selection criteria and responses received to the invitations.

The overall process allowed the school principals to invite individuals who would provide valuable insights into the research problem, irrespective of them representing the broader population. Consent forms were received from all participants (Appendix D). The process bore in mind ethical considerations and was approved by the GDE (Appendix A). A flyer summarising the aim of the study, research questions and data gathering methods was prepared for the principals (Appendix E).

3.3 DATA GENERATION

Qualitative data generation entails a process of selecting, interpreting and organising the gathered information (data) to analyse and understand the phenomenon; this would allow the researcher to answer the research questions (Flick, 2017). Data generation is complementary to the sampling process (§ 3.3.1). Data generation can be either direct or indirect data. Direct data generation methods are spoken and written words, observed actions, and body language of participants within their social setting. Indirect data emerges from the analysis of documents (Lopez & Whitehead, 2013).

Table 3.1: Summary of data generation methods – documents

Documents (public records)	1. National Curriculum Statement: Grade R-5 for learners with Severe Intellectual Disability, Mathematics, Grade 1 (CAPS for Learners with SID). 2. National Curriculum Statement: Grade R-5 for learners with Severe Intellectual Disability, mathematics, Grade 1. Lesson Plan Tracker and clarification notes.
Documents (personal document)	Teachers' planned lesson plans for number sense development (Participant A1, A2, A3, B1, C1 and C2)

Table 3.2: Summary of data generation methods – interviews

	Total number of participants	Number of schools	Total number of interviews
Individual interviews	Six participants	School A	Interview with Participant A1
	Three SID schools		Interview with Participant A2
	Six interviews	School B	Interview with Participant A3
		School C	Interview with Participant B1
			Interview with Participant C1
			Interview with Participant C2
Focus group interviews	12 Grade 1 teachers	(Focus group interview – Group 1)	Focus group 1: Six participants
	Five SID Schools	School:	Participant A1
			Participant A2

	Two focus group interviews	A, B, C	Participant A3 Participant B1 Participant C1 Participant C2
		(Focus group interview – Group 2) School: D, E School D School E	Focus group: two to six participants Participant D1 Participant D2 Participant D3 Participant E1 Participant E2 Participant E3

3.3.1 Data generation methods and instruments

Data were collected from three sets of data: CAPS for Learners with SID (document analysis), Lesson Plan Tracker and teachers' personal lesson plans; semi-structured individual interviews; and focus group interviews (see Figure 3.1). These multiple data sources were used to enhance data credibility (Yin, 2018). Every data source was viewed as a component of the larger puzzle, with each component enhancing my comprehension of the overall phenomenon (Lester et al., 2020).

Figure 3.1 indicates the systematic organisation of the data generation that assisted the researcher to keep track of the datasets, with a firm focus on solving the main research question.

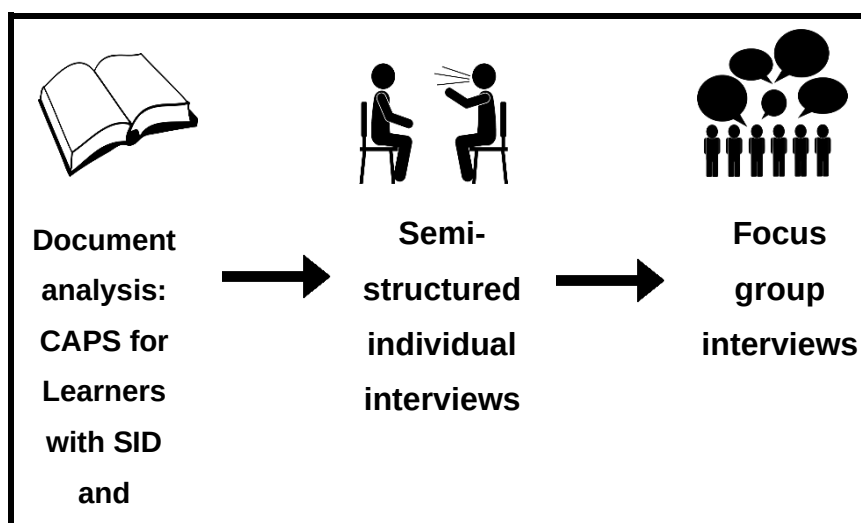




Figure 3.1: Flow diagram of data collection methods

Figure 3.1 illustrates the systematic organisation of data generation, which played a pivotal role in helping me maintain a structured approach to data collection. This approach was instrumental in staying focused on addressing the main research question. The data generation process unfolded in three distinct stages, each serving a unique purpose. The first stage involved document analysis, specifically examining CAPS for Learners with SID and teachers' lesson plans. The second stage involved conducting semi-structured individual interviews, and the third stage involved focus group interviews. For each interview session, a dedicated interview protocol was used (see Appendices G and H). The participants were provided with the interview protocol before the study. This proactive measure significantly impacted the study's credibility by creating a more comfortable and reflective environment for the participants. While this approach introduced the potential for social desirability bias, it also allowed for more consistent responses and better time management. To mitigate the risk of bias, researchers ensured anonymity, included open-ended questions, used reflective probing techniques, and provided opportunities for member checking. These strategies were instrumental in maintaining the integrity and validity of the study.

The next subsections (§ 3.3.2.1 through 3.3.2.3) discuss the various data collection methods and instruments, presented in the order they were utilised during the research process. An overview of these data collection methods and the participants involved can be found in Table 3.1.

3.3.1.1 Dataset one: Documents

A document is a text which relates to some aspect of the social world. An official document is intended to be read as an objective statement of fact but is, however, socially constructed (Rahman, 2020). The researcher should interpret the meaning of the document through the lens of the research question. The data was analyzed utilizing a document analysis schedule (§ 4.6.1). To ensure the authenticity of the data, the researcher exclusively selected authoritative sources and thoroughly verified their trustworthiness before incorporating them into the study. The first dataset consisted of documents selected for the information they offer as it relates to the first and second sub-research questions. The first research question focused on the guidance provided by the curriculum policy related to the teaching of number sense to Grade 1 learners with SID. The relevant document that provided the information needed was the National Curriculum Statement: Grade R-5 for learners with Severe Intellectual Disability, Mathematics, Grade 1 (CAPS for

Learners with SID). A second related document that was read in conjunction with CAPS for Learners with SID, was the CAPS for Learners with SID Lesson Plan Tracker and clarification notes (DBE, 2018). The third set of related documents were the teachers' lesson plans. Lesson plans are considered personal documents, as they are first-person accounts of the participants' actions and experiences. The lesson plans were used to examine the teachers' elements of PCK in number sense development evident during lesson planning. Six lesson plans were collected. The use of lesson plans to examine the teachers' PCK was advantageous because the data were considered permanent – the data can be checked in their original form by others. When the researcher considers the use of documents as datasets, the focus should be on the quality of the documents rather than on the number of documents (Stahl & King, 2020). The CAPS for Learners with SID learning programme, Lesson Plan Tracker and clarification notes satisfied the criteria for trustworthy data, namely being highly organised and contextualised (Erlingsson & Brysiewicz, 2017).

In addition to the data collection methods mentioned earlier, document analysis was employed as a supplementary approach. Specifically, CAPS for Learners with SID was utilised to formulate the questions for the semi-structured individual interviews. This allowed for a comprehensive exploration of key aspects related to the study, such as the guidelines, lesson plans and explanations of number sense development. The data analysis process unearthed valuable insights from these documents, contributing to a more nuanced understanding of the research topic. Furthermore, the document was analysed to provide me with essential contextual information. Regular interaction with this document, as part of my daily work, facilitated a deep familiarity with its content. This familiarity was instrumental in formulating relevant and meaningful semi-structured interview questions that effectively captured the nuances of the research topic. Document analysis served as a crucial foundation for the data collection process, ensuring that the interviews were targeted and insightful.

Analysing CAPS for Learners with SID – with a particular focus on the suggested content, resources, and guidelines provided to teachers – entailed a comprehensive process. To begin, I gathered all relevant learning programme documents:

- National Curriculum Statement: Grade R-5 for learners with Severe Intellectual Disability, Mathematics, Grade 1 (CAPS for learners with SID)
- Lesson Plan Tracker and clarification notes.

The data analysis process involved employing a document analysis schedule (§ 4.6.1), teaching guides and lesson plans, and supplementary materials. This initial step was followed by a thorough examination of the learning programme content, learning objectives, teaching strategies and assessment methods. It was crucial to assess how well the learning programme aligned with

broader educational goals and addressed the diverse educational needs of learners with SID. The analysis also included the identification of potential implementation challenges and drew on teachers' feedback for valuable insights.

3.3.1.2 Dataset two: Semi-structured individual interviews

The aim of the second dataset was to see the world through the eyes of the participants, as participants are valuable sources of information from whom to obtain rich descriptive data (Nieuwenhuis, 2019b). The interviews enabled me to collect data by asking questions for clarification or probing for more information. This information acquired in this stage required participants to recall their decision-making processes and reasoning during a lesson on number sense presented to Grade 1 learners with SID. Six teachers from selected schools A, B and C were invited to participate in individual interviews (Table 3.1).

I conducted the individual interviews. The researcher scheduled semi-structured interviews with individual participants at times that were convenient for them, after school hours. The interviews were conducted in the most suitable location for the interviewees, which was their own school classrooms. The duration of each interview ranged from 30 to 45 minutes. During the interviews, the researcher used their laptop and cellular device for digital recording purposes, while also taking notes as the interviewees responded to the questions. The interview protocol was available in two languages, Afrikaans and English, to enable all participants to feel comfortable answering the questions in their preferred language. All participants could speak Afrikaans and English fluently and felt comfortable being interviewed in these two languages. The interview questions were semi-structured (see Appendix G) and were guided by the research questions, document analysis (§ 3.3.2.1), factors influencing PCK, and elements of TSPCK. The open-ended nature of the questions allowed for more discussion to occur in a less structured manner (Nieuwenhuis, 2019b). The research questions were the driving force of the study because they were associated with all aspects of the approach. The questions started with "what", "how", or "why", and they focused on the exploration of the participants' perspectives (DeJonckheere & Vaughn, 2018). A total of seven questions were prepared for the participants to answer.

To gain an in-depth understanding of the participants' views, the participants were allowed to expand on their own answers, and I asked for clarification if their responses were unclear. The participants' perspectives and comments added to the value of the study (Nieuwenhuis, 2019b). The duration of the interviews depended on the answers of the participants, as the aim was to reach data saturation or the point where no new answers are presented (Saunders et al., 2018). I was observant of the answers and responses of the participants to identify any new emerging line of exploration. The interviews were conducted in a neutral setting at each of the three different

schools while adhering to all Covid-19 protocols. Appendix J presents a transcript of one of the six semi-structured individual interviews.

The principals of School A, School B and School C were approached and requested to identify potential participants who met the specified criteria outlined in section 3.2.4. These schools were chosen for their geographical proximity, which allowed for convenient in-person interviews for both the researcher and participants.

In School A, three teachers were identified who met the specific participant criteria and expressed their willingness to participate in the study. Similarly, School B had one teacher who met the criteria, while School C had two teachers who met the requirements. These individuals were selected based on their suitability for providing valuable insights into the research problem, as determined by the inclusion criteria.

By involving multiple teachers from different schools, the study aimed to capture a diverse range of perspectives and experiences related to the research topic. This approach contributed to a comprehensive and well-rounded understanding of the phenomenon under investigation.

3.3.1.3 Dataset three: Focus group interviews

The third dataset for this study was generated through focus group interviews with the aim of capturing the collective PCK employed by a group of teachers when teaching number sense to Grade 1 learners with SID. Focus group interviews are professional conversations involving a carefully selected group of participants, allowing for the exploration of attitudes, opinions and perceptions related to the social phenomenon under investigation (Kumar, 2018; Nyumba et al., 2018). These interviews enhance the trustworthiness of the data by validating or refuting responses of group members which enables clarification of ambiguous data (Nowell et al., 2017). Hence, focus group interviews contributed significant value to the study (Nieuwenhuis, 2019b).

The focus group interview protocol consisted of seven questions (Appendix H) adapted based on the data generated from the semi-structured individual interviews. These questions encompassed factors influencing PCK and characteristics of TSPCK identified in the conceptual framework presented in chapter 2 (§ 2.3.1). The protocol served as a guideline for the researcher during the interviews (Appendix H).

Two focus group interviews were conducted, each with six purposively selected participants from the five schools catering to learners with SID. The duration of each focus group interview ranged from 60 to 90 minutes, encouraging debates and leveraging group dynamics to facilitate data collection (Nieuwenhuis, 2019b). The interviews took place after school hours, with Focus Group 1 conducted at School B because of the convenience of the location for all participants, while Focus Group 2 was conducted online using *Zoom*, adhering to Covid-19 protocols. The interviews

continued until data saturation was achieved (Saunders et al., 2018). A transcript of one of the two focus group interviews is provided in Appendix J.

The focus group interviews were conducted in two separate groups. Group one consisted of participants from School A, School B and School C, which were the same participants involved in the semi-structured individual interviews (Table 3.3). These participants were invited to the focus group interview to generate more in-depth, rich data. In a group setting, participants can build on each other's answers and contribute additional insights, resulting in a more comprehensive dataset. Moreover, some participants may feel more comfortable expressing their views in a group setting rather than individually.

Focus Group 2 was conducted with participants from School D and School E. Unfortunately, the sixth school (School F), which was invited to participate, did not respond to the invitation after the initial meeting with the principal.

To ensure that all participants were prepared for the focus group interviews, they received the interview questions in advance. This allowed them to familiarise themselves with the topics and formulate their thoughts and responses more effectively during the interviews. The provision of interview questions in advance was intended to enhance participants' preparedness and facilitate more comprehensive responses, yet it also introduced the risk of social desirability bias, potentially affecting the authenticity and trustworthiness of the data.

By combining the findings from the semi-structured individual interviews and the focus group interviews, this study yielded a rich dataset that provides insights into instructional practices and underlying cognitive processes (Nieuwenhuis, 2019b).

3.3.2 Data analysis

During the analysis phase of research, findings need to be generated by transforming raw data into new knowledge (Ngulube, 2015). Data analysis is an ongoing process based on what researchers bring with them to investigate, and what they pay attention to and select from what they hear, see and record (Creswell & Poth, 2016). These decisions, including the write-up, are all part of the analysis, confirming the argument that data analysis, in a decisive way, form the outcome of the research (Flick, 2014). The goal of data analysis is to uncover themes, patterns, concepts, insights and understanding (Cleland, 2017) by searching for similarities in the data that lead to categories such as codes and themes.

The following general qualitative analytical strategy was followed: (1) become familiar with the data by listening to the audio recordings, transcribing each interview verbatim and reading through all the documents; (2) organise the data into categories to maintain alignment with research questions before applying a coding framework to the data; (3) generating themes, reviewing themes, defining

and naming themes, and writing up (Caulfield, 2019). Writing up data is considered as another analytic layer because it shapes the way the researcher thinks about the data (Labani et al., 2017). It is also in this phase that the ethical dimensions of the study are evident, as the researcher strives for transparency and the inclusion of participant voices (Labani et al., 2017).

The overall analytical strategy for the three datasets (§ 3.3.2.1 & 3.3.2.2) can be described as directed qualitative content analysis (Kibiswa, 2019). Three different approaches to qualitative content analysis that can be used to interpret meaning from the content of text data have been identified: conventional, directed or summative (Kibiswa, 2019). Conventional content analysis starts with the data and codes are derived from the data during the actual process of analysis. Directed content analysis, on the other hand, starts with codes that are derived from the conceptualisation of the conceptual framework employed for the study and as such, the codes are defined before the data analysis but could also be defined during the data analysis (Assarroudi et al., 2018). Lee Shulman's (1986) theory on PCK formed the theoretical framework as identified and discussed in section 2.2.

The themes that emerged from a discussion on the contextual knowledge that influences PCK (§ 2.5) were further used as themes in the analysis of the interview transcripts as they would answer the last research question: *What are the challenges teachers experience when applying PCK during the teaching of number sense to Grade 1 learners with SID?*

The documents and interview transcripts were arranged to facilitate the process of systematically searching the data to increase the understanding of the phenomenon (Bernard et al., 2016). The data analysis strategy for each of the datasets was selected to suit the data type and the response to the research question. A flow diagram of the sequence of the data collection and associated analytical strategy employed in each dataset is presented in Figure 3.1.

Table 3.3: Identified main themes and sub-themes

Themes	Sub-themes
The Role of Teacher's PCK in Supporting Learners to Develop Number Sense	• Strategies • Training • Prior Knowledge • Challenges
Learners with SID	• Profile • Barriers to Learning
Strategies to Support Learners with SID to Develop	• Classroom Organisation and

Number Sense	Management
	• Lesson Plans • Resources • CAPS for Learners with SID • Developing Number Sense

3.3.2.1 Dataset one: Document analysis

Document analysis involves the researcher interpreting documents in relation to a specific research question where the data are processed through systematisation, categorisation and interpretation (Flick, 2014). In this study, document analysis was conducted by analysing the words and concepts used in CAPS for Learners with SID, focusing on the meanings and relationships of these words and concepts within the context of teaching number sense to Grade 1 learners. The first dataset for analysis consisted of three sets of documents: CAPS for Learners with SID, supplemented by its Lesson Plan Tracker and clarification notes; and teachers' personal lesson plans. Some participants referred to the learning programme as DCAPS, because it was first introduced to their schools as DCAPS by the DBE. The analytical focus was to use the elements of PCK as an analytical framework to identify the PCK embedded in CAPS for Learners with SID learning programme implemented in schools for these learners. The lesson plans were used as a dataset in this study to analyse teachers' transformation of the content knowledge of mathematics with the specific aim of teaching number sense to Grade 1 learners with SID.

A document analysis schedule was employed to analyse the documents (§ 4.6.1) by examining the meanings and relationships of words and concepts used in the learning programme specifically related to PCK for teaching number sense to Grade 1 learners (Vaismoradi et al., 2016; Wilson, 2016). A document analysis schedule is a highly efficient method that prioritizes the selection of pertinent information over the time-consuming task of collecting data. In the research process, the following steps were taken when employing the document review method: objectives, selection criteria, data collection, coding scheme, analysis techniques and validation (Morgan, 2022). I employed a conceptual framework, informed by relevant literature, to guide and structure the analysis of the data, and the words and concepts from CAPS for Learners with SID were grouped to form a conceptual map representing the phenomenon of PCK application during the teaching of number sense to Grade 1 learners. This abstraction process allowed for the identification and organisation of themes within the data (Elo et al., 2014).

Relevant texts that aligned with the research questions were identified, and these texts were then grouped into themes, forming the basis for further analysis and reporting on the emerging themes. The themes corresponded to the concepts of the conceptual framework used in this study, namely in-depth content knowledge, pedagogical knowledge, awareness of learner thinking, adaptive teaching strategies, contextual understanding and ongoing professional development. Guiding questions were used for each element of the PCK framework, and the responses to these questions indicated the presence or absence of PCK elements in the planning process. Figure 2.1 illustrates the components of the PCK framework (§ 2.5).

Additionally, emerging themes relevant to the research sub-questions were reported. The understanding and analysis of these themes are subjective and interpretative in nature, as I made personal evaluations when I discussed the emerging themes. This subjective scrutiny aligns with the interpretive nature of qualitative data analysis.

Overall, the consensus model of PCK (Figure 2.1) served as a deductive analytical framework during the abstraction process, allowing for the representation of the PCK envisioned in the CAPS for Learners with SID learning programme.

3.3.2.2 Dataset two and dataset three: Semi-structured individual interviews and focus group interviews

The semi-structured and focus group interviews were transcribed verbatim from the audio recordings, allowing for a comprehensive record of the participants' statements. To gain a deeper understanding of the content, I repeatedly read the transcripts, familiarising myself with the data and gaining an overview of the participants' perspectives. Using a coding system (see Table 3.4), I marked similar passages of text with coding labels, facilitating easy access for further analysis and comparison in relation to the research questions.

Relevant texts from the interviews were then grouped into themes, which served as the basis for reporting on the emerging themes. These themes were aligned with the concepts of the conceptual framework used in this study. The identified themes focused on the role of teachers' PCK in supporting learners to develop number sense, learners with SID, and teaching strategies to support learners with SID to develop number sense. Additionally, emerging themes relevant to the research sub-questions were identified and reported. It is important to note that the analysis and interpretation of these themes are personal and subjective, as I made individual evaluations when I discussed the emerging themes (see Table 3.4). This subjective scrutiny aligns with the interpretive nature of qualitative data analysis, recognising that interpretations may differ among researchers.

Moving forward, the PCK of individual teachers in the six schools was compared through a between-case analysis, aiming to crystallise a collective framework. This analysis allowed for the identification of commonalities and differences in PCK among the teachers.

Following the individual data gathering phase, focus group interviews were conducted. These interviews provided an opportunity for participants to engage in professional conversations and build upon each other's answers, fostering a collaborative and interactive data collection process. The focus group interviews aimed to generate additional insights and perspectives, complementing the individual interviews and enriching the overall data analysis.

3.4 TRUSTWORTHINESS

In this research, as with all qualitative research, there was a need to demonstrate the trustworthiness of the research (Nieuwenhuis, 2019b). This led to the implementation of strategies for establishing credibility, confirmability, transferability and dependability, which aim to support the argument that the findings are worth paying attention to (Anney, 2014; Lincoln & Guba, 1985). The recommendation by Elo et al. (2014) to scrutinise the trustworthiness of every phase of the analysis process was taken into consideration.

3.4.1 Credibility

Credibility in qualitative research is achieved through practices such as thick description, triangulation, or crystallisation (Stewart et al., 2017). The aim is to allow the reader to establish the credibility of the findings from the perspective of the participants (Stahl & King, 2020). As there is no absolute truth in qualitative interpretive research; everyone comes with their own perspective, resulting in differences in the interpretation of the research, but if the researcher can justify how their perspective was formed, credibility is established (Kivunja & Kuyini, 2017).

Triangulation is a technique that supports the validation of data through cross-verification from multiple sources of data (Rossman & Rallis, 2016). In the context of this study, data triangulation was employed, as three datasets were utilised to achieve convergence and/or contradiction (Nieuwenhuis, 2019b). More than one teacher at five different schools were included in the study to incorporate several viewpoints (Joslin & Müller, 2016). These datasets were compared. The different data gathering methods ensured that rich data were collected that enabled me to provide the envisaged thick descriptions (Korstjens & Moser, 2018). Confirmation and completeness of the data as the main goals of triangulation are major strengths (Nieuwenhuis, 2019b).

It is, however, important to acknowledge that there could have been bias in the study on the part of the participants (teachers). It is possible that the teachers were not fully honest in their responses

during the interviews and could have given responses to avoid being judged by the researcher as a colleague or during the focus group interviews by their fellow colleagues.

3.4.2 Dependability

Dependability refers to the consistency and reliability of the research findings. Amankwaa (2016) suggested two strategies to ensure dependability: triangulation and an audit trail. To achieve dependability in this study, I ensured that the research process was logical and traceable and the process was audited (Merriam & Grenier, 2019). Data triangulation was employed, as explained in sub-section 3.4.1. The provision of a detailed and accurate description of the research methods and data collection procedures provides the necessary audit trail to ensure dependability. All research procedures were clearly documented. This allows anybody to follow the research and to audit and critique the findings (Moon et al., 2016). Furthermore, the process of how categories and codes were obtained and the decisions made throughout the research process contributed to the audit trail (Nowell et al., 2017). The use of direct quotations from data confirmed that the findings were based on the participants' responses. It also contributes to a thick description of how the data were analysed.

3.4.3 Transferability

Transferability in qualitative research pertains to the extent to which the findings and conclusions can be applied or transferred to different contexts or settings. It involves assessing the potential generalisability of the results beyond the specific study participants and conditions (Konradsen et al., 2013). The aim of qualitative research is not primarily to provide transferable findings; however, the transferability judgement by a potential reader of the research can be facilitated through thick descriptions (Korstjens & Moser, 2018). The implementation of purposive sampling (selecting a cross-section of knowledgeable Grade 1 teachers from six different schools) of the participants enabled me to achieve heterogeneity in the sample and increase the transferability of the findings (Polit & Beck, 2017), as it increases the potential for extrapolation of the findings to other settings or groups.

3.4.4 Confirmability

Confirmability addresses the interpretation of the data as well as the reporting of the findings to ensure the constructed knowledge around the social phenomenon under study is not figments of my imagination but undoubtedly derived from the data (Korstjens & Moser, 2018). I had experience of the teaching of number sense to Grade 1 learners with SID, which allowed me to build rapport with the participants, reducing the potential of socially desirable responses in interviews and

reflections, and enabled me to collect and understand the multiple perspectives among the participants (Nieuwenhuis, 2019b). This ensured my familiarity with the data and reduced possible misunderstandings or misinterpretations of data (Korstjens & Moser, 2018; Tracy, 2010).

3.5 ETHICAL CONSIDERATIONS

Ethics are the moral and legal principles by which this research was conducted, and it ensures that research is completed in the right manner (Anwar, 2015). Ethical research is based on the relationship of trust between the researcher and the participants (teachers). As the researcher, I was obliged to respect participants' rights, values and desires throughout the study. This is necessary to avoid harming or deceiving the participants (Flick, 2017).

Ethical standards were adhered to by obtaining ethical permission from the Potchefstroom Campus of North-West University Faculty of Education Ethics Committee (EduREC) prior to the commencement of the study (Appendix J). The Committee issued an ethical clearance certificate (N W U – 0 1 9 0 1 – 2 0 - A 2) to conduct the research. The application addressed aspects such as informed, voluntary consent by the participants, confidentiality of the data and participants' identities, and no harm to participants (Anwar, 2015). The ethical issues of informed consent, confidentiality and trust were taken into consideration (Ryen, 2016).

The data collected during this study was exclusively accessible to the researcher and supervisors involved in the project, stored on both a protected memory stick and a permission-required share drive to ensure data security, and transcribed and anonymized from audio recordings soon after the interviews took place. Following ethical guidelines, the data will be retained for a period of five years from the date of publication before being securely disposed of. The intended research outputs comprise an article intended for submission to an academic journal, where the findings will be disseminated to the broader research community, contributing to ongoing discussions in the field. Additionally, a presentation aimed at the Department of Education is planned as another avenue for sharing the study's outcomes.

3.5.1 Ethical permission

Permission is needed to conduct a study in public schools in South Africa. Permission was obtained from the Gauteng DBE to collect data from teachers (Appendix A) as well as from the five school principals, SGB and 12 teachers at the schools identified as sites for the research (Appendices B, C & D).

3.5.2 Informed consent

A consent form was provided to the 12 teachers invited to participate in the study. Informed consent involves informing participants about their role in the research, any potential consequences of their participation, and that permission is required for participation (Bos & Bos, 2020). Guidance notes and informed consent information were made available to all participants before they gave their consent to participate in the research (Manti & Licari, 2018). See Appendices D and E for the flyer (§ 3.2.4.2) outlining the aim of the study, research questions and data gathering methods.

3.5.3 Confidentiality

Confidentiality requires the researcher to protect all research participants from potential harm by protecting their identity (Saunders et al., 2015). Confidentiality also demands that participant data not be linked to any individual when reporting the research findings (Hilton et al., 2020). Codes were assigned to schools and participants (e.g., School A–E, and Teacher 1–12). The focus group participants were informed at the start of the interviews about the measures in place to protect their identities, and they were also requested to protect each other's identities.

3.5.4 Participant withdrawal

Research participants had the right to withdraw from the research at any time without disclosing any explanation (Bos, 2020). No participant withdrew during the study.

3.6 CONCLUSION

This chapter started with a description of the research methodology and research design. The rationale behind a qualitative interpretive case study as research methodology was discussed, followed by a detailed description of the research design. The discussion on the research design included the selection and invitation of the participants. The chapter was concluded with a discussion on the trustworthiness of the study, followed by the ethical considerations applicable to this study. Trustworthiness was ensured by using more than one dataset and ensuring traceability in the reporting of the findings. The ethical standards as set out by the Faculty of Education, North-West University, Potchefstroom Campus, were taken seriously throughout the research process. The following chapter reports on the findings of this study.

CHAPTER 4: FINDINGS AND ANALYSIS OF RESULTS

4.1 INTRODUCTION

In chapter 3, the research methodology was described. The reason for selecting a qualitative case study and positioning it within the interpretive research paradigm was explained. The discussion covered case study design, participant selection and the procedures for data collection and analysis used in this study. A case study design was pertinent to this research, as such a design centred on the examination of PCK in action within the authentic teaching environment, specifically in the context of teaching number sense to Grade 1 learners with SID. The chapter concluded with a discussion on the ethical aspects implemented throughout the study, followed by a discussion on how the trustworthiness of the findings was ensured.

In this chapter, my objective is to analyse and interpret the data that were gathered. I adopted the interpretive paradigm approach. This paradigm was chosen for this study because of its emphasis on understanding intricate social phenomena. Specifically, I delve into the realm of teachers' PCK as it pertains to the instruction of number sense to Grade 1 learners with SID.

4.2 RESEARCH QUESTIONS AND PURPOSE OF THE RESEARCH

To contextualise the data analysis process, it is imperative to reiterate the primary research question for this study, as originally formulated in section 1.3: *How do teachers use PCK when they teach number sense to Grade 1 learners with SID?* The question refers to the intricate nature of teaching learners with SID, highlighting the pragmatic necessity for specialised PCK among teachers within the South African educational context. The study's primary focus revolved around the utilisation of PCK to effectively convey a specific subject matter, namely the development of number sense. The question was supported by secondary questions that helped me to understand how teachers showed their PCK, the training they had received, how they used this knowledge, and their experiences while using it. These secondary questions are discussed along with the data analysis in section 4.6.

4.3 BACKGROUND OF THE PARTICIPATING SCHOOLS

The study was conducted within the context of schools that prioritise a holistic education for each learner. Five schools were selected for participation based on their location within the selected Gauteng region. These schools provided education to learners ranging from age three to 18 years old, covering the entire spectrum of learners with SID in South Africa.

Admission to these schools is based on the intellectual ability of the learners, and they follow the adapted learning programme and Assessment Policy Statements (CAPS) for learners with SID. Although CAPS for Learners with SID has not yet been officially gazetted, the DoE requires these schools to implement the adapted learning programme outlined in CAPS.

4.4 PARTICIPANTS IN THE STUDY

In section 3.2.4, I explained that I had chosen convenience sampling, a non-probability sampling method in site selection, while the participants were purposively selected. The six participants of School A, School B and School C formed part of the individual semi-structured interviews. The same six participants of School A, School B and School C also formed part of focus group interviews. The six participants from School D and E formed part of Focus Group two. As I planned to conduct the interviews with a specific purpose in mind (to determine how teachers use PCK when they teach number sense to Grade 1 learners with SID), I decided on purposive sampling when I selected participants for the semi-structured interviews as well as for the focus group interviews. For the interviews, I sent out a letter to school principals together with invitations to give permission for their school to be used as a site for data collection. Five principals replied that they were willing to use their schools as a site. Subsequently, a meeting with all eligible teachers was arranged by the researcher; the aim was to provide a more detailed explanation of the research process. A presentation was prepared for this meeting. I was present to answer any potential questions raised by the participants and members of the school management teams, such as principals, deputy principals, or departmental heads.

Participants in the research had the opportunity to respond to questions in either Afrikaans or English, considering their comfort and familiarity with the languages. As the dissertation is presented in English, responses provided in Afrikaans were thoughtfully translated into English. To distinguish the translated responses, they have been consistently marked in purple text throughout this document, ensuring clarity for the reader and acknowledging the linguistic diversity of the participants. This approach was taken to maintain the integrity of the research while accommodating the linguistic preferences of our participants.

The biographical detail of the participants was as follows:

Table 4.1: Biographical detail of the participants

Participant	Number of years teaching	Teaching at mainstream schools	Teaching at schools for learners with SID	Professional Teacher Development Qualifications
A1	2 years	0	2 and a half years	BEd in ECD and Foundation Phase (birth to Grade 3)
A2	16 years	9 years	7 years	Diploma in EduCare National Certificate in Reception Year Teaching BEd in ECD and Foundation Phase (birth to Grade 3) Advanced Certificate in Education.
A3	7 years	3 and a half years	3 and a half years	BCom Law Degree Postgraduate Certificate in Education (Foundation Phase)
B1	20 years	12 years at	8 years	B Prim Ed

		various types of schools (Private schools, preprimary schools, preschools and own preprimary school)		degree Diploma in remedial education
C1	31 years	25 years	6 years	Higher Education Diploma in Junior Primary
C2	21 years	0 years	3 years	NQF Level 1-6 Junior Primary Diploma in Education BEd in Foundation Phase Education Hons in Inclusive Education: barriers to learning Educational kinesiology
D1	7 years	0 years	7 years	Postgraduate Certificate in Education (Foundation

				Phase and ECD)
D2	3 years	0 years	3 years	BEd in ECD and Foundation Phase (birth to Grade 3) BAHons in AAC
D3	12 years	8 years	4 years	BEd BEd Hons Educational Psychology BA Hons in Industrial Psychology
E1	28 years	24 years	4 years	Diploma of Higher Education Diploma in remedial teaching
E2	30 years	18 years	12 years	Higher Education Diploma in Junior Primary with remedial teaching as main subject
E3	14 years	10 years	4 years	Diploma of Higher Education

The study involved twelve participants, each with diverse teaching experiences and qualifications. A1 had 2 years of teaching experience, all of which were at schools for learners with SID, with a BEd in ECD and Foundation Phase. A2 had 16 years of teaching experience, 9 of which were at mainstream schools and 7 at schools for learners with SID, with qualifications including a Diploma in EduCare, a National Certificate in Reception Year Teaching, and a BEd in ECD and Foundation Phase. A3 had 7 years of teaching experience, 3 and a half of which were at mainstream schools and 3 and a half at schools for learners with SID, with qualifications including a BCom Law Degree and a Postgraduate Certificate in Education. B1 had 20 years of teaching experience, 12 of which were at mainstream schools and 8 at schools for learners with SID, with qualifications including a B Prim Ed degree and a Diploma in remedial education. C1 had 31 years of teaching experience, 25 of which were at mainstream schools and 6 at schools for learners with SID, with a Higher Education Diploma in Junior Primary. C2 had 21 years of teaching experience, all of which were at mainstream schools, with qualifications including an NQF Level 1-6 Junior Primary and a Diploma in Education. D1 had 7 years of teaching experience, all of which were at mainstream schools, with qualifications including a Postgraduate Certificate in Education. D2 had 3 years of teaching experience, all of which were at mainstream schools, with qualifications including a BEd in ECD and Foundation Phase. D3 had 12 years of teaching experience, 8 of which were at mainstream schools and 4 at schools for learners with SID, with qualifications including a BEd and a BEd Hons in Educational Psychology. E1 had 28 years of teaching experience, 24 of which were at mainstream schools and 4 at schools for learners with SID, with a Diploma of Higher Education and a Diploma in remedial teaching. E2 had 30 years of teaching experience, 18 of which were at mainstream schools and 12 at schools for learners with SID, with a Higher Education Diploma in Junior Primary with remedial teaching as the main subject. E3 had 14 years of teaching experience, 10 of which were at mainstream schools and 4 at schools for learners with SID, with a Diploma of Higher Education.

4.5 DATA GENERATION

Data for this study were generated through a multifaceted approach. Firstly, I analysed CAPS for Learners with SID and teachers' lesson plans. This document analysis provided a foundational understanding of the learning programme and the integration with teachers' lesson plans. Next, semi-structured individual interviews and focus group interviews with the teachers were conducted to gain deeper insights into their personal PCK. The integration of data from these varied sources served as a form of triangulation, enhancing data reliability. The choice of qualitative methods – interviews and document analysis – was driven by the need to explore the complexities of developing number sense for Grade 1 learners with SID and contributed to the field of special needs education.

4.6 DATA ANALYSIS: DOCUMENT ANALYSIS AND INTERVIEWS

The analysis adopted a deductive approach, drawing upon data obtained from a variety of sources, including the analysis of CAPS for Learners with SID and lesson plans received from the teachers. Six lesson plans submitted by teachers were analysed to assess their alignment with CAPS for Learners with SID, revealing areas of congruence and contradiction. Following this initial stage, semi-structured individual interviews and focus group interviews were conducted. The findings from these diverse sources are presented through thick descriptions, capturing the nuanced experiences and perspectives of the teachers concerning their PCK within the context of teaching number sense to Grade 1 learners with SID. The inclusion of verbatim quotes is recommended by Castleberry and Nolen (2018) to enhance the depth of meaning within the text and reinforce the credibility of the accumulated data.

4.6.1 Dataset one: Document analysis

The data that emerged from the document analysis was dataset one. I analysed the following documents: (1) National Curriculum Statement: Grade R-5 for learners with Severe Intellectual Disability, Mathematics, Grade 1 (CAPS for Learners with SID); and (2) National Curriculum Statement: Grade R-5 for learners with Severe Intellectual Disability, Mathematics, Grade 1 – Lesson Plan Tracker and clarification notes. The teachers' personal lesson plans served as the third dataset. Some participants referred to the learning programme as DCAPS, because it was first introduced to their schools as DCAPS by the DBE. CAPS for Learners with SID outlines the content, objectives, and standards that teachers are expected to cover during their lesson presentation. The learning programme provides a context for understanding the teachers' PCK. I identified number sense as the TSPCK and examined the expectations and guidelines for teachers set by CAPS for Learners with SID, which helped me to evaluate how teachers adapt and apply their PCK. The learning programme gave me the opportunity to trace the influence of this document on teachers' PCK when developing a sense of numbers in Grade 1 learners with SID.

Document analysis enhanced the validity of this study (Vaismoradi et al., 2016). Including CAPS for Learners with SID as part of the analysis added credibility to the study. The research was grounded in the official educational context and not solely reliant on teachers' opinions and lesson planning.

As part of the analysis, it was essential to explore the concept of curricular saliency in CAPS for Learners with SID. *Curricular saliency* in CAPS for Learners with SID refers to the visibility, emphasis and prominence given to specific educational components intended for learners with SID.

After analyzing the documents in accordance with the document analysis schedule, the following themes and sub-themes were identified (§ 3.3.1.1 & 3.3.2.1). The findings are presented holistically in tabular form with direct reference to the CAPS for Learners with SID.

Themes	Sub-themes	Documents analysis: CAPS for Learners with SID
The role of teachers' PCK in supporting learners to develop number sense	Strategies	"teachers should use various curriculum differentiation strategies..." (DoE, 2018:8) Teachers should be familiar with each learner's unique learning style (auditory, visual, or kinesthetic) and tailor activities accordingly. They should differentiate the content by transitioning from known to unknown concepts, utilizing concrete, visual, and auditory learning resources. It's essential to introduce concepts from the concrete and semi-concrete stages to the abstract stage.
	Training	The CAPS for Learners with SID primarily focus on providing learners with training in accordance with the National Qualification Framework. Concerning teacher training, participants mentioned that they had received training in the CAPS for Learners with SID.

	Prior knowledge	The document does not specifically mention the teachers' prior knowledge.
	Challenges	The document does not discuss any challenges teachers may encounter when developing number sense.
Learners with SID	Profile	The document only specifies the suggested grades for learners with SID based on their age, such as Grade 1 for learners who are 8 to 9 years old.
	Barriers to learning	Individualized adaptation is necessary concerning content, presentation methods, classroom pedagogy, instructional pacing, and assessment accommodations. The guiding principle is to maintain high expectations for every learner while identifying and addressing learning barriers such as cognitive, physical, emotional, or environmental factors. This ensures fairness in assessment and maximizes each learner's potential. The objective of this document is to address barriers to learning at each level in order to facilitate learners' progress. This learning programme aims

		to eliminate obstacles that hinder learners with moderate to severe intellectual disabilities and learning difficulties from accessing the learning programme. It will empower them to acquire and apply knowledge and skills that are relevant to their lives.
Strategies to support learners with SID to develop number sense	Classroom organisation and Management	According to classroom organization and management, the program should cater to each individual learner's needs. Instruction and support should be tailored to the required level of assistance (high, moderate, low). Emphasizing small group teaching can enable individualized support and foster a more intimate teacher-learner connection. Small group teaching allows learners to negotiate meanings, express themselves, and develop essential skills like listening and presenting ideas. It also provides a safe space for learners to share ideas and thoughts. Independent activities should be chosen by the teacher based on each learner's level. These activities are particularly beneficial for learners who can

		work independently for short periods. Creating a visually stimulating classroom environment can enhance learning. Colour can improve visual processing, reduce stress, and support brain development. Visual stimulation promotes stronger connections in the brain and encourages visual thinking, problem-solving, and creativity. Therefore, the colours used in the learning environment should promote information retention and stimulate learner participation.
	Lesson plans	The Lesson Plan Tracker and clarification notes (in a separate document) provide guidelines on how progression should be addressed. Therefore, the specification of content should be read in conjunction with the lesson plan tracker and clarification notes.
	Resources	Various resources, such as counters, Legos, abacus, and a weather chart, are listed in the learning programme at 2.10. Other essential areas include: - Areas for sand and water play

		- Apparatus for climbing, balancing, swinging, and skipping - A Mathematics corner/centre in the classroom equipped with mathematical games, etc.
	CAPS for Learners with SID	The learning programme, developed in response to the needs of learners identified and assessed through the 2014 Policy on Screening, Identification, Assessment, and Support, aligns its curriculum content with the Foundation and Intermediate Phase of the National Curriculum Statement. This curriculum emphasizes practical application, tailored to the learners' ages, interests, and aptitudes. It caters to a broad spectrum of learners with moderate to severe intellectual disabilities and learning difficulties across various age groups, aiming for their full human potential, dignity, and self-worth. The programme also fosters the development of their personality, talents, creativity, as well as mental and physical abilities, cultural, social, environmental, and economic competencies, enabling effective and independent

		participation in society as adults (Convention on the Rights of Persons with Disabilities, 2006, and White Paper on the Rights of Persons with Disabilities, 2015).
	Developing number sense	According to the learning programme, the content area is Numbers, Operations, and Relationships. For this study, the focus is on general content in the area of Number Sense Development.

To facilitate the analysis of document data, in collaboration with teachers' lesson plans, it is important to note that I had specifically requested lesson plans for Term 2. Consequently, the excerpts from CAPS for Learners with SID that I examined also pertained to Term 2. This deliberate alignment in the timing of the lesson plans and the relevant curriculum sections ensured a focused and contextualised analysis.

According to CAPS for Learners with SID, the number range for counting objects are 1 to 13. The number range for counting forward and backward, number symbols and number names are 1 to 7.

GRADE 1 OVERVIEW NUMBER, OPERATIONS AND RELATIONSHIPS	
COUNTING WITH WHOLE NUMBERS	Term 2
Count objects	Number range 1 to 13 One to one correspondence Count in ones Clapping hands Count concrete objects Count body parts Stamping feet

	Practise rote counting using number rhymes and songs
Count forwards and backwards	Number range: 1 to 7 Incidental counting using number rhymes and songs, concrete objects counters, counting with body movements. Count in ones, forward and backward, from any given number between 1 and 7.
NUMBER CONCEPT DEVELOPMENT: Represent whole numbers	Term 2
Number symbols and number names	Number range: 1 to 7 Recognise, identify and read number symbols 1 to 7 Reinforce the knowledge gained Trace, colour, copy and write number symbols incidentally

According to the literature, number sense includes a range of skills for daily life activities, including recognising number symbols (such as 1, 3, 5), counting objects, naming and valuing numbers (one, three, five), understanding place value (tens and ones), comparing and ordering numbers (1, 2, 3) (DBE, 2018; Naudé, 2014). Consequently, it becomes imperative to thoroughly scrutinise expectations regarding the development of number concepts as outlined in CAPS for Learners with SID. It is noteworthy that for the specific topic of counting objects, there is a discrepancy in the number range. While the learning programme prescribes a number range of 1 to 13 for counting objects, a different number range of 1 to 7 is prescribed for activities related to counting forward and counting backward, including the use of number symbols and number names. The topic describes, compares and orders numbers in a number range from 1 to 3. This distinction in the prescribed number range implies a clear difference in the scope and depth of the learning objectives associated with these specific aspects of number sense development in the learning programme.

The six teachers' lesson plan topics stated the following:

According to the literature, the concept of "number(s)" falls within the content area of "Number, Number Operations, and Relationships". This concept is specifically concerned with fostering the

understanding of concrete numbers such as 1, 4 and 7, encompassing knowledge of number symbols, number values and number names (DBE, 2018). Participant A1's lesson aim was in harmony with the lesson aim of four other analysed lesson plans, all of which revolved around the theme of "understanding number symbols, number values, and number names". This objective closely aligns with the recommendations stated in CAPS for Learners with SID, emphasising a number range of up to 7.

However, Participant A1's decision to extend the number range to 9 might have been influenced by the differentiated curriculum delivery required for learners with SID. This could be an indication of her awareness of the varying pace at which learners develop number sense, as per the CAPS for learners with SID. It is important to note that the learning programme serves as a guide rather than a rigid instruction manual.

According to the literature, instruction materials as representations include different ways to visually present subject matter information, such as illustrations, analogies, metaphors, diagrams, tables and models (Eames, 2016). When teachers use content representations, it indicates their ability to understand the learners' background experiences and misconceptions, and this would assist them to use the correct form of representation to convey and teach the topic according to the learners' understanding. Teachers need to use different forms of content representations to explain the content of the specific topic. In terms of PCK demonstrated in her lesson planning, Participant A4 employed a diverse range of instructional resources, including a programme called "Number Land" designed to enhance learners' number sense by using numbers as characters. While this resource diversification showcased a commitment to engaging teaching strategies, it introduced additional sums that were not necessarily in alignment with the primary lesson aim. Expanding opportunities for learners should ideally remain closely tied to the core lesson objective. However, one aspect that required improvement in Participant A4's lesson planning was the lack of detailed explanations regarding what the teacher would do and what the learners would do during a lesson.

*"Use topics of Life Skills as source of content, Number Land: Dolly Dolphin
Number 9."*

(Lesson Plan; Participant A1)

Participant A2 demonstrated a comprehensive approach in her lesson planning for Mathematics by seamlessly integrating it with her Life Skills topic:

"Hoe om my liggaam veilig te hou."

[How to keep my body safe.]

(Lesson Plan; Participant A2)

According to the Education White Paper 6 Inclusive Learning Programmes Participant's Manual (EWP 6) (2007), a broadcast teaching strategy was suggested where media like YouTube, radio, television, video, or film and imaginative strategies are used to extend the educational experience beyond the classroom, making it accessible to all learners. The participant's primary lesson aim was to help her learners understand number symbols, names and values, with a specific emphasis on introducing the number 6. A noteworthy element of her teaching strategy was the incorporation of songs and rhymes, enriching the language development aspect of her lessons.

According to the Education White Paper 6 Inclusive Learning Programmes Participant's Manual (EWP 6) (2007), interest-based teaching strategies are designed to cater to the diverse needs of learners with SID, ensuring that CAPS for Learners with SID is inclusive and effective in promoting number sense development. The literature highlights that learners' individual needs need to be considered in lesson planning. Strategies may involve organising learners into groups based on their support requirements, such as high support and low support (DBE, 2018; Gentry et al., 2013). Participant A2 exhibited a keen awareness of the diverse needs of her learners. To provide expanded opportunities for her low-support group while remaining aligned with the primary lesson aim, she included additional exercises that reinforced number symbols, names and values and avoided the introduction of unrelated topics such as addition and subtraction. Simultaneously, for her high-support group, she incorporated numerous sensory activities to enhance their learning experience, staying consistent with the core objectives of her lesson. One remarkable aspect of her lesson planning was her intention to introduce the number 7, even though her primary focus was on the number 6. This multitiered approach reflects her commitment to a comprehensive, holistic mathematical education. However, her teaching experience came with a notable challenge: the one-to-one support required by her learners, which demanded a significant investment of her time and resources to meet their unique needs effectively. It is a critical aspect to address learners' support needs through one-on-one assistance from a teacher, as highlighted by Buli-Holmberg and Jeyaprabhan (2016). The question arises as to whether Participant A2 initially planned to introduce the number 6 in her lesson and subsequently added the number 7 due to the learners' well-established knowledge of the number 6, or if there may have been another reason for this adjustment. It prompted consideration of whether she perhaps momentarily forgot her original intent to focus on the number 6 while drafting the lesson plan, leading to the inclusion of the number 7.

“Leerder[s] wat almal op verskillende vlakke is. Om genoeg een-tot-een tyd met leerders te hê.”

[Learners who are all at different levels. To have enough one-on-one time with learners.]

(Lesson Plan; Participant A2)

According to the literature, the expected chronological age for Grade 1 learners with SID in a South African special education needs school is eight to nine years old (DBE, 2018); however, this is not always the reality. Learners' ages in specialised education classrooms can vary considerably because of their varying developmental stages. Participant A3's choice of a different topic in contrast to the other participants is a striking observation. Notably, she taught a Grade 2 class; however, she made a deliberate decision to instruct mathematics at a developmental level akin to Grade 1. Six of her learners were nine years old. In the semi-structured interview with Participant A3, she referred to her learners as "much younger, although they are nine, they are still not on [sic] the level". Within this context, she ventured into the realm of TSPCK, focusing on the description, comparison and ordering of numbers within the range of 1 to 3. To foster her learners' understanding of numerical relationships, with a primary emphasis on "more and less", she thoughtfully integrated an array of resources into her teaching approach. These resources included plastic containers filled with plastic balls, engaging learners in active counting and discerning containers with varying quantities of balls. Complementing this, she harnessed the power of number cards to visually represent the quantities within the containers, and she also transitioned to drawing containers and balls on the board as part of her teaching strategy.

An intriguing aspect of Participant A3's teaching strategy was her expansion of the number range, extending it beyond the prescribed 1 to 3 and embracing numbers up to 10. This significant departure from the specified number range within the established learning programme raises pertinent questions about the underlying rationale for this extension. It implies that Participant A3 may have developed a unique and distinctive TSPCK perspective, one that reflects her interpretation of the subject matter's intricacies and the specific educational needs of her Grade 2 learners functioning at a Grade 1 developmental level. For teachers to be effective, they need to make practical and effective use of different types of knowledge that go beyond the understanding of the subject matter (Stronge, 2018). A closer examination of this TSPCK could provide valuable insights into the motivations and personal PCK deployed by Participant A3.

NUMBER CONCEPT DEVELOPMENT: Describe, compare and order whole numbers	Term 2
Describe, compare and order numbers	Number range: 1 to 3 • Identify whole numbers • Compare which of the two given collection of objects are:

	○ Small and big ○ More and less ○ Number rhymes and songs
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“Number symbols and number names”

(Lesson Plan; Participant B1)

Participant B1’s lesson planning, centred on number symbols and number names, effectively demonstrated a strong grasp of TSPCK. Notably, she seamlessly integrated these concepts into the practice of counting forward and backward within the range of 1 to 7. What stood out was the meticulous integration of planned resources into the lesson, which reflected an understanding of how to enrich the learning experience for learners. Her focus on revising the number 7 showcased a thoughtful understanding of their developmental needs. Moreover, her incorporation of sensory activities – like sand trays, finger writing and fingerprints – highlighted her keen awareness of the diverse learning modalities that could enhance understanding and retention.

The true testament to Participant B1’s PCK was the coherent and visible integration of number symbols, number names and counting forward and backward in her lesson planning. This alignment was further underscored by the explicit lesson aim, which stated “[k]now number symbols, number values, and number names: Number range 1–7, revising number 7.” Participant B’s approach exemplified a pedagogical method that not only effectively imparted knowledge but also fostered a comprehensive understanding of numbers and their representations, showing a well-communicated and proficient PCK. According to the research findings of Mavhunga and Rollick (2013), this approach aligned with their identified content-specific components, such as learner prior knowledge, curricular relevance, challenging concepts, representations, and effective conceptual teaching strategies that work synergistically.

“Know number symbols, number values and number names: Number range: 1–7, revising number 7.”

(Lesson Plan; Participant B1)

“Number range: 1 to 7. Incidental counting using number rhymes and songs, concrete objects counters, counting with body movements. Count in ones, forwards and backwards from any given number between 1 [and] 7.”

(Lesson Plan; Participant C1)

Participant C1’s lesson plan topic is in line with the objectives set in the learning programme according to counting forwards and backwards but both participant C1 and C2 lesson aims were:

“Know number symbols, number values and number names...”

(Lesson Plan; Participant C1 and C2)

Based on CAPS for Learners with SID, it is clear that the lesson aims in these lesson plans are inaccurately formatted. The specified lesson aim appears to align more with another topic related to number sense development, showing a misalignment in the lesson's intended content and objectives:

NUMBER CONCEPT DEVELOPMENT: Represent whole numbers	Term 2
Number symbols and number names	Number range: 1 to 7 Recognise, identify and read number symbols 1-7 Reinforce the knowledge gained Trace, colour, copy and write number symbols incidentally

As part of Participant C1's introduction to her lesson, she clearly aligned it with the topic of counting forward and backward, but as the lesson progressed in her planning, she mostly focused on counting forward to number 7. The participant integrated different topics in the content area: number, operations and relationships. She planned activities for the learners to count in ones, counting concrete object, counting with body movements and recognise, identify and read number symbols 1 to 7. As part of the lesson plan, Participant C1 planned for learners to use their fingers to count, forming the numbers with play dough, and using a number line. This made it a rounded-off lesson with well-planned integration.

"Wys getal 7 op getallelyn, getalkaarte, maak 'n 7 met klei, skryf op chalkboard, vind getal 7 tussen ander getalle, tel 7 voorwerpe uit. Wys sewe vingers. Wys met vingers wat kom ná 6."

[Show number 7 on number line, number cards, make a 7 with playdough, write on chalkboard, find number 7 among other numbers, count 7 objects. Show seven fingers. Show with fingers what comes after 6.]

(Lesson Plan; Participant C1)

In participant C1's lesson introduction, she initially aligned it with the topic of counting forward and backward but progressively primarily focused on counting forward up to the number 7. What was

particularly noteworthy was how she seamlessly integrated various topics in the content area, encompassing number, operations and relationships. Her well-planned activities for the learners included one-to-one counting, hands-on counting with concrete objects, the incorporation of body movements, and the development of skills in recognising, identifying and reading number symbols ranging from 1 to 7.

According to the literature, by using more than one sense, the brain receives new information in multiple ways (Bear et al., 2020). As a result, new information is retained better. In kinesthetic-tactile teaching, learners experience concepts with their body and five senses (see, hear, taste, smell and touch) (DBE, 2018). Participant C1's lesson plan featured engaging elements that encouraged learners to use their fingers for counting, shape numbers using play dough, and utilise a number line. This holistic and well-integrated approach enriched the overall quality of the lesson. Her exceptional lesson planning clearly reflected a profound understanding of PCK. Her adept integration of various topics and teaching strategies demonstrated a strong command of how to teach number sense effectively to learners with SID. By seamlessly weaving together activities that involved counting, concrete objects, body movements and symbol recognition, she showcased a nuanced grasp of the subject matter and the unique requirements of her learners. This not only enhanced the overall quality of the lesson plan but also underscored her expertise in adapting and tailoring teaching strategies to the developmental level and needs of her learners. Participant C1's well-structured lesson plan serves as a commendable example of planned PCK.

"Count in ones."

(Lesson Plan; Participant C2)

In alignment with the learning programme's content on counting objects, it becomes clear that the lesson plan designed by Participant C2 featured a number range limited to 1 to 10. Participant C2 implemented recommended activities involving one-on-one correspondence and counting concrete objects, effectively aligning with the learning objectives of CAPS for Learners with SID. However, a noteworthy observation was the discrepancy in the specified number range, which should have encompassed numbers 1 to 13. This prompts a pertinent question: Did participant C2 intentionally restrict the number range to 10 because of considerations of learners' prior knowledge or her pedagogical expertise, emphasising the foundational importance of mastering numbers 1 to 10 before progressing further?

In the lesson plan, it is evident that she used a variety of resources but only listed the following:

"Videoclip song, counting up [from] 0 to 10 – Jack Hartman

Worksheets

Number charts”

(Lesson Plan; Participant C2)

According to the existing literature and cognitive learning theory proposed by Piaget in 1957, learning occurs as learners progress through distinct developmental stages along a continuum, which has been expanded on by Lefa in 2014. These stages are the sensorimotor stage (0–2 years), the preoperational or intuitive stage (2–7 years), the concrete operational stage (7–11 years), and the formal operational stage (adolescence to adulthood). Upon analysing the lesson plan of Participant C1, it became evident that her learners, despite their chronological age of 10 to 11 years, were functioning at a developmental level that ranged from six to 10 years. This observation underscores the importance of aligning instructional strategies with the learners’ developmental readiness to optimise their educational experiences. She integrated counting in ones with patterns, although the integration was not clearly outlined in the lesson plan as a cohesive whole. Notably, for the low-support learners in her class, Participant C1 provided expanded opportunities by using counters and repetition as teaching strategies. However, for the high-support group, there was no indication of specific resources or activities to assist these learners, as the participant primarily focused on explaining barriers to learning without a corresponding plan. The lesson mainly centred around counting sweets and distributing them. Although participant C1 mentioned planning worksheets for the learners, these worksheets were not attached for analysis.

In conclusion, as I conclude the document analysis, it became clear that a key focal point was the examination of the CAPS for learners with SID Lesson Plan Tracker. Considering the TSPCK model developed by Mavhunga and Rollick (2013) – which emphasises the significance of content-specific PCK elements in the preparation and implementation of lessons for specific topics – it is worth noting that although only Participant B1 explicitly included the week in her lesson plan, four other participants demonstrated thorough planning in designing lessons related to the topic “Number names and symbols”. This underscores the participants’ dedicated effort and alignment with the learning programme, emphasising the significance of this topic in the context of learners with SID. Participant A3 also incorporated the designated week for their lesson, which was week 5, focusing on the topic “Describing, comparing, and ordering numbers”.

“Datum / Date: 25-04-2022 (Week 4)”

(Lesson Plan; Participant B1)

“Datum / Date: Week 5”

(Lesson Plan; Participant A3)

Participant A1's lesson plan contained a discrepancy, as it indicated planning for the topic "Know number symbols, number values, and number names" during week 9. However, according to the provided Lesson Plan Tracker, week 9 is exclusively designated for covering the topics "Repeated addition leading to multiplication" and "Sharing leading to fractions". This discrepancy between the planned topic and the designated week in the tracker may indicate a misalignment in the lesson planning process, which could benefit from further clarification or revision to ensure coherence. It is also worth noting that this may simply reflect the reality of teaching in a classroom with learners with SID, where lesson schedules may not always align perfectly with the pace of learning.

"Datum / Date: 31-05-2022"

(Lesson Plan; Participant A1)

The CAPS for learners with SID Lesson Plan Tracker serves as compelling evidence outlining the specific teaching requirements for different weeks. This tracker explains the mandated learning programme and provides clear guidance on what teachers are expected to cover during each week of instruction.

Table 4.2: Lesson planning

GRADE 1 LESSON PLANNING TERM 2			
Topic	Content	Recommended Resources	Clarification Notes
Week 4 Continue with the following daily	Counting objects Mental Mathematics	Solve problems in context Time	Patterns, functions and algebra Measurement Data handling
Number Names and symbols	Number range: 1 to 7 Recognise Identify Read number symbols 1 to 7 Trace	Flash card Counting Chart Number Frieze	Number range: 1 to 7 Semi-concrete with picture cards and number cards Reinforce the knowledge gained

	Colour Copy		Write number symbols incidentally by coping or tracing
Week 5 Continue with the following daily	Counting objects Mental Mathematics	Solve problems in context Time	Patterns, functions and algebra Measurement Data handling
Describe, compare and order numbers	Number range: 1 to 3 Identify whole numbers	Counters Concrete objects	Number range: 1 to 3 - Compare which of the two given collection of objects are: - Small and big - More and less - Number rhymes - Songs
Week 9 Continue with the following daily	Counting objects Mental Mathematics	Solve problems in context Time	Patterns, functions and algebra Measurement Data handling
Repeated addition leading to multiplication	Add the same number repeatedly up to 6	Concrete objects	Make groups of objects by tying objects in groups of 1 and 2, then add together
Sharing leading to fractions	Introduction to half using concrete objects	Sweets Paper	Share between two People

While examining the Lesson Plan Tracker, it was evident that the provided clarification notes were somewhat vague. One notable deficiency in the tracker was the lack of clear indications regarding what teachers had to assess and when, which is a crucial aspect of TSPCK. To enhance the clarity and effectiveness of the tracker, it is recommended that a comprehensive list of potential teaching

strategies be included, accompanied by clear differentiation and enrichment activity ideas. This would not only provide a more detailed and actionable framework for teachers but also contribute to a more inclusive and effective way of teaching learners with SID. Such enhancements would address the deficiency in assessment guidance, ensuring that teachers have a well-rounded and comprehensive tool for preparation and planning that supports both TSPCK and the unique learning needs of learners with SID.

As per the existing literature, lesson plans are the outcomes of the transformation process of TSPCK (Stender et al., 2017). The actualisation of TSPCK occurs in the classroom setting, with static TSPCK involving the thought and planning of teaching a particular topic, and dynamic TSPCK being associated with in-class implementation (Mavhunga & Miheso, 2021). The significance of a clear, well-structured lesson plan tracker for teachers' TSPCK cannot be overstated. Such a tracker serves as a guiding tool, ensuring that teachers align their teaching strategies with established learning programme standards and specific learning objectives. This alignment is instrumental in effective teaching, as it directs teachers to focus on what learners need to learn. Moreover, a well-organised tracker provides a roadmap for delivering instruction, encompassing the sequence of lessons, topics and learning goals. Consistency in teaching is another vital benefit, especially when addressing learners with diverse learning needs, such as those with SID. The tracker aids teachers in maintaining uniformity in the content covered and the depth of understanding expected from their learners. Additionally, it allows for differentiation, offering strategies to meet the varying needs of learners within the classroom. This adaptability enhances TSPCK by catering to diverse abilities and learning styles. Assessment and progress monitoring strategies can also be seamlessly integrated. Efficient time management is an additional advantage that ensures that essential concepts are covered without rushing through the learning programme. Finally, the tracker supports professional growth by facilitating reflection on teaching practices and informed decisions for enhancing TSPCK. In conclusion, a clear lesson plan tracker empowers teachers with a well-organised, goal-oriented and adaptable tool for effective and inclusive teaching strategies, ultimately benefitting both teachers and learners.

4.6.2 Dataset two: Semi-structured individual interviews

Dataset two, comprising semi-structured individual interviews, played a pivotal role in the research methodology. It is important to note that because of the unique composition of participants, I chose to discuss the findings of dataset two and three simultaneously despite their different formats. Six individuals who participated in one focus group also participated in the semi-structured individual interviews. In contrast, the second focus group included new participants – three individuals from two separate schools who were unacquainted with each other.

The semi-structured interviews (dataset two) were meticulously designed to explore and delve into teachers' PCK from various angles. The questions focused on their knowledge about learners with SID, their approaches to lesson planning, the teaching strategies they employed, the use of resources, and the teachers' prior knowledge and professional development experiences. On the other hand, dataset three was focused on number sense development, revealing the challenges associated with teaching this critical concept, learners' prior knowledge, barriers to effective learning, and the overarching importance of nurturing a deep understanding of numbers among learners with SID.

Following careful analysis of the data that emerged from the semi-structured interviews and the focus group interviews, the decision was made to collate the data into a single dataset for the purpose of the discussion. This comprehensive approach allowed me to draw meaningful insights and conclusions from the perspectives and experiences shared by the participants, ultimately contributing to a more holistic understanding of the research aims and objectives.

During the semi-structured individual interviews, the participants were asked the following questions:

1. Describe the typical profile of Grade 1 learners in your classroom in terms of abilities, developmental level and motivation to learn?
2. How do you organise your classroom and adapt your lesson plans to accommodate all unique needs of learners when teaching number sense to Grade 1 learners with SID?
3. What teaching strategies do you use to teach the sub-set “numbers, number operations and relationships”?
4. Name the resources that you use to teach number sense in your classroom.
 - 4.1 Explain how you use these resources to teach number sense.
5. Which skills did you acquire during initial training to teach learners with SID in the Foundation Phase?
 - 5.1 How did your initial training prepare you to apply these skills in the classroom?
 - 5.2 What gaps can you identify in your training to prepare teachers for teaching learners with SID?
6. What prior knowledge do teachers need to instil before teaching number sense?
7. What challenges do you experience when accommodating the individual needs of Grade 1 learners with SID when developing number sense?

4.6.3 Dataset three: Focus group interviews

The following questions were asked during the focus group interviews:

1. Which outcome in the general content focus area of numbers sense development do you find challenging to teach?
2. Why is it challenging to teach?
3. Name the difficulties and knowledge limitations you, as a teacher, experience when teaching the concept of numbers.
4. How do you address learners' prior knowledge in your lesson planning and presentation?
5. What barriers to learning do learners with SID experience in developing a concept of numbers?
6. How do you address and overcome these barriers to learning in your classroom?
7. Why is it important for learners to develop a concept of numbers?

4.7 THEMES AND SUB-THEMES

The data revealed three main themes with sub-themes, presented in Table 4.2. The themes and sub-themes are presented and used as sub-headings. Evidence is given in the form of verbatim quotes.

Table 4.3: Themes and sub-themes

Themes	Sub-themes
4.10.1 The role of teachers' PCK in supporting learners to develop number sense	4.10.1.1 Strategies
	4.10.1.2 Training
	4.10.1.3 Prior knowledge
	4.10.1.4 Challenges
4.10.2 Learners with SID	4.10.2.1 Profile
	4.10.2.2 Barriers to learning
4.10.3 Strategies to support learners with SID to develop number sense	4.10.3.1 Classroom organisation and Management
	4.10.3.2 Lesson plans
	4.10.3.3 Resources
	4.10.3.4 CAPS for Learners with SID

	4.10.3.5 Developing number sense
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4.7.1 Theme one: The role of teachers' PCK in supporting learners to develop number sense

4.7.1.1 Strategies

The findings revealed a comprehensive understanding among all participants regarding the utilization of diverse teaching strategies for fostering number sense development. Participants articulated their pedagogical approaches by illustrating specific activities and methods they employ. The integration of sensory activities and the use of diverse resources were prominently highlighted in their explanations, indicating a rich and varied approach to teaching number sense. Teaching approaches and strategies combine teachers' understanding of the content and how they teach it (Barendsen & Henze, 2019). Participant A1 employed a range of teaching strategies, incorporating both teacher- and learner-centred approaches in the classroom. This stood in contrast to the prevailing trend among most participants who predominantly favoured teacher-centred methods. Participant C1's insight into the challenges faced by learners when working independently highlighted teachers' inclination towards teacher-centred approaches. This observation underscores the preference for teacher-centred methods in contexts where learners struggle with self-directed learning.

Furthermore, Participant C2, during her semi-structured individual interview, highlighted the potential for self-discovery through a specific approach in the classroom. She mentioned that opportunities for self-directed learning could be facilitated on the classroom carpet, where she placed various resources for learners to explore, fostering independent exploration and discovery within a controlled environment. This approach provided a unique avenue for self-directed learning, encouraging learners to engage with resources and explore potential concepts and numbers.

"... teacher centered. Ek staan voor in die klas. Ons tel as 'n groep saam. Ek gebruik my witbord. Ons kyk video's. Dan het ek ook... eh... leerdergesentreerd, waar ek vir hulle die kaartjies gee en hulle moet dit vir my uitpak en meer self ontwikkel."

[... teacher centred. I stand in front of the class. We count together as a group. I use my whiteboard. We watch videos. Then I also ...eh... learner centred, where I give them the cards and they have to unpack them for me and develop more themselves.]

(Semi-structured individual interview; Participant A1)

According to Piaget (1952), it is necessary in the early stages of number concept development for learners to establish a one-to-one correspondence. Tirosh et al. (2020) further elaborate on this by highlighting that this correspondence entails the ability to link concrete objects with numbers, such as recognising the number “five” and being able to physically count “five” objects. Participants A1 and B1’s emphasis on the importance of teaching at a concrete level, involving multiple senses to introduce new concepts, particularly when teaching numbers, was a noteworthy aspect of their teaching strategy. Their profound understanding of their learners and their adept use of various teaching strategies, seamlessly integrated into their lessons, reflected their excellent development of PCK. Throughout the interviews, it was evident that all participants recognised the significance of employing concrete resources in their teaching.

Participant B1’s lesson, as described in her semi-structured individual interview, showcased a multifaceted approach that included explicit teaching, demonstrations and guided discovery, demonstrating a comprehensive teaching strategy in one lesson. Her typical lesson for developing number sense started with the use of videos or songs, effectively incorporating the broadcast teaching strategy. The introduction of a specific number as a character involves roleplay, adding an interactive element to the lesson. Furthermore, sensory integration and kinaesthetic movement are incorporated by physically shaping numbers using materials and engaging learners in tactile activities such as walking, crawling, or using various resources. The inclusion of games like “feely bags” or blindfolds further enhances the sensory experience. B1 also utilised tangible resources such as unifix/Lego blocks or counters and flashcards with numbers for visual input. Additionally, her recognition of the importance of practical exercises, such as drill work, aligned with the guidelines provided by the DBE (2018) regarding kinesthetic-tactile, concrete and semi-concrete teaching methods. This exemplary approach by Participant B1 resonates with the concepts discussed in the literature (§ 2.5), underscoring the effectiveness of her teaching practices in fostering a deep understanding of number sense development among her learners.

“Baie konkreet ... vat ’n les voorbeeld, né. Kom ons vat die getal 6. Dan sal ek begin met ’n video’tjie of ’n liedjie wat dalk net 6 as ’n karaktertjie voorstel. En dan doen ons baie keer, ek het sulke [materiaalbande] dan vorm ons vir 6 op die mat en ons loop hom, ons loop hom. Ons voel hom te eers met ons lyfies of ons kruip hom of ons ry met [n] karretjie, so dit is ’n absolute konkrete vlak. Dan sal ons dikwels ’n speletjie speel soos die feely bags of die blindfolds, en dan het ek fisiese nommertjies, houtnommertjies, wat hulle dan vir my moet probeer ’n 6 vind. Voel hom so, dan is dit die verskillende sintuie wat ons in werking sit om vir hulle die 6 aan te leer, soos byvoorbeeld touch, en die ander ding wat ek ook nogal doen is in sand. Hulle skryf baie keer in sand of ons maak hom met klei, maar dis nou maar meer as hulle werkstasies toe kom. So, op die mat self as ons

daai aanbieding gedoen het... uhm... het hulle hom saam geoefen. Elkeen het hom, sê nou maar, gewys op die mat of gebou of ses blokkies uitgetel. Ons werk baie met blokkies, met tellertjies, die cubes, of met Lego-blokkies byvoorbeeld, want elkeen kry sy houpie. 'So wys vir Juffrou hoeveel is 6. Tel bietjie vir my uit wat is 6.' En dan doen ons baie met die flashcards... uhm... watter [een] is 6? Ons speel speletjies met die flashcards, so pak dit in rye, sequence. 'Haal 6 uit, wie is weg? Wys vir my hoe lyk 6 die getal' ... byvoorbeeld. 'Kom tel jy vir my 6 blokkies uit [tot] by nommer 6'. So dis daai ... praktiese inoefening van getalbegrip."

[Very concrete ... take a lesson example. Let's take the number 6. Then I will start with a video or a song that may just represent 6 as a character. And then often, I have material bands, then we form [the number] 6 on the carpet and we walk him, we walk him. We first feel him with our small bodies, or we crawl [along the form of the number] or we drive with a toy car, so it is an absolutely concrete level. Then we will often play a game like feely bags or blindfolds, and then I have physical numbers, wooden numbers, among which they then have to try and find a 6 for me. Feel it, then it is the different senses that we put into action to teach them the [number] 6, such as touch, and the other thing that I also quite often do is in sand. Often, they write in sand, or we make it with clay, but this is more the case when they come to the workstations. So, on the carpet, when we did that presentation ... uhm they practised it together. Each of them, say, illustrated it on the carpet or built or counted 6 squares. We work a lot with blocks, with counters, cubes, or with Lego blocks, for example, because everyone gets their pile. 'So, show Teacher how much is 6. Count 6 for me.' And then we do a lot with the flashcards ... uhm ... which one is 6? We play games with the flash cards, so pack them in rows, sequence. Take out 6. 'Which one is missing? Show me what the number 6 looks like', for example. Count out six squares for me up to number 6. So ... practical practising of number sense.]

(Semi-structured individual interview; Participant B1)

Participant C1 used technology and digital tools to deliver content in the classroom. Notably, one learner used a laptop, while another learner used a tablet. Additionally, one of the learners relied on eye-gaze technology. While both learners needed support when using these technologies, it was noteworthy that these tools enabled them to actively participate in the classroom, providing them with valuable opportunities for engagement and learning.

“Ek het twee kinders – die een het ’n laptop en die een het ’n tablet. Die een met die laptop het die heelyd iemand nodig, want hy het die eye gaze, maar die ander een met die tablet nie. Sy soek net speletjies. So ek moet fisies by haar staan om te kyk of sy haar werk doen. Ek het ’n assistent in my klas. Sy help my baie in die oggende met Wiskunde, want die een [leerder] werk op ’n laptop. So hy kan ook ’n bietjie selfstandig [werk].”

[I have two children – one has a laptop, and the other has a tablet. The one with the laptop needs someone all the time, because he has eye gaze, but the other one with the tablet does not. She is just wants games. So, I have to physically stand by her to see if she is doing her work. I have an assistant in my class. She helps me a lot in the mornings with Mathematics, because the one (learner) works on a laptop. So, he can also work a little independently.]

(Focus group interview – Group 1; Participant C1)

Learners with SID need consistent one-to-one support from a teacher to address their specific educational needs.

“... lae ondersteuning soek nog steeds heelyd een-tot-een.”

[...low support still wants one-to-one all the time.]

(Semi-structured individual interview; Participant C2)

4.7.1.2 Training

During the semi-structured and focus group interviews, all participants reported undergoing training. Specifically, they received training in the CAPS for Learners with SID. A significant number of participants also engaged in practical training sessions, such as Dr. Melodi de Jager's Mind Moves training and training sessions on using Lego building bricks. Notably, some participants funded their own training sessions, while others benefited from schools that were proactive in arranging or financially supporting these sessions. Allam and Martin (2021) state that teachers do not always receive special training and may experience a sense of not being qualified to teach learners with SID. Allam and Martin (2021) argue that the teaching and learning of Foundation Phase learners with SID can be influenced by limited experience, insufficient training, and limited knowledge on the learning programme. One crucial element to consider is the pivotal role of PCK in facilitating the development of number sense among learners. In this context, teacher training emerges as a significant determinant of the level of PCK that teachers bring to the specialised classroom. During various interviews, four participants agreed, highlighting the value of

experience as a cornerstone while underscoring that initial training lays a vital foundation. Participant B1 emphasised the significance of university modules on early childhood development, stressing their importance in comprehending learners' developmental stages and the subsequent adaptation of activities to suit these developmental levels. Additionally, Participant C1 confirmed that teachers had received training in CAPS for Learners with SID. Participant C1 elaborated, saying that her expertise not only derived from experience but also from completing relevant courses. She highlighted the transformative impact of a particular short-term course that significantly enhanced her ability to teach learners with SID. Participant A3, on the other hand, expressed a distinct viewpoint, asserting her grasp of the learning programme and suggesting that additional training in understanding and effectively addressing the needs of learners with SID would be a valuable enhancement to personal PCK.

"...I think it is definitely something that you possibly need a lot of experience more than training. Uhm... they can tell you what to do, but to actually put it into practice in your classroom is quite hard. So, I think it comes with more experience..."

(Focus group interview – Group 2; Participant D2)

"Daai was vir my verskriklik waardevol, en ons het steeds op universiteit die didaktiek oor [vroë kinderontwikkeling]. En ek dink as jy verstaan hoe 'n kind ontwikkel, watter vlak en watter tipe metodes jy kan gebruik om daai kind te leer op daai vlak, dan gaan 'n lig vir jou aan. Want jy kan nie 'n kindjie van agt kom leer op [...] ek wil amper sê [n] neurotypical manier en hy het hierdie [vroë kinderfasies] uitgemis, dan vat jy hom nou maar net terug na 'n tweejarige leerfase toe en jy leer vir hom getalle op daai manier aan. Ek dink daai was vir my waardevol."

[That was incredibly valuable to me, and we still have the didactics at university on early childhood development. And I think if one understands how a child develops, which level and which types of methods one can use to teach that child at that level, then you see the light. Because you can't teach an eight-year-old child in an [...] almost neurotypical way and they missed these small child phases, then you just take them back to a two-year-old learning phase and you teach them numbers in that way. I think that was valuable for me.]

(Semi-structured individual interview; Participant B1)

"DCAPS... baie opleiding gekry, maar ek voel net met my jare ervaring en met my interne opleiding wat ek hier gekry het, het ek ook eintlik baie meer geleer as wat ek in my studente jare geleer het."

“Jou aanvanklike opleiding en die werklikheid is ’n hemelsbreë verskil van mekaar. En om met gestremde kinders te werk en jy het nie jou opleiding nie, jy leer uit jou ervaring uit, jy leer uit jou opleiding uit wat jy gekry het met kursusse ensovoorts. Dan het ek... ’n bringim kursus gedoen. Uhm... wat ook help met die integrasie van die brein. So dit het my baie gehelp, dit wat ek daar geleer het. Of dit help my nog steeds baie met die tipe kinders waarmee ons werk. En soos ek sê, met indiensopleiding, daarmee win mens baie meer kennis in om jou vaardighede toe te pas.

“Bringim is ... baie tipe[s] oefening wat jy doen om die integrasie van die brein en die liggaam met mekaar te kombineer.”

[DCAPS... got a lot of training, but I just feel with my years of experience and with my internal training that I got here, I also actually learned a lot more than I learned in my student years.

Your initial training and reality are vastly different from each other. And working with disabled children and you don't have your training, you learn from your experience, you learn from your training you obtained through courses, et cetera. Then I... did a brain gym course. Uhm... that also helps with the integration of the brain. So, what I learned there helped me a lot. Or it still helps me a lot with the type of children we work with. And as I say, with on-the-job training, with that you gain much more knowledge to apply your skills.

Brain gym is ... many types of exercise that you do to combine the integration of the brain and the body.]

(Semi-structured individual interview; Participant C1)

“Dalk net meer om in-diepte te leer ... meer opleiding te kry in kinders met gestremdhede, want onderwys is, jy weet, net oor die algemeen. In spesiale skole weet ons nie altyd van al die vaardighede wat ons moet weet of moet ken om dit te kan toepas nie.”

[Maybe just more to learn in-depth ... getting more training on children with disabilities, because education is, you know, just in general. In special schools, we don't always know about all the skills we need to have knowledge about or need to know to be able to apply them.]

(Semi-structured individual interview; Participant A3)

4.7.1.3 Prior knowledge

The participants primarily discussed the importance of understanding learners' prior knowledge in the context of number sense development. However, some also emphasized the significance of their own prior knowledge, which includes knowledge of the learning programme, familiarity with their learners, awareness of different disabilities, and a solid grasp of the subject matter in mathematics.

They noted that while the training they received at the tertiary level was beneficial, it was not exhaustive. Instead, they highlighted the importance of in-service training, which they found to be more crucial in enhancing their prior knowledge base. This comprehensive understanding of both learner and teachers' prior knowledge is integral to effective number sense development. Learners' prior knowledge is the knowledge teachers have about the way learners think and their understanding of the concept. This influences the way teachers teach a specific topic (Mazibe et al., 2020). While it is crucial to analyse teachers' prior knowledge, an equally significant aspect is the examination of learners' prior knowledge (Mavhunga & Rollick, 2013). Understanding the foundation of learners' prior knowledge is crucial. Several participants underscored the value of baseline assessments to test learners' existing comprehension. Among the more seasoned participants, a unanimous perspective emerged that assessing prior knowledge is not inherently challenging. This perspective may be ascribed to their wealth of experience.

As teachers, it is imperative to consistently revisit fundamental and easily comprehensible concepts when imparting knowledge about number sense. A noteworthy observation made by several participants was the noticeable shifts in their learners' understanding following extended breaks, such as holiday periods. To address this, a common practice was to 'collaborate with the previous year's teacher to conduct summative assessments.

The consensus among these participants was that when considering learners' prior knowledge, it is imperative to return to the fundamentals. This "back to basics" approach involves revisiting simple, straightforward and easily graspable knowledge, thereby nurturing the development of a strong foundation in number sense.

"... ons het mos 'n basislynassessering gedoen, so ons het 'n goeie idee watter kinders met watter begrip kan werk. So nou is my klas in drie ability groups gedeel."

[... we did a baseline assessment, so we have a good idea which children can work with which understanding. So, now my class is "divided into three ability groups.]

(Focus group interview – Group 2; Participant E1)

“Nee, ek tel redelik gou op watter vlak elke kind is. Uhm... ek weet nie of dit ervaring is nie. Mens kan gou-gou agterkom die vlak van elke kind. Ons groepe is ook nie so groot dat mens partykeer kinders oorsien nie. Ons het klein groepies van 13, 14 kinders, so mens kan gou-gou optel en bepaal wat is elkeen se vlak en daarop konsentreer.”

[No, I quickly pick up on at what level each child is. Uhm ... I don't know if it's experience. One can quickly notice the level of each child. Our groups are also not so large that children are sometimes overlooked. We have small groups of 13, 14 children, so you can pick up quickly and determine what everyone's level is and concentrate on that.]

(Focus group interview – Group 2; Participant E3)

“Voorkennis is nie vir my so 'n groot, belangrike konsep nie, want om getalbegrip vir 'n kind aan te leer, moet [n mens] teruggaan na die eenvoudige, die maklike, die verstaanbaarste gedeelte...”

[Prior knowledge is not such a hugely important concept to me, because to teach a child to understand numbers, one has to revisit the simplest, the easier, the most comprehensible part...]

(Semi-structured individual interview; Participant C1)

“... [om] voorkennis te toets is baie uitdagend, veral ná 'n vakansie. So ons het 'n summative assessment wat ons van 'n vorige juffrou af kry, maar baie keer sal jy sien ná 'n vakansie, die kind het bietjie van hulle kennis verloor. En dan moet jy weer terug gaan, back to the basics amper. Om weer op te vang wat hulle die vorige jaar gedoen het...”

[... testing prior knowledge is particularly challenging, especially after a holiday. So, we have a summative assessment that we get from a previous teacher, but often, one will see that after a holiday, the child has lost some of their knowledge. And then you have to almost go back to basics. I pick up where they left off the previous year...]

(Focus group interview – Group 2; Participant D3)

4.7.1.4 Challenges

The participants voiced several challenges, primarily related to the learning programme, expectations, and the unique profiles of their learners, including the barriers to learning they face

due to disabilities. They recognized the varying developmental levels of learners but acknowledged the challenge of managing this diversity in the classroom and using different resources effectively. Additionally, they noted the difficulty of providing tangible evidence of learners' progress, particularly when the learning programme emphasizes 80% practical work and 20% abstract work, and ensuring that this balance is clearly demonstrated. Learners with SID face specific challenges as regards developing a sense of numbers (Schnepel et al., 2020). For this study, I focused on the literature of the challenges teachers experience because of these learners' limited conceptual skills when they teach number sense (Shree & Shukla, 2016). Exploring the impact of teachers' PCK on fostering number sense for learners revealed several challenges that the participants experienced. These challenges involved various aspects, including learner behaviour; the need for differentiation due to diverse developmental levels among learners; the self-paced nature of learning; the challenges faced by learners who struggle with independent work; and the limitation of short memory spans. Participant A1 provided valuable insights into these challenges, aligning with the perspectives of other participants. She specifically addressed the varying levels of learners and the prevalent issue of low motivation among them. Additionally, she highlighted the complexities associated with understanding the learning programme, which often leads to uncertainty about what to teach, when to teach it, and the relative importance of different topics. Focus was also directed at the learners' struggles with one-to-one correspondence, which presents a significant educational hurdle. The teachers expressed challenges in managing time and assessments while ensuring that they keep pace with Individual Support Plans (ISPs). They emphasized the importance of engaging actively with the children, as their memory is short and they can easily forget what they learned. Additionally, they highlighted that many of the children come from environments where they are not adequately stimulated, which adds to the complexity of teaching and learning.

“... een van my grootste uitdagings is nou nog gedrag. Om net hulle op 'n punt te kry om te konsentreer. En 'n mens kan nie net een-tot-een met hulle sit nie. Dis 'n baie groot uitdaging.”

“Ek dink diversiteit verseker, want differensiasie, want ... jy moet werklik elkeen ontmoet op sy vlak...”

[...one of my biggest challenges still is behaviour. Just to get them (learners) to a point to concentrate. And one cannot just sit one-on-one with them. It's a huge challenge.

I think diversity definitely, because (of) differentiation, because ... one really has to meet everyone at their level...]

(Focus group interview – Group 1; Participant B1)

“Ek het ook my uitdagings met van die leerders wat nie iets wil doen op daai oomblik nie.”

[I also have my challenges with some of the learners who don't want to do something at that moment.]

(Semi-structured individual interview; Participant A2)

“Elke leerder het maar sy eie tempo van werk... gister alles weet het, kan nie vandag doen wat jy van hulle verwag om te doen nie... [dan] sukkel ons leerders om onafhanklik te werk...”

[Each learner has their own work pace... yesterday they knew everything, and today they cannot do what one expects them to do... (then) our learners struggle to work independently...]

(Semi-structured individual interview; Participant C1)

“Hulle het beperkte lang en kort geheue. Soos ek gesê het, as ek daar voor [in die klaskamer] verduidelik het, kan hulle almal onthou en 50% van hulle; as ek by die tafel kom, dan het hulle vergeet wat ek gesê het.”

[They have limited long and short memory. As I said, if I explained in the front (of the classroom), they can all remember and 50% of them; when I come to the table, they have forgotten what I said.]

(Semi-structured individual interview; Participant C2)

“Uhm, daar is kinders wat baie min gemotiveerd is om getalbegrip aan te leer... uhm, kinders is op verskillende vlakke... Uhm, wat is belangrik en wat is nie belangrik om onderrig nie? Waar begin jy? Begin jy weer by nommer een of kan ek nou by vyf aangaan? Want ek weet laas jaar het hulle tot by vyf... vyf gegaan. Uhm, hulle is goed met route counting, maar een-tot-een korrespondensie vind hulle baie uitdagend. So dit is baie uitdagend vir die volgende onderwyser ook.”

[Uhm, there are children who have very little motivated to learn number sense... uhm, children are at different levels. Uhm, what is important and what is not important to teach? Where do you start? Do you start again at number one or can I continue from five onward? Because I know last year, they went to five ... five. Uhm, they are good at route counting, but they find one-to-one correspondence very challenging. So, it's very challenging for the next teacher as well.]

(Semi-structured individual interview; Participant A1)

“Die kinders is vir my ‘n uitdaging en dan tyd. En dan die assessering ook. Daar is soveel assessering dat jy over assess and under teach, want jy weet jy moet by bly met ISP’s en all die goed. En eintlik is dit belangrik om op die mat te rol met hulle.”

[The children are a challenge for me and then time. And then the assessment too. There is so much assessment that you over-assess and under-teach because you know you have to keep up with ISPs and all that stuff. And actually, it's important to roll on the mat with them.]

(Focus group interview – Group 2; Participant E1)

“Jy leer hulle vandag iets en dink joh, ek het dit reg gekry. Hulle, hulle verstaan dit en tot more dan weet hulle niks daarvan nie. Hulle vergeet letterlik, so hulle geheue is baie kort.”

[You teach them something today and think, wow, I got it right. They, they understand it and then tomorrow they know nothing about it. They literally forget, so their memory is very short.]

(Focus group interview – Group 2; Participant E3)

“Jy weet ons kinders kom ook uit ‘n milieu waar hulle nie baie gestemuleer word nie. So by die skool, jy weet die milieu is fine. Ons doen met hulle goed, maar baie van hulle kom nie uit ‘n, uit ‘n milieu waar hulle gestemuleer word nie.”

[You know our children also come from an environment where they are not very stimulated. So at school, you know the environment is fine. We do well with them, but many of them do not come from an environment where they are stimulated.]

(Focus group interview – Group 2; Participant E2)

4.7.2 Theme two: Learners with SID

4.7.2.1 Profile

All participants demonstrated a comprehensive understanding of their learners' profiles, although some expressed that additional training in specific disabilities would further enhance their understanding. They articulated clear barriers to learning within their learners, including their age and the support groups they belong to. It was evident that the participants have a deep understanding of their learners and the challenges they face. According to research, the following

is the typical profile of a learner with SID. The Screening, Identifying, Assessment and Support (SIAS) document (DBE, 2014) defines the different types of *disabilities*, also called multiply disabled; deaf, hard of hearing; blind, partially sighted; deaf/blind; cerebral palsy; specific learning disability; behavioural disorder; mild or moderate intellectual disability; severe intellectual disability; physical disability; autistic spectrum disorders; epilepsy; and attention deficit disorder, with/without hyperactivity. Regarding learners with SID, it is vital to examine how teachers delineated the characteristics and profiles of these learners in their respective classrooms. During the semi-structured interviews, three participants explicitly mentioned that their learners were approximately 10 years old, while Participants A1, A2 and B1 specified that their learners were around nine years old. Notably, these age groupings align with the suggested age range for Grade 1 learners, as outlined in CAPS for Learners with SID. Furthermore, a substantial number of participants showed a solid understanding of the developmental levels at which their learners functioned. This understanding was notably reflected in the teachers' lesson plans, underscoring the importance of aligning teaching strategies and content with the unique needs and developmental stages of learners with SID.

Additionally, many participants explained the specific disabilities present in their classrooms, shedding light on the multifaceted challenges they encountered. Furthermore, the participants highlighted the integral roles of communication and hearing abilities, which significantly influence how teachers apply their PCK in their classrooms. These factors underscore the intricate nature of teaching learners with SID and the necessity for an adaptive teaching approach.

“... kindertjies tussen agt en nege jaar oud. Hulle is almal gediagnoseer met ASD en van hulle... uhm... [met] ADHD ook. Ons sit met kindertjies wat regtig... support... uhm... ondersteuning nodig het.”

[...small children between eight and nine years old. They have all been diagnosed with ASD and some of them... uhm... (with) ADHD, too. So, we have small children who really need support.]

(Semi-structured individual interview; Participant B1)

“Ek het kinders wat 10 jaar oud is. Dis die ontwikkelingsouderdom, dan wissel hulle vermoëns van tussen 3 tot 4 jaar [oud]. Ek doen graad RR werk, ek doen graad R werk met hulle en dan het ek ook kinders wat in die low-support group is wat dan tot graad 1 werk kan doen.”

[I have children who are 10 years old. That's the developmental age, then their abilities vary from between three to 4 four (years old). I do grade RR work, I do

grade R work with them, and then I also have children who are in the low-support group who can do up to Grade 1 work.]

(Semi-structured individual interview; Participant C1)

“... groepie ... noem hulle die SP2, wat beteken hulle is nou al die vierde jaar in die skool. Uhm... hulle intellektuele vermoë, hulle is 10 jaar; hulle word dié jaar 11. Hulle is op die intellektuele vermoë van 'n vyf-, sesjarige kind. Party van hulle is nóg laer. Hulle hou daarvan om te leer, maar hulle hou nie noodwendig daarvan om lank te leer nie. Dis vir hulle lekker om te hoor ons gaan iets doen, maar hulle raak gou moeg, want party, as jy daar voor in die klas sit en jy verduidelik vir hulle iets, teen die tyd wat jy by hulle tafel kom het hulle klaar vergeet wat jy verduidelik het. So hulle het nie 'n baie goeie geheue nie.”

[...group... call them SP2, which means they are already in the fourth year in school. Uhm... their intellectual ability, they are 10 years old; they will turn 11 this year. They have the intellectual ability of a five-, six-year-old child. Some of them are even lower. They like to learn, but they don't necessarily like to learn for a long time. It's nice for them to hear that we're going to do something, but they tire quickly, because sometimes, if one sits in front in the class and one explains something to them, by the time one gets to their table, they've already forgotten what one explained. So, they don't have a very good memory.]

(Semi-structured individual interview; Participant C2)

“...vyf [nieverbale] kinders in my klas, maar hulle kan wel met Makaton kommunikeer ... uhm... eintlik is almal in staat om te leer. Hulle is verstandelik in staat om te leer. Uhm... ontwikkelingsvlak, hulle is agt [jaar oud]. Daar is een wat nege word, maar hulle almal se ontwikkelingsvlak is op die jaar vier tot ses [jaar oud].”

[...five non-verbal children in my class, but they can communicate with Makaton. ... uhm, actually, everyone is capable of learning. They are mentally capable of learning. Uhm... developmental level, they are turning eight (years old). There is one that is turning nine, but they are all at the developmental level of four to six (years old).]

(Semi-structured individual interview; Participant A1)

4.7.2.2 Barriers to learning

Building upon the previous discussion of learners' profiles, it is important to address the participants' understanding of barriers to learning. While the participants demonstrated a clear understanding of these barriers, they also expressed a lack of knowledge on how to intervene or overcome them. They described various ways in which they address these barriers, particularly in the context of number sense development. According to the literature, when examining the challenges faced by learners with SID in terms of conceptual and practical aspects, it becomes apparent that there are inherent barriers to their learning. These barriers comprise difficulties with abstract symbolic thinking, reading, emotional regulation, attention deficit-related difficulties, and physical skills (APA, 2013; Paulsen & Dednam, 2016; Shogren & Turnbull, 2010). The specific criteria for the different needs and difficulties learners with SID experience due to their barriers to learning include the following: difficulty using problem-solving techniques; short attention span and short-term memory; barriers related to holistic motor integrational skills (auditory and visual perceptual, fine and gross motor); and poor sensory integration (APA, 2013; Cavendish, 2013; Van Niekerk et al., 2014).

Participants shared their insights into the barriers to learning in the context of number sense development and highlighted several general barriers. Among these challenges, learners with SID face difficulty with grasping the sequence of numbers, including identifying what number comes before or after a given number. The abstract nature of numbers presents a significant barrier, as learners struggle to discern the meaning of numbers, including identifying numbers or understanding concepts related to larger or smaller numbers.

Participant E3 mentioned a significant barrier, namely the challenge learners face in identifying numbers because of their inability to recognise shapes. This crucial observation underscores the multifaceted nature of obstacles learners encounter in the pursuit of developing their number sense.

Participant D3, in line with Participants E1 and E2, emphasised these learners' difficulties in comprehending concepts such as "before" or "after" and comparing numbers in terms of greater or smaller. Furthermore, D2 underscored the abstractness of numbers as an impediment to learning, and she also emphasised language barriers. Participant D2 highlighted a critical observation: learners might successfully solve a problem in one context but may encounter challenges when they are expected to apply their knowledge to a new and different situation. This finding underscores the complexity of fostering number sense development among learners with SID. According to the literature, a solid understanding of numbers forms the foundation for developing mathematical abilities and skills. This involves understanding the representation of numbers according to their value. Learners using these skills can apply them to any mathematical problem

(Brown, 2018; Carr et al., 2020; Yilmaz, 2017). Additionally, mastering numbers entails recognising patterns, leveraging numerical resources, and effectively manipulating them in various activities (Yaman, 2015).

“drie, byvoorbeeld, soos amper agterstevoor om skryf of die twee anderkant toe. Meer reversals...”

[three, for example, almost like writing it backwards or (writing) the two the other way around. More reversals...]

(Focus group interview – Group 2; Participant D3)

“... poor pencil grip, so hulle kan nie eers die potlood vashou nie.”

[...poor pencil grip, so they can't even hold the pencil.]

(Focus group interview – Group 2; Participant D1)

“Hulle sukkel byvoorbeeld ook as die getalle nie in 'n volgorde is nie, dan herken hulle ook nie die getalle nie. Die sequencing. En om dan hulle weer reg te sit, die getalle weer in orde te kry, is ook vir hulle 'n probleem.”

“As jy byvoorbeeld vra watter nommer kom vóór 4, dan kan hulle dit nie doen nie. Hulle kan 1, 2, 3, 4 tel, maar hulle weet nie watter nommer kom vóór 4 of watter nommer kom ná 4 nie.”

[For example, they also struggle if the numbers are not in a sequence, then they don't recognise the numbers either. The sequencing. And then re-ordering them, to re-order the numbers is also a problem for them.

For example, if you ask which number comes before 4, they can't do it. They can count 1, 2, 3, 4, but they don't know which number comes before 4 or which number comes after 4.]

(Focus group interview – group 2; Participant E1)

“Die getalle, eerstens, wat ek ook gesê het, die abstrakheid om 'n getal te verstaan. Regtig die konsep van wat 'n getal beteken. En dan ook... uhm... om die getalle selfs te skryf, te herken omdat baie van hulle nog nie eers vorms kan herken nie. Dan ook natuurlik jou groter as, jou kleiner as, en ook maar voor en

agter. Groter as nommers, kleiner as hulle nommers. Hulle kan nie verstaan as ek vra 'Which number is bigger or which side has got more'? [nie]"

[The numbers, first of all, what I also said, the abstractness of understanding a number. Really, the concept of what a number means. And then also... uhm... even to write the numbers, recognise them, because many of them can't even recognise shapes yet. Then, of course, your greater than, your less than, and also just front and back. Greater-than numbers, less-than numbers. They cannot understand when I ask 'Which number is bigger or which side has more?']

(Focus group interview – Group 2; Participant E2)

"In my klas voel ek dat amper alles 'n hindernis is, van die tel-goed; die tel is nie so moeilik nie. Hulle kan dit doen, maar soos voorheen gesê, dit is 'n rympte wat afgejaag word. Hulle tel 1, 2, 3, 4, 5 en party van hulle kan terug tel, 5, 4, 3, 2, 1, maar as ek nou vra op die einde wat kom ná 3 of vóór 3 of skryf vir my die nommer 3... uhm... is dit asof ek blank stares kry."

[In my class, I feel that almost everything is an obstacle to the counting matters; counting is not that difficult. They can do it, but as said before, it is a rhyme that is rushed. They count 1, 2, 3, 4, 5 and some of them can count backward, 5, 4, 3, 2, 1, but if I ask in the end what comes after 3 or before 3 or write me the number 3... uhm... it's like I'm getting blank stares.]

(Focus group interview – Group 2; Participant D3)

"I said that one of the things was that it is so abstract so for them to have that bridge between concrete, between what is meaningful like all the abstract concepts. I mean, the concept of more and less is very abstract, but I've found that the language we use is also a barrier. Sometimes, they actually don't know what you are asking from them. 'Tell me what is more?' Okay, but to them 'more' doesn't mean anything. So, to try and bridge the gap for language is also very hard. I said things like their carry over, integration of things. Sometimes, they can do it in one situation, but take them out of that situation somewhere else and they can't carry over the knowledge into the new situation. So, they seem like they are very inconsistent, but actually they can't carry over the information into a new environment or situation."

(Focus group interview – Group 2; Participant D2)

4.7.3 Theme three: Strategies to support learners with SID to develop number sense

4.7.3.1 Classroom organisation and management

Classroom organization and management were discussed in detail by the participants during interviews. They described the layout of their classes and their preferred carpet activities. In all classes, learners complete activities on tabletops. Regarding classroom management, participants mentioned support groups and how they differentiate activities to accommodate learners with diverse needs. Some participants also highlighted the importance of discipline in preparing learners to engage in learning. The diverse needs of learners contribute to the complexity of classroom management. According to the literature, several factors may influence the teaching of number sense to Grade 1 learners in highly specialised classroom settings such as for learners with SID (DBE, 2018). The specific challenges experienced by individual learners with SID, teachers' knowledge, the classroom organisational strategies and the teaching strategies employed influence learners' ability to develop mathematical concepts (DBE, 2011). Both Participants A2 and A3 highlighted organisation in their classrooms – their learners were predominantly seated at tables. Participant C1 offered a more detailed perspective by explaining that her learners engaged in activities both on the carpet and at their tables. Across the board, all participants underscored the importance of tabletop activities and carpet work in their teaching approaches.

Participant B1 described a unique classroom arrangement, as her learners occupied TEACCH workstations. These workstations are specifically designed for learners with autism, reflecting a tailored approach to classroom organisation and management. Importantly, Participant B1 integrated TEACCH tasks into her daily lesson planning with the explicit goal of fostering independent learning among her learners.

“kinders sit elkeen by... [’n] enkel tafel. Hulle sit nie in groepies nie – elkeen by hulle eie tafel.”

[children each sit at (a) single table. They don't sit in groups – each at their own table.]

(Semi-structured individual interview; Participant A3)

“...werk bitter graag op die mat. Hulle sit ook, ek het twee groepe, maar die low support en hoë support groep.”

[...loves to work on the carpet. They also sit, I have two groups but the low support and high support group.]

(Semi-structured individual interview; Participant C1)

Numerous sources confirm that one of the significant challenges faced by learners with SID is emotional regulation (APA, 2013; Paulsen & Dednam, 2016; Shogren & Turnbull, 2010). Participant B1's approach to classroom organisation and management was highlighted by her emphasis on preparing her learners to be in an optimal state for learning. She achieved this by teaching her learners self-regulation skills, which included daily emotional check-ins upon entering the classroom. B1 found this strategy to be highly effective and it clearly demonstrated her deep understanding of her learners' profiles and potential barriers to learning.

"En dan kan jy met jou foto'tjie na juffrou toe kom en sê, 'Now I'm ready to learn'. So ons probeer hulle só reguleer, of hulle selfreguleer om op 'n goeie plek te kom om te leer. Dis nou maar meer die emosionele ondersteuningskant in die klas, elke oggend voordat ons begin leer..."

[And then you can come to the teacher with your picture and say, 'Now I'm ready to learn'. So, we try to regulate them in this way, or they self-regulate to get to a good place to learn. This is now more the emotional support side in the class, every morning before we start learning...]

(Semi-structured individual interview; Participant B1)

Participant D3, in agreement with other participants, showed a profound understanding of the significance of tailoring learning experiences to each learner, considering the learner's individual abilities, interests and developmental progress. These customised learning opportunities involve an array of resources, activities and assessment strategies.

Moreover, Participant D3's insights extend to a broad comprehension of how these support groups operate, including the intricate process of differentiating activities to cater to learners in all three groups. This includes the ability to adapt and modify activities to meet the specific needs of each group, ensuring that they receive an appropriate level of support, challenge and engagement, all within the framework of the classroom management approach.

"... vir die laag-groep sal ek dan nou drie goedjies uitpak. Drie konkrete blokkies of drie sweeties. En vir die middel-groep sal ek dan nou sê sit 'n prentjie van drie by drie blokkies. So ek sal byvoorbeeld sê, 'n driewielprentjie sal ek sê, sit die drie blokkies op die drie wielletjies. En vir die hoë groep sal ek... uhm... 'n werkkaart gee wat hulle dan nou basies moet uitknip en 'n prentjie van drie blokkies by die getalnommer 3 sit, maar met die lae kinders doen ek glad nie werkkaarte nie. So eerder middel en hoog sal werkkaarte doen, basies sorting

and matching. Sit dit op 'n dice en pak drie knopies uit op 'n papiertjie soos 'n dice, maar die lae groep glad nie werkkaarte nie. Dis basies maksimum support vir die lae groep en minimum support vir die high groep.”

[I will unpack three things for the low group. Three concrete blocks or three sweeties. And for the middle group, I will now (show) a picture of three-by-three squares. So, for example, I would say a three-wheel picture, I would say, put the three squares on the three little wheels. And for the high group, I will... uhm... give a worksheet that they now basically have to cut out and put a picture of three squares next to the number 3, but with the low children, I don't do worksheets at all. So rather medium and high worksheets will basically do sorting and matching. Put it on a dice and unpack three buttons on a piece of paper like a dice, but the low group no worksheets at all. It's basically maximum support for the low group and minimum support for the high group.]

(Focus group interview – Group 2; Participant D3)

“Orde en respek, want... uhm... jou aandagafleibare [leerder] funksioneer beter in 'n omgewing waar daar orde is en respek vir mekaar is.”

[Order and respect, because... uhm... your distractible (learner) functions better in an environment where there is order and respect for each other.]

(Semi-structured individual interview; Participant C2)

4.7.3.2 Lesson plans

During the semi-structured individual interviews, participants emphasized the importance of lesson planning. They adapt lessons based on the classroom management needs of the day, with some days focused on learning while others are focused on behavior management. Understanding learners is crucial in this process. Lesson planning is considered part of prior knowledge, and having a plan ready is essential. The lesson plan tracker is seen as helpful but integrating assessments into the tracker poses a challenge. According to *CAPS for Learners with SID, Mathematics Teacher Guide: Lesson Plans*, the purpose of the lesson plan is to provide teachers with a weekly overview of the content that must be taught and assessed during each week of each term. The tracker outlines the content, including concepts and skills, which should be covered on a weekly basis (DBE, 2018). The teacher should organise the content accordingly for their daily lesson plans, spanning from Monday to Friday. The tracker also empowers the teacher to guarantee that the learning programme prescribed for the term is comprehensively addressed.

The participants' opinions showed that they viewed lesson planning as a dynamic and adaptable process. They acknowledged that what they prepared in their lesson plans might not have always aligned with what took place in their classrooms. This suggests that they recognised the need for flexibility in their teaching approach. One significant factor influencing this flexibility was the ever-changing needs of their learners. The participants mentioned that they often deviated from their lesson plans because their learners' support needs continually evolved. This highlighted the importance of responsive teaching, where teachers are attuned to the unique requirements of their learners and are willing to adjust their plans accordingly.

Additionally, the participants revealed that while they had standard lesson plan templates, they did not rigidly adhere to them.

Furthermore, one participant emphasised the importance of aligning their teaching with the learning programme. This suggests a deliberate effort to ensure that their instruction is coordinated with the prescribed learning objectives and content standards. Analysing this aspect could shed light on how learning programme alignment influences teachers' lesson planning and teaching strategies.

“Ons het ’n standaard beplanningsbladsy waar ons les alles moet uitlê, maar ek pas dit ook aan om te kyk op daai spesifieke dag waar ek ietsie ekstra kan doen of waar ek myself kan bevorder, maar daar is ’n standaard een uitgelê... So ek... ek werk volgens die DCAPS-kurrikulum wat ek ... my uitkomstes wat ek daar moet bereik. Dan breek ek dit ook op in die kwartaal, en dan breek ek dit ook op in die weke. Basies verdeel ek dit wat ek daai week gaan doen.”

[We have a standard planning page where we must lay out everything for our lesson, but I also adjust it to look at that specific day, where I can do something extra or where I can promote myself, but there is a standard one laid out... So, I work according to the DCAPS curriculum that I... my outcomes that I have to achieve there. Then I also break them down into the quarter and then I also break them down into the weeks. Basically, I divide what I'm going to do that week.]

(Semi-structured individual interview; Participant A3)

“... somtyds doen mens jou beplanning, dan kom jy in die klas. Dit is nou wat jy wil doen en skielik is daar die kind wat gister alles geweet het, [maar] kan nie vandag doen wat jy van hom verwag om te doen nie. Al het jy nou hoe goed voorberei en beplan, moet jy in ’n japtrap vinnig ’n ander plan maak om by jou uitkoms uit te kom. En jy moet ook gaan sit en jou werkkaarte so goed deurdink en beplan dat jy nie dalk ’n té moeilike of té maklike werkkaart vir jou kinders gee om te voltooi nie.”

[...sometimes you do your planning, then you come to class. This is what you want to do now and suddenly, there is the child who knew everything yesterday (but) can't do today what you expect from them. No matter how well you have prepared and planned, you must quickly make another plan to reach your outcome. And you also have to sit down and think and plan your worksheets so well so that you don't give your children a too difficult or too easy worksheet to complete.]

(Semi-structured individual interview; Participant C1)

“So ek sal sê ek gebruik die kurrikulum, maar meer as net 'n framework en pas my lesse dan so aan omdat ek 'n baie diverse klas het.”

[So, I would say that I use the curriculum but more than just a framework and then I adapt my lessons that way because I have a very diverse class.]

(Focus group interview – Group 1; Participant A1)

4.7.3.3 Resources

In the analysis of resources, it becomes clear that numerous participants take the initiative to create their own resources, primarily due to the yearly variations in their learners' needs and abilities. Literature emphasises the importance of facilitating the development of mathematical understanding in learners during the preoperational stage and using concrete objects, pictures, actions and symbols (Bashrin, 2015). When teaching number sense to learners at this stage, it is recommended to capitalise on their ability to grasp the connection between objects and the symbols that represent them (Vatavu et al., 2015). The participants' approaches were marked by a strong emphasis on the utilisation of tangible, sensory-integrated resources that facilitated active engagement through both tactile and visual experiences. These participants underscored the pivotal role of visual stimuli in providing support to both teachers and learners. Additionally, it is noteworthy that some participants frequently incorporated YouTube videos into their lesson presentations to enhance the learning experience.

Participant A1 emphasised a crucial aspect regarding resources, namely that they must align with the developmental level of the learners. This emphasis on resource alignment with learners' developmental levels is instrumental in ensuring that the materials effectively cater to their unique needs and foster meaningful educational experiences. Furthermore, it was evident that the resources referred to by the participants aligned with the suggested resources in CAPS for Learners with SID, reflecting a deliberate effort to follow established guidelines and enhance the quality of education provided to these learners.

Additionally, Participant C1's response underscored her proficiency in utilising available resources to address the diverse needs of her learners. She provided a concrete example of a learner who faced challenges with writing but could effectively use a number line to indicate numerical values. This demonstrates how resourcefulness and adaptability are key attributes in accommodating the individual requirements of learners with diverse needs and abilities in the classroom.

"So ons maak ons eie hulpbronne en sulke goedjies, want wat jy vandag gebruik gaan jy dalk volgende jaar nie weer gebruik nie. En dan is dit nou weer alles van voor af maak vir die nuwe groep. Dit vir my is nogal 'n groot ding."

[So we make our own resources and things like that, because what one uses today one might not use again next year. And then it's making everything all over again for the new group. This is quite a big issue for me.]

(Focus group interview – Group 2; Participant D1)

"... nommerkaartjies maak en vassteek en, sê nou maar, 'n klippie in 'n sakkie gooi. Een klippie, dat hy kan voel... uhm... een is ligter as twee..."

[...make and stick number cards and now just throw a pebble in a bag. One pebble so that they can feel... uhm ...one is lighter than two...]

(Focus group interview – Group 2; Participant E1)

"En die hulpbronne is vir elke kind op sy ontwikkelingsvlak... ons gebruik video's, ons gebruik klei... uhm... ons gebruik ons sand waarin ons skryf, asook macaroni ... uhm... ons Letterland-stories, Unifix en ons nommerkaarte."

[And the resources are for each child at their developmental level... we use videos, we use clay... uhm... we use our sand in which we write, as well as macaroni... uhm... our Letterland stories, Unifix and our number cards.]

(Semi-structured individual interview; Participant A1)

"Die witbord... Penne, tellers, getalkaart en dan enige fisiese objekte."

[The whiteboard... Pens, counters, number card and then any physical objects.]

(Semi-structured individual interview; Participant A3)

"Ek gebruik getalkaarte, 'n getallelyn nie 'n getallelyn om optel en aftrek te doen... Die getallelyn is maar basies om die kinders wat nie kan skryf nie te help 'n getal te identifiseer. As ons 'n getallelyn gebruik en hy weet se nou maar die antwoord is 5. Hy kan nie skryf nie dan moet hy op die getallelyn wys waar is die 5."

[I use number cards, a number line not a number line to do addition and subtraction.... The number line is just basically to help the children who can't write identify a number...]

(Semi-structured individual interview; Participant C1)

4.7.3.4 CAPS for Learners with SID

In the South African education system, CAPS for learners with SID is used in schools for learners with special educational needs. By instructing the adapted learning programme based on the principles of CAPS, schools strive to cater to the unique needs and abilities of learners with SID, ensuring a more inclusive and supportive educational experience (DBE, 2018). The participants in the study demonstrated a comprehensive understanding of the CAPS for Learners with SID. They attributed this understanding to the training they received and their collective experience using this learning programme over the years. While most participants expressed a strong preference for the DCAPS, one school's participants mentioned that their own school's programme was more effective for them, and they continue to refer back to it. Despite acknowledging gaps in the progression, most participants appreciated having a framework to work and plan from. During the interviews, participants identified the CAPS for Learners with SID learning programme as the main policy applied in the classrooms to guide the teaching of number sense development in classes for Grade 1 learners with SID. Participants in both the individual interviews and focus group interviews confirmed this. The participants elaborated on CAPS for Learners with SID in their holistic answers to various questions that were asked. Some participants referred to the learning programme as DCAPS, because this is how it was first introduced to their schools by the DBE. Participant A3 emphasized the importance of understanding what one has learned, knowing the learning programme well, particularly in mathematics, and having clear planning and lesson plans in place. Participant B1 mentioned the use of DCAPS for assessment and described the process as comprehensive, covering all aspects from top to bottom. The following extracts illustrate this:

“Jy moet natuurlik dit wat jy geleer het, moet jy seker maak jy weet wat jy geleer het. Jy moet jou kurrikulum ook goed ken, jy moet weet wat in daai tipe vak, soos Wiskunde, al die uitkomstes wat bereik moet word. Ek sal sê dit is die belangrikste. En jou beplanning en jou lesplanne, en dit wat jy gaan doen, moet definitief in plek wees en voorbereid wees.”

[Of course, from what you have learned, you must make sure you know what you have learned. You must also know your curriculum well, you must know what in that type of subject, such as mathematics, all the outcomes that must be

achieved. I would say this is the most important. And your planning and your lesson plans, and what you are going to do must be in place and be prepared.]

(Semi-structured individual interview; Participant A3)

“Ons doen die DCAPS en die assessering is genadevol. Jy kan regtig, dis die hele ding van straddle up and down.” (Focus group interview – Group 1; Participant B1)

[We do the DCAPS, and the assessment is gracious. You really can, it's the whole straddle up and down thing.]

(Focus group interview – Group 1; Participant B1)

A prominent concern of School D was the perceived weaknesses and gaps within the current CAPS for Learners with SID. School D consistently referred to the current learning programme as “DCAPS”. Furthermore, it became clear that School D's connection with their previous learning programme, which they had in place prior to implementing DCAPS, remained a crucial aspect of their approach to education. School D frequently deemed it necessary to refer back to their previous learning programme because of their perception of gaps and weaknesses within the current DCAPS learning programme, which they viewed as potentially inhibiting the quality of education for learners with SID.

The emphasis School D placed on their former learning programme underscored the extent to which they believed that the previous system addressed certain educational challenges more effectively.

“Voordat ek by die skool was, was ek by 'n ander skool. Ek weet nie... niemand het vir my gesê 'hier is 'n kurrikulum, gebruik hom' nie. En vir almal wat ek gevra het [het gesê] 'nee, jy doen maar wat jy wil in die klas'. So toe die DCAPS nou uiteindelik kom, toe is ek soos in die sewende hemel, so ek het actually nou riglyne. En toe skuif ek na 'n ander skool toe wat actually 'n kurrikulum gehad het wat uitstekend gewerk het en toe moes hulle die DCAPS begin gebruik het en ek voel die kurrikulum wat hulle gehad het, is eintlik baie beter gewees as die DCAPS. Jy sal nie glo hoe baie verwys ons nog terug na daardie kurrikulum toe nie omdat die DCAPS sulke baie gate in het nie.”

[Before I was at the school, I was at another school. I don't know... no one told me 'here is a learning programme use it'. And everyone I asked (said) 'no you do whatever you want in class'. So, when the DCAPS finally came, I was like in seventh heaven, so I actually now have guidelines. And then I moved to another

school that had a learning programme that worked excellently and then they started using the DCAPS, and I feel the learning programme they had was much better than the DCAPS. You wouldn't believe how much we still refer to that learning programme because the DCAPS has so many gaps in it.]

(Focus group interview – Group 2; Participant D1)

“I just find our old learning programme, ja, it worked as a process of how you go through the year. So it started at a certain place and you build on that, whereas I find with DCAPS you do this and then you have to do something like on the complete opposite end of what you were doing, then it is count here, do this, assess this and then you are like how are you assessing more and less when I'm route counting to 10. Uhm... so I find it like jumps too much, and you don't actually have a sequence of where you are going. So, by the end of the year, you kind of done all these random little bits of everything and assess stuff that is so meaningless. I mean some of our children, they want us to assess identification and stuff. So, I find in some places, it is so basic and in other places, it is so difficult, and there is no middle ground for the children who really are struggling. I feel like the DCAPS is literally doing to them what the CAPS did, but it is just a tiny bit easier.”

(Focus group interview – Group 2; Participant D2)

The participants' opinions revealed a diversity of viewpoints regarding CAPS for Learners with SID. For some participants, this learning programme posed a significant challenge, while others perceived it as characterised by excessive repetition, with concerns about learners' progress. In the case of learners with SID, developing their number sense presents significant challenges, as they struggle to grasp numbers as a concept. Their learning progress hinges on specific competencies, such as connecting numbers to quantities (Sermier et al., 2019).

Participant B1 expressed an interesting perspective. She believed that the repetitive nature of the learning programme may have a positive aspect, as it could ensure the thorough exploration of curricular saliency. This viewpoint introduces a unique dimension to the analysis, suggesting that although some participants viewed the repetition negatively, there might be educational benefits associated with this approach.

“Dit [is] moeilik want partykeer dan dink ek die DCAPS is heeltemal te maklik vir hulle en die doelwitte is oor en oor dieselfde en dit voel of my kinders nie vorder nie, maar as jy baie mooi gaan kyk, is daar tog [iets om deeglik] te doen en maar terug te gaan en termyn na termyn te herhaal.”

[It's difficult because sometimes I think the DCAPS is way too easy for them and the goals are the same over and over again, and it feels that my children aren't progressing, but if you look very closely, there is something to be done thoroughly and just go back and repeat term after term.]

(Semi-structured individual interview; Participant B1)

4.7.3.5 Developing number sense

All participants in the study recognized the critical importance of developing a sense of numbers, particularly for learners with SID. During the focus group interviews, participants articulated numerous reasons why number sense development is vital for daily living activities. Moreover, they demonstrated a clear understanding of what number sense development entails. However, some participants expressed uncertainty about how to initiate number sense development due to the diverse abilities of their learners. Nonetheless, most participants agreed that learners must first experience numbers through their bodies to develop a sense of numbers effectively. The development of number sense includes knowing and understanding number symbols, numerical values and number names (DBE, 2018). Number knowledge is a crucial part of the hierarchical development of number sense, resulting in skills enabling learners to work with numbers (DBE, 2012). Number sense incorporates the meaning and relationship of “different kinds of numbers, the relative size of different numbers, [the] representation of numbers in various ways, the effect of operating with numbers and the ability to estimate and check solutions” (Paulsen & Dednam, 2016). When I inquired about the challenges of developing a sense of numbers, participants shared insights that not only shed light on the barriers to learning but also underscored their influence on the broader theme of number sense development. These challenges, as mentioned by the teachers, hold significant relevance in shaping their PCK and guiding their approaches to fostering a comprehensive understanding of numbers.

According to the literature, it is crucial for teachers to grasp the developmental progression of number sense, which emphasises the progression from concrete experiences to abstract understanding and fosters the connection between numbers and their representations (Peucker & Weißhaupt, 2013). Participants identified abstract concepts, such as addition and subtraction, as formidable challenges in the context of number sense development. The abstract nature of mathematical operations can pose difficulties for learners with SID, making it essential for teachers to employ concrete strategies to bridge this gap. Additionally, participants mentioned challenges related to abstractness when writing mathematical expressions, which further highlights the importance of providing tangible and visually comprehensible materials to support the learning process.

Key challenges highlighted by participants also included fundamental concepts like understanding number symbols, one-to-one correspondence, and the concepts of “more” and “less”. These challenges resonate with the foundational elements of number sense and emphasise the critical role of teachers in simplifying and reinforcing these concepts through targeted teaching strategies.

Effective teaching typically involves various strategies, including multisensory instruction, which enables learners to engage multiple senses simultaneously, optimising their capacity to form cognitive patterns and enhance information retention (DBE, 2018). Participants consistently emphasised the significance of working with learners with SID at a concrete level. This emphasis on concrete, sensory-based learning experiences reflects the teachers’ commitment to providing a supportive and effective learning environment for their learners. As such, these challenges form an integral part of number sense development and underscore the complex interplay between barriers to learning, teachers’ PCK, and their teaching in the quest to foster a deep and meaningful understanding of numbers among learners with SID.

“So ek sal sê abstrakte begrippe is moeilik. Goed wat vir ons kindertjies bitter moeilik is, is doodeenvoudige goed soos... uhm... swaar en lig. As hulle dit nie kan voel of vat nie. Of lank en kort. Voor en agter. Dis nogal die tipe begrippe waarmee my kindertjies veral sukkel.”

[So, I would say abstract concepts are difficult. Things that are very difficult for our children are simple things like... uhm... heavy and light. If they can't feel it or take it. Or long and short. Front and back. Those are the types of concepts that my children especially struggle with.]

(Focus group interview – Group 1; Participant B1)

“Ek sal sê in getalbegrip, die uitdagendste enetjie sal wees bewerkings, plus en minus. Dis is nogal moeilik soos... uhm... wat sy ook verduidelik het – die abstrak en konkreet bymekaar gebring word om daai konsep te verduidelik. Die abstrakte gedeelte [is] waar jy dit fisies neerskryf. 'n Plus-sommetjie. Hulle... dis vir hulle moeilik om te verstaan as hulle dit nie ook kan fisies doen nie...”

[I would say that in terms of numbers, the most challenging part would be operations, plus and minus. It's quite difficult, as... uhm... she also explained – the abstract and concrete are brought together to explain that concept. The abstract part (is) where you physically write it down. A little extra. They... it's hard for them to understand if they can't do it physically too...]

(Focus group interview – Group 1; Participant A3)

“Uhm... knowing number symbols. So, my kinders sukkel om een-tot-een-korrespondensie te doen, so hulle sukkel om daai een blokkie is gelykstaande aan die nommer een... hulle sukkel om daai konsep te snap en dit maak plus en minus ook moeilik.”

[Uhm... knowing number symbols. So, my children struggle to do one-to-one correspondence, so they struggle to that one box is equivalent to the number 1... they struggle to grasp that concept, and it also makes plus and minus difficult.]

(Focus group interview – Group 1; Participant A1)

“Ook met minder en meer.”

[Also with less and more.]

(Focus group interview – Group 1; Participant A2)

“...nagal, dis asof jy heeltemal konkreet met hulle moet teruggaan.”

[...rather, it's like you have to go back with them totally concretely.]

(Focus group interview – Group 2; Participant E1)

The essence of independent living is the ability to understand number concepts and developing a sense of numbers (DBE, 2018). The ability to understand numbers and the skills to work with numbers play a crucial role in an individual's daily life, enabling a person to navigate and control various aspects of it (Brown, 2018). As part of the exploration into number sense development, I posed a crucial question during the focus group interviews: *Why is it important for learners to develop a concept of numbers?* In response, all the participants underlined the fundamental role numbers play in a person's daily life. This resonates with the essence of independent living, as highlighted in section 1.1, where the ability to comprehend number concepts and cultivate a profound sense of numbers is regarded as essential (DBE, 2018). The participants articulated various compelling reasons for the significance of number sense, drawing from real-life experiences and practical applications. These reasons included diverse aspects of daily living, such as determining shoe sizes, preparing meals, celebrating birthdays, recalling cell phone numbers, setting the table, and managing financial matters. This collective perspective underscores the multifaceted and pervasive nature of numbers in our everyday routines and reinforces the critical role of fostering a comprehensive understanding of numbers among learners.

“Nommers is so integrale deel van die lewe en... skoennommer moet ken.... Jy moet weet as jy tuckshop toe gaan, wat gaan jy betaal. Jy werk met nommers, hoeveel kan dit jou kos. Jy moet jou verjaardagdatum ken ... elke dag die datum

ken. Dit is nommers, nommers, tyd is nommers. Jou ouderdom is nommers, Nommers is deel van die lewe.”

[Numbers are such an integral part of life and... must know shoe size... You must know when you go to the tuckshop what you will pay. You work with numbers, how much can it cost you. You must know your birthday date... know the date every day. It's numbers, numbers, time is numbers. Your age is numbers, Numbers are part of life.]

(Focus group interview – Group 2; Participant E3)

“They need to be able to say this is my mom’s number... werk met geld. Hulle gaan ... activities of daily living moet doen. Hulle gaan ‘n brood by ‘n winkel moet koop. Ek voel ook baie keer gestremde mense word ingedoen... Dit is nogal vir my ‘n groot ding dat hulle moet leer van nommers.”

[They need to be able to say this is my mom's number... work with money. They are going to have to do ... activities of daily living. They will have to buy a loaf of bread from a shop. I also feel that many times disabled people are cheated... It's quite a big thing for me that they have to learn about numbers.]

(Focus group interview – Group 2; Participant D3)

“Net gaan dek vir my die tafel...”

[Just go set the table for me...]

(Focus group interview – Group 2; Participant D1)

Udoba (2014) highlights that teachers often do not know how to accommodate and address the special needs of learners with SID. It is argued that there is a need for teachers to have specific knowledge, including personal knowledge, knowledge of initial and continuous training, knowledge of curriculum and knowledge of professional practice when teaching learners with SID (Fernandez, 2014). As part of the follow-up questions, I inquired about the specific methods participants employed to develop number sense during a lesson. The responses revealed a clear understanding among participants that fostering a comprehension of numbers as a concept necessitates a careful consideration of the learners' developmental stage. They emphasised the importance of employing a diverse range of teaching strategies, tailoring their approach to meet the needs of individual learners and using the learning programme as a helpful guide. Furthermore, participants underscored the significance of utilising resources across all three levels – concrete, semi-concrete, and abstract – to provide a well-rounded and effective approach to developing

number sense. Several participants also noted the need to remain adaptable in their lesson planning, as unforeseen factors often require on-the-spot adjustments to the instructional strategy.

...nommer 5... begin met number blocks. Dis ook 'n vorm van 'n video... die Unifix blocks is basies die number blocks. Dan is dit 'n hele storie oor die nommer 5 en hoe het hy die nommer vyf... geword. Hy was eers 4, en dan word hy 5. So dit help dan met die konsep van number blocks, wat eers visueel in 'n play-based ... voorgestel word... begin ons tel. Eers in 'n groep en dan begin ons... uhm... mannetjies tel en dan sal ons, ons klei uithaal en op ons kleimat wat 'n nommer 5 op het, sal ons dan vyf stukkies klei opsit en dan sal ons eers vier en dan een bysit en dan tel ons dan het ons vyf, en dan sal ons dit afhaal en dan sit ons twee en dan sit ons weer drie, so dan begin ons met die plus, maar op 'n konkrete manier. Uhm... in die sand sal ons vyf lyntjies trek en dit tel en dan sal ons drie lyntjies trek en dit tel. En dan sê dis nie vyf nie... ons moet vyf lyntjies hê. Dan sal ons vyf lyntjies trek. Uhm... die Unifix en die kaartjies gebruik ek saam. Hulle lê die kaartjies een tot by vyf neer en dan sal hulle die Unifix blokkies hulle, number blocks, nou moet mooi pak en hulle number blocks vorm van een tot vyf.

[...number 5... start with number blocks. It's also a form of video... the Unifix blocks are basically the number blocks. Then it is a whole story about the number 5 and how it became the number 5. It was 4 at first, and then it will be 5. So, it helps with the concept of number blocks to start developing it first, which is first presented visually in a play-based ... then we start counting. First in a group and then we start counting... uhm... toys and then we would take out our clay and on our clay mat that has a number 5 on it, we would then put five pieces of clay on it, and then we would first add four and then one more, and then we count then we have five and then we would subtract it and then we put two and then we put three again, so then we start with the plus, but in a concrete way. Uhm, in the sand, we would draw five lines and count them, and then we would draw three lines and count them. And then they say it's not five, we have to have five lines. Then we would draw five lines. Uhm, I use the Unifix and the tickets together. They place the tickets one to five, and then they would have to pack the Unifix blocks their number blocks carefully and place their number blocks from one to five.]

(Semi-structured individual interview; Participant A1)

4.8 INTEGRATED DISCUSSION OF FINDINGS

The integrated discussion of findings from the document analysis, semi-structured individual interviews, and focus group interviews revealed several commonalities and differences. All three data sources emphasized the importance of number sense development and the CAPS for Learners with SID, with a particular focus on the role of PCK in supporting learners. Strong teaching strategies were identified across all data sources. In the learning programme, these strategies were referred to as methods, while in the interviews, participants did not necessarily label them as strategies but showed clear evidence of using effective teaching strategies. The theme of teachers' prior knowledge emerged in both the interviews and the learning programme. In the interviews, participants discussed the learners' prior knowledge as well as their own, which was interlinked with the sub-theme of training. While the learning programme did not specifically label challenges, the interviews highlighted several challenges faced by teachers, including time constraints, learners' abilities, expectations of the learning programme, assessments, and high and low support needs groups. The theme of learners with SID and the sub-theme of their profile and barriers to learning were identified in both interviews and the learning programme. Participants in both forms of interviews indicated a clear understanding of SID and the various disabilities, as well as the barriers to learning experienced by learners. Strategies to support learners with SID to develop number sense emerged as a theme, with the sub-theme of classroom organization and management. The learning programme provided clear expectations for classroom organization and management, such as small group teaching and support need groups, and participants in the interviews also indicated how they managed their classrooms. The sub-theme of lesson plans emerged across all data sources. The participants in the interviews used a lesson plan tracker but indicated that there were gaps in the learning programme and lesson plan tracker and not a clear indication of progression. They also mentioned that they worked out lessons but did not rigidly stick to them due to the learners' state on a specific day. Lastly, the sub-theme of resources emerged across all data sources, with the participants in the interviews, the learning programme and the lesson plan tracker clearly listing the resources. The main integration among all the data sources is the shared goal of preparing learners for life after school and fostering independence in daily living activities. This objective is also evident in the literature. In conclusion, the participants in the interviews are committed to equipping learners for life after school, as outlined in the learning programme. Therefore, it is essential to enhance teachers' PCK and deepen their understanding of it, as this will significantly influence their professional development and serve as a metric to assess their effectiveness in teaching and learning. This, in turn, provides a basis for identifying areas for improvement as teachers.

4.9 CONCLUSION

In this chapter, my aim was to interpret the data gathered. An interpretive paradigm approach was selected, as this approach allows one to comprehensively grasp complex social phenomena. The primary focus of this exploration revolved around teachers' PCK in the context of imparting number sense development to Grade 1 learners with SID, as outlined in the conceptual framework. In this chapter, I presented the findings and an in-depth analysis of the data and shed light on the multifaceted nature of teachers' PCK and its crucial role in Grade 1 classrooms for learners with SID while fostering the development of number sense.

In chapter 5, I conclude this study. The chapter presents a comprehensive discussion of the key conclusions, notable contributions, acknowledged limitations, and recommendations for future research. The significance of the findings and their implications for schools for learners with SID, within the framework of teachers' PCK, learners with SID, and number sense development, is summarised.

CHAPTER 5: CONCLUSIONS, CONTRIBUTIONS, LIMITATIONS AND RECOMMENDATIONS FOR FURTHER STUDY

5.1 INTRODUCTION

Chapter 4 presented the findings of an extensive data analysis process, involving document analysis, semi-structured interviews and focus group discussions. In this chapter, chapter 5, conclusions are drawn, the contributions of the study are highlighted, the limitations of the study are acknowledged, and the stage is set for future research on teachers' PCK and its influence on developing number sense for Grade 1 learners with SID. The rationale behind selecting the research topic – *Developing number sense for Grade 1 learners with severe intellectual disabilities: Exploring teachers' pedagogical content knowledge* – is briefly revisited. The research objectives, scope and theoretical foundations are discussed alongside a reiteration of the primary research question. However, the chapter does not shy away from recognising inherent research limitations, and recommendations are made for further exploration on this topic. Chapter 5 serves as a pivotal point of reflection and as a foundation for the discussion on the implications of the study and its potential contributions to the exploration of teachers' PCK.

5.1.1 Why the topic? Developing number sense for Grade 1 learners with severe intellectual disabilities: Exploring teachers' pedagogical content knowledge

The reason for selecting this research topic – *Developing number sense for Grade 1 learners with severe intellectual disabilities: Exploring teachers' pedagogical content knowledge* – was rooted in a compelling need to bridge a critical knowledge gap within the field of special education needs. As clarified in chapter 1, the driving force behind this choice was the recognition that comprehensive insights into teachers' PCK were pivotal for optimising the development of number sense in learners with SID. While extensive research has been conducted on PCK within mainstream education, a discernible gap exists in addressing the unique context of learners with SID. This void underscored the imperative to delve into the specific PCK essential for teaching learners with SID.

Being a teacher engaged in the instruction of Grade 1 learners with SID, I have first-hand understanding of the challenges of and intricacies inherent in this educational context. The decision to undertake this research was fundamentally driven by a commitment to enhance the quality of education for my learners and others like them. By examining what teachers teach and how they teach it, particularly concerning the development of number sense, this study aspired to not only inform and improve the pedagogical strategies employed but also contribute to the broader discourse on special educational needs, ultimately fostering more effective and inclusive learning environments for learners with SID.

5.1.2 Aims that motivated the research

As reflected by this study's research questions (§ 1.3) and research aims (§ 1.4), I intended to explore how teachers use PCK when they teach number sense to Grade 1 learners with SID.

To achieve this aim, the following objectives were set:

- to explore the training that teachers received to use PCK when they teach number sense to Grade 1 learners with SID
- to investigate how teachers apply PCK when teaching number sense to learners with SID
- to identify and describe the challenges teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID.

5.1.3 Boundaries that were set for this specific research and reasons why these were chosen

I set research boundaries to align with the study's aims, carefully considering the following aspects to maintain the planned scope of the research:

- Site: The precise location for data collection was thoughtfully chosen (§ 3.2.4.1).
- Sample: The criteria for participant selection enabled me to intentionally select possible participants who possessed valuable insights into the phenomenon under investigation (§ 3.2.4).
- Research design and methodology: I carefully selected a suitable design and methodology to conduct the exploration on teachers' PCK. My decision was based on their alignment with the existing literature gap, as many prior studies on teachers' PCK had predominantly used quantitative research designs and methodologies.

5.2 A BRIEF REFLECTION ON THE RESEARCH PROBLEM, RESEARCH QUESTIONS AND AIMS OF THE STUDY

In the literature I reviewed, there was a noticeable paucity of research that specifically delved into teachers' PCK within the context of fostering number sense development in learners with SID. I also conducted a thorough examination of literature related to PCK in other subjects, such as Mathematics and Science. As detailed in chapter 2 (§ 2.2), I extensively discussed the theoretical framework. Although literature exists for the three distinct conceptual frameworks – teachers' PCK, learners with SID, and number sense development – there is still a noticeable gap in the literature when it comes to integrating these three concepts into a unified framework.

Given that teachers played a pivotal role in this research, it was crucial to first explore teachers as learning specialists (§ 2.3). These teachers possessed specialised, in-depth knowledge of number sense development. The research also addressed the learner with SID and the strategies for teaching number sense to this specific group of learners. An integral aspect of teachers' PCK concerns the challenges they encounter when applying their knowledge in the context of number sense development for Grade 1 learners with SID.

5.3 OVERVIEW OF CHAPTERS IN THIS DISSERTATION

Chapter 1: Orientation and background

This chapter provided an overview of the research study, including the research problem, the phenomenon under study, knowledge gap, research questions and aims.

Chapter 2: Pedagogical content knowledge for number sense development

Chapter 2 served as the foundational framework for the study. It focused on two crucial theories that underpinned the research: Piaget's (1957) cognitive learning theory, particularly his developmental stages, and Lee Shulman's (1986) consensus model of PCK. I began by delving into the specifics of Shulman's framework, with an emphasis on TSPCK, relevant to my examination of teachers' PCK and number sense development, the central theme of this study. Following this, I explored the concept of teachers as learning specialists, highlighting their specialised and profound understanding of the subjects they teach, often referred to as TSPCK, and discussed the characteristics that define it.

Given the primary research focus on teachers' PCK, I also addressed a critical aspect of the study title, *Developing number sense for Grade 1 learners with severe intellectual disabilities*. I initially provided context by discussing learners with SID. Subsequently, the focus shifted to number sense development and the essential teaching strategies and the pivotal role of activity-based learning in achieving this objective were emphasised (§ 1.6).

Chapter 3: Research methodology and design

Chapter 3 elaborates on the research design and methodology, as was briefly explained in chapter 1. The explanation for selecting a qualitative case study and positioning it within the interpretive research paradigm was provided. The case study, participant selection and the data collection and analysis process were discussed. The chapter concluded with a discussion on the ethical aspects that were borne in mind throughout the study, followed by a discussion on how the trustworthiness of the findings was ensured.

Chapter 4: Data analysis and findings

The fourth chapter offered a detailed description of the analysis process and presented the results and discussed the findings. The findings were discussed in the context of the conceptual framework proposed in chapter 2.

The following main themes were identified:

- The role of teacher's PCK in supporting learners to develop number sense
- Learners with SID
- Strategies to support learners with SID to develop number sense.

Chapter 5: Conclusions, contributions, limitations and recommendations for further study

Chapter 5 discusses the conclusions, the study contributions and the limitations of the study, and sets the stage for future research on teachers' PCK and its influence on developing number sense for Grade 1 learners with SID. The rationale behind selecting the research topic – *Developing number sense for Grade 1 learners with severe intellectual disabilities: Exploring teachers' pedagogical content knowledge* – is revisited. The research objectives, scope and theoretical foundations are discussed alongside a reiteration of the primary research question. However, the chapter does not shy away from recognising inherent research limitations and provides recommendations for further exploration on this topic. Chapter 5 serves as a pivotal point of reflection and as a foundation for the subsequent discussion on the implications of the study and potential contributions to the exploration of teachers' PCK.

5.4 CONCLUSIONS

5.4.1 Research questions: Conclusions

In this section, I provide conclusions drawn from the answers to the research questions (§ 1.3) that guided this study. The main research question was formulated as follows:

- How do teachers use PCK when they teach number sense to Grade 1 learners with SID?

In order to explore the main research question, the following secondary questions were asked:

- What training did teachers receive to use PCK when they teach number sense to Grade 1 learners with SID?
- How do teachers apply PCK when teaching number sense to learners with SID?
- What challenges do teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID?

The following conclusions were drawn in relation to the research questions:

Although it was clear how teachers used PCK in teaching number sense to Grade 1 learners with SID, there are still certain problems that need to be addressed, such as the following:

- While teachers had a well-defined understanding of the typical profile of Grade 1 learners with SID as regards their abilities and developmental levels, there was a distinct need for support in motivating these learners to engage in learning effectively. Additionally, the teachers were familiar with the developmental levels of these learners but often experienced challenges in determining the appropriate starting point and content to ensure the successful development of number sense.
- Teachers typically organised their classrooms in a very traditional manner, with learners sitting at their tables and occasionally incorporating carpet activities. This traditional organisation prompted the question of whether the classroom environment itself was truly accommodating to the unique needs of Grade 1 learners with SID when teaching number sense. Additionally, there was a noticeable gap in clarity on how the teachers adapted their lesson plans to effectively address the diverse needs of these learners in this setting.
- Teachers showed a clear understanding of the teaching strategies they employed to teach the sub-set “numbers, number operations, and relationships”; their primary focus was on practical, concrete-based strategies. However, there was a lack of clarity regarding whether these strategies effectively facilitated progression in learners’ understanding or if teaching ought to be tailored to each individual learner’s developmental level. The question arises as to whether it is feasible to adopt such an individualised approach to teaching in this context.
- Teachers showed familiarity with the recommended resources outlined in CAPS for Learners with SID to support the teaching of number sense in their classrooms. These resources predominantly included concrete materials and the use of flashcards. However, there was a notable variation in the extent to which these resources were introduced in the classroom, with one participant notably integrating multiple resources and maintaining a resource centre. The presence of appropriate resources appeared to motivate teachers to deepen their PCK and design lessons tailored to accommodate the diverse needs of the learners.
- Two participants clearly articulated how they utilised resources in their classrooms and demonstrated a solid grasp of resource facilitation. Most teachers discussed how specific resources were employed to address various barriers to learning. For instance, when faced with learners who had difficulty writing or speaking, teachers often resorted to the use of a number line to help learners indicate a number. The broader challenge lies in ensuring that all teachers are equipped with comprehensive knowledge and strategies to effectively

employ these resources in a manner that caters to the diverse needs of their learners when teaching number sense.

- One participant explicitly described how their initial training had equipped them with an understanding of developmental levels and brain development. The majority of participants conveyed that their initial training had limited impact, emphasising the significance of practical experience over formal training. Additionally, three participants mentioned that their training had included subjects related to learners with special needs, but there was mixed recognition of their preparedness to understand the unique profiles of learners with SID. This underscores the need to bridge the gap between formal training and practical application, particularly in the context of teaching number sense to learners with SID.
- Teachers must possess specific prior knowledge to effectively instil number sense for their learners. This knowledge involves a comprehensive understanding of CAPS for Learners with SID, with a focus on the content area of number sense development. Equally important is their prior knowledge of the learners themselves, including an understanding of the various disabilities and the associated limitations that may impact their ability to acquire new knowledge. However, two participants conveyed a reliance on their extensive experience rather than specific prior knowledge, highlighting the need to strike a balance between formal knowledge and practical expertise in teaching number sense to learners with SID.
- Teachers encountered considerable challenges when striving to accommodate the diverse individual needs of Grade 1 learners with SID in the development of number sense. The classroom presents a multitude of unique needs that cannot always be fully addressed, leading to frustration and difficulties for teachers. Learners often required one-on-one assistance and struggle to work independently, placing teachers in a challenging position of providing individualised support. Additionally, there was a lack of sufficient resources such as classroom assistants, worsening the challenges faced in catering to the learners' impatience and the need for personalised attention when teaching number sense to this group.
- In the general content focus area of number sense development, teachers found it particularly challenging to teach certain concepts, such as the abstract nature of numbers, addition and subtraction, and the sequence of numbers (what comes before and after). However, there was a lack of clear explanation from the participants regarding the specific reasons why these concepts posed challenges in teaching number sense to Grade 1 learners with SID. Further exploration is needed to understand the root causes of these challenges and to develop effective strategies to address them.

- Teachers encountered difficulties and knowledge limitations when teaching the concept of numbers to Grade 1 learners. These challenges revolved around determining the starting point for instruction, assessing the learners' current level of understanding, and acquiring specific knowledge to address barriers to learning effectively. Additionally, teachers struggled with the task of re-engaging learners after holiday breaks when they may have forgotten previously learned concepts. The learners' attention span and willingness to learn were additional areas of concern. These limitations in knowledge and challenges in teaching number concepts to learners with SID underscore the need for targeted strategies and support in this instructional context.
- Learners with SID face a range of substantial barriers to learning when it comes to developing a concept of numbers. These barriers include language difficulties, number reversals, limited attention span, challenges in grasping basic concepts, memory deficits, struggles with abstract concepts, difficulty transferring newly acquired knowledge to different situations, and the inability to identify numbers solely by sight. The broad scope of these barriers underscores the complexity of teaching number concepts to learners with SID, emphasising the necessity for tailored instructional approaches and support to address these multifaceted challenges.
- Teachers employed various strategies to address and overcome the barriers to learning in their classrooms when teaching number concepts to Grade 1 learners with SID. These strategies included revisiting fundamental concepts, incorporating sensory integration to make learning more meaningful, and utilising drill work to reinforce understanding. However, while some strategies were mentioned, there is a need for more comprehensive insights into the specific approaches and techniques that effectively address the various barriers to learning experienced by learners with SID when developing a concept of numbers.
- Developing a concept of numbers is crucial for learners, as it enables them to lead more meaningful, independent lives. This encompasses various practical aspects such as handling money, using cell phone numbers, recognising important dates, and even basic tasks like knowing one's shoe size. The question arises as to whether the lessons presented by teachers effectively incorporate real-life situations, integrating them with Life Skills and other subjects. It is essential to consider whether teachers teach learners the critical skill of transferring knowledge from one situation to another, as this capacity is pivotal for learners with SID to apply their understanding of numbers in diverse contexts. Further exploration is needed to ascertain the extent to which these essential skills are addressed in the classroom.

5.4.2 Factual conclusions

The following conclusions were drawn from the results that emerged from the document analysis, semi-structured individual interviews and focus group interviews:

5.4.2.1 Theme 1: The role of teachers' PCK in supporting learners to develop number sense (§ 4.10.1)

Sub-theme 1: Strategies (§ 4.10.1.1)

Participants reported a range of teaching strategies. Some participants incorporated both teacher- and learner-centred approaches, while others favoured only teacher-centred approaches. The prevailing trend leaned towards teacher-centred approaches, particularly in contexts where learners struggled with self-directed learning. Some participants highlighted the significance of teaching at a concrete level, engaging multiple senses and using tangible resources, especially when teaching numbers. This emphasis on hands-on, sensory-based learning aligns with guidelines provided by the DBE. Additionally, one participant employed technology and digital tools to actively engage learners with SID. This approach facilitated their participation and learning, underscoring the importance of adaptive tools and individualised support for these learners.

Sub-theme 2: Training (§ 4.10.1.2)

The pivotal role of PCK in fostering number sense development among learners was key. Teacher training is a significant factor that influences the level of PCK that teachers bring to the specialised classroom. During interviews, participants collectively emphasised the value of experience while recognising the foundational importance of initial training. Some participants underscored the significance of university modules in early childhood development to understand learners' developmental stages and tailor activities accordingly. Additionally, they mentioned that teachers had received training in CAPS for Learners with SID. Furthermore, one participant cited the transformative impact of a specific short-term course, as it enhanced her ability to teach learners with SID. Another participant expressed a desire for additional training to further enhance her PCK in effectively addressing the unique needs of learners with SID.

Sub-theme 3: Prior knowledge (§ 4.10.1.3)

Analysing teachers' prior knowledge is crucial, but equally significant is examining learners' prior knowledge, especially understanding their foundational comprehension. Participants highlighted the importance of baseline assessments to gauge learners' existing understanding; more experienced participants found this less challenging because of their wealth of experience. It is essential for teachers to consistently revisit fundamental and easily comprehensible concepts, particularly after extended breaks like holidays. To address this, participants often collaborated

with the previous year's teacher to conduct summative assessments. The consensus was that focusing on the fundamentals, adopting a "back to basics" approach, nurtures a strong foundation in number sense.

Sub-theme 4: Challenges (§ 4.10.1.4)

Exploring the impact of teachers' PCK on developing number sense for learners revealed several challenges. These challenges comprised learners' behaviour, the necessity for differentiation because of varying developmental levels, their self-paced learning nature, difficulties faced by learners with independent work, and short memory spans. One participant provided valuable insights, echoing the perspectives of other participants. She highlighted the varying levels of learners and the issue of low motivation. Additionally, complexities linked to understanding the learning programme were mentioned, leading to uncertainty about what and when to teach. A focus was also placed on learners' struggles with the concept of one-to-one correspondence, a significant educational challenge.

5.4.2.2 Theme 2: Learners with SID (§ 4.10.2)

Sub-theme 1: Profile (§ 4.10.2.1)

In the context of learners with SID, it is essential to understand how teachers delineated their characteristics and profiles within their classrooms. During the semi-structured interviews, several participants mentioned the approximate ages of their learners, aligning with the suggested age range for Grade 1 learners in CAPS for Learners with SID. Moreover, a substantial number of participants showed a solid understanding of their learners' developmental levels, which was reflected in their lesson plans. Participants also elucidated the specific disabilities present in their classrooms, emphasising the roles of communication and hearing abilities. These factors underscore the complex nature of teaching learners with SID and the need for an adaptive teaching approach.

Sub-theme 2: Barriers to learning (§ 4.10.2.2)

Participants shared insights into barriers to learning in the context of number sense development for learners with SID. These challenges included difficulties grasping the sequence of numbers, abstract nature of numbers, and issues related to recognising shapes. Participants emphasised learners' struggles in comprehending concepts like "before" or "after" and the comparison of numbers in terms of greater or smaller. Additionally, they mentioned language barriers and the challenges learners face when applying knowledge to different situations, highlighting the complexity of fostering number sense development in learners with SID.

5.4.2.3 Theme 3: Strategies to support learners with SID to develop number sense (§ 4.10.3)

Sub-theme 1: Classroom organisation and management (§ 4.10.3.1)

Participants discussed various classroom organisation strategies in the context of teaching Grade 1 learners with SID. Most participants mentioned that their learners were predominantly seated at tables and engaged in activities both at tables and on the carpet. All participants emphasised the importance of table-top activities and carpet work in their teaching approaches. One participant adopted a unique classroom arrangement with TEACCH workstations designed for learners with autism, integrating these tasks into her daily lesson planning to foster independent learning. Additionally, she emphasised teaching self-regulation skills and emotional check-ins to prepare learners for optimal learning. Another participant showed a comprehensive understanding of tailoring learning experiences to individual learners, accommodating their abilities, interests and developmental progress. One participant's insights extended to managing support groups and adapting activities to meet the specific needs of each group within the classroom management approach.

Sub-theme 2: Lesson plans (§ 4.10.3.2)

CAPS for Learners with SID emphasises the importance of lesson plans in providing teachers with a weekly overview of the content to be taught and assessed, ensuring comprehensive coverage of prescribed content for each term. However, the participants viewed lesson planning as a dynamic and adaptable process, acknowledging that what they prepared may not always have aligned with classroom realities because of the evolving needs of their learners. This flexibility in teaching approach reflects the participants' responsiveness to their learners' unique requirements. While they had standard lesson plan templates, they did not rigidly adhere to them, possibly using them as a foundational structure for organisation and consistency. Additionally, aligning teaching with the learning programme is essential – this indicates a deliberate effort to sync instruction with prescribed learning objectives and content standards, which could impact the teacher's lesson planning and teaching strategies.

Sub-theme 3: Resources (§ 4.10.3.3)

The data revealed that participants took the initiative to create their own resources, driven by the evolving needs and abilities of their learners. They prioritised the use of sensory-integrated, tactile, and visual resources to actively engage learners, with a notable emphasis on the importance of visual stimuli for both teachers and learners. Some participants incorporated YouTube videos to enhance the learning experience. The crucial aspect that resources must align with learners' developmental levels to effectively meet their unique needs was highlighted. This alignment with

developmental levels ensured meaningful educational experiences. The mentioned resources aligned with CAPS for Learners with SID, reflecting a commitment to established guidelines and enhancing the quality of education.

Sub-theme 4: CAPS for learners with SID (§ 4.10.3.4)

Participants identified CAPS for Learners with SID as the primary policy which guides number sense development in Grade 1 classes for learners with SID. Some participants referred to it as “DCAPS” because of its initial introduction under that name by the DBE. However, School D consistently referenced the previous learning programme; this emphasised its importance in their educational approach. They viewed the current DCAPS programme as having weaknesses and gaps that could hinder the quality of education for learners with SID. School D's reliance on their former programme underscored their belief in its effectiveness in addressing educational challenges. Participants had varied opinions on CAPS for Learners with SID – some found it challenging and repetitive, while others, like Participant B1, considered the repetition a potentially beneficial aspect for exploring the curriculum thoroughly. This diversity of perspectives highlighted the complexities of implementing educational policies for learners with SID.

Sub-theme 5: Developing number sense (§ 4.10.3.5)

Participants highlighted the challenges involved in developing a sense of numbers, revealing their influence on PCK and teaching approaches. These challenges encompassed abstract concepts like addition and subtraction, the use of mathematical symbols, one-to-one correspondence, and the concepts of “more” and “less”. Teachers recognised the importance of addressing these challenges through concrete, sensory-based learning experiences to support learners with SID effectively.

In response to the question of why it is important for learners to develop a concept of numbers, participants emphasised the fundamental role of numbers in daily life, which includes practical applications like determining shoe size, preparing meals, recalling cell phone numbers, managing finances, and more. This collective perspective highlights the pervasive nature of numbers in daily routines and the critical role of fostering a comprehensive understanding of numbers in learners with SID.

Regarding methods to cultivate number sense during a lesson, participants stressed the importance of considering the learners’ developmental stage, using diverse teaching strategies, tailoring their approach to individual learners, and following the learning programme as a guide. They also highlighted the need to employ resources across concrete, semi-concrete and abstract levels and remain adaptable in lesson planning to address unforeseen challenges effectively.

5.4.3 Conceptual conclusions

According to Grant and Osanloo (2014), when the factual findings are conceptualised, it allows the researcher to align them with the components of the conceptual and theoretical framework (see chapter 2). As a result, the conceptual circle is now closed with the presentation of the following conceptual conclusions.

In the realm of education, teachers are often referred to as learning specialists, implying a need for multifaceted knowledge to excel in their roles (Guerriero, 2014). Effective teaching involves more than subject matter expertise; it requires pedagogical skills, an understanding of learners, and the ability to adapt to diverse contexts (Diezmann & Watters, 2015; Moje, 2015). Over the past few decades, teachers have identified various domains of teacher knowledge, with a focus on PCK in the context of mathematics teaching. PCK, particularly its richness, strongly influences teaching effectiveness and learners' achievement in mathematics (Lee et al., 2018; Zelkowski et al., 2013). Therefore, this study centres on PCK as a critical component of teachers' knowledge base (§ 2.3).

Teacher specialist TSPCK encompasses in-depth content knowledge, pedagogical knowledge, awareness of learner thinking, adaptive teaching strategies, and contextual understanding. This multifaceted knowledge enables teachers to effectively teach specific topics to learners with diverse needs, particularly those with SID. In the case of number sense development, TSPCK empowers teachers to identify key concepts, plan the sequence of teaching, and adapt to individual learners' needs (Witzel et al., 2012). This knowledge helps teachers to create an inclusive and responsive learning environment that caters to learners with SID (§ 2.3.1).

Furthermore, ongoing professional development plays a pivotal role in enriching TSPCK (O'Brien, 2017). As teachers gain more experience and knowledge, their PCK becomes more adaptive and flexible, deepening over time. Teachers can acquire PCK from a variety of sources, including prior experiences as learners, professional development, and interaction with colleagues (Kind & Chan, 2019). Consequently, teachers' expertise in teaching learners with SID continues to evolve as they learn and reflect on their practices.

Understanding the role of teachers as learning specialists and the key characteristics of TSPCK is fundamental for effective teaching of learners with SID. This study's focus on PCK as a knowledge base reinforced the importance of equipping teachers with the tools, they need to promote number sense development among these learners. This conceptual framework provides a solid foundation for further exploration into this critical educational domain.

SID, also known as cognitive impairment or intellectual disability, includes a range of mental and developmental disorders that affect cognitive, speech and motor development in early childhood. SID is characterised by significant sub-average intellectual functioning (IQ of 70 or below) and

deficits in adaptive skills, including practical, conceptual and social skills. In the case of this study, the focus was on the influence of SID on cognitive skills, particularly its impact on learners' number sense development (§ 2.4.1).

Learners with SID face various barriers to learning, which directly correlate with the deficits outlined in the diagnostic criteria. These barriers stem from intellectual deficits, medical and health needs, as well as specific learning difficulties, such as dyslexia, dyscalculia and dyspraxia. They experience delays in development, learn at a slower pace, and process information differently. Each learner with SID is unique, and the severity and range of difficulties and needs vary (§ 2.4.2).

Challenges faced by learners with SID include difficulties with abstract symbolic thinking, reading, emotional regulation, attention deficit-related difficulties, and physical skills. Specific criteria for the different needs and difficulties they encounter include issues with problem-solving, attention span, short-term memory, motor skills, sensory integration, and the transfer of acquired knowledge and skills to new situations. Effective educational activities for learners with SID should focus on transferring knowledge acquired during the teaching process to real-life situations (§ 2.4.2).

The concept of “numbers” holds a significant place in the learning programme for learners with SID, as outlined in the National Curriculum Statement: Grade R-5. This learning programme emphasises the development of learners' understanding of actual numbers, number symbols, number values, and number names. A well-developed sense of numbers is crucial for the hierarchical development of number sense, which, in turn, enhances independent functioning in everyday interactions where numerical skills are applicable. Understanding the barriers and unique characteristics of learners with SID is essential for teachers to tailor their teaching strategies effectively, particularly when it comes to fostering number sense development (§ 2.4.3).

Number sense serves as the fundamental foundation for mathematical development, commencing with the recognition of numbers, extending to their meaningful representation, and culminating in a profound understanding of their practical applications in everyday life. It embodies an intuitive grasp of numerical concepts, involving not only the cognition of numbers but also practical thinking when engaging with mathematical operations.

The development of number sense is most potent when learning experiences are imbued with meaning. It traverses a series of developmental stages, including counting all, counting on, and the intricate processes of breaking down and building up numbers. These stages mirror the gradual progression towards a nuanced understanding of numerical concepts.

In the context of learners with SID, the focus shifts towards addressing their unique learning needs. Learning is contingent upon interactions with others, knowledgeable individuals and external resources. This interaction cultivates physical, social and conceptual knowledge, each of which plays a pivotal role in fostering a profound sense of numbers. It is important to acknowledge that in

South Africa, SID learners are promoted to the next grade based on their age, which gives rise to the complexity of addressing their varying developmental stages within a single classroom. Consequently, teachers must tailor teaching strategies that cater to the multifaceted cognitive growth of each learner.

Learners with SID experience specific challenges, notably in the realm of processing numbers and visual representations of discrete quantities. Developmental readiness becomes paramount, as effective learning necessitates an alignment with cognitive-developmental stages. To propel learners forward, teachers must consider the cognitive-developmental prerequisites for mastering mathematical concepts (§ 2.5).

Activity-based learning emerges as a dynamic and learner-centred approach that encourages active participation through multisensory teaching. Within the context of learners with SID, this approach fosters motivation, exploration, communication and problem-solving. It empowers learners with SID to engage profoundly with mathematical problems, stimulating their cognitive and creative faculties. It is the thoughtful integration of activity-based learning that makes the learning environment truly inclusive (§ 2.5.2).

The underpinning challenge lies in the fact that teachers often lack specialized training to effectively address the distinctive needs of learners with SID. In this regard, professional development becomes not only desirable but imperative. Teachers require a comprehensive knowledge base, inclusive of personal understanding, initial and continuous training, curriculum familiarity, and proficiency in professional practice. It is vital to bridge the gap between conventional teacher training and the specific requirements of this diverse learner demographic, ensuring that teachers are well-equipped to provide effective support. To address this challenge, customized training modules, hands-on workshops, peer learning and mentoring, ongoing support and feedback, community engagement, and evaluation and reflection should be implemented. These strategies can have a positive impact on teaching practices, ultimately leading to improved outcomes for learners with SID.

The teaching of number sense to learners with SID necessitates a deep understanding of their unique developmental profiles and the application of multisensory instruction, firmly rooted in differentiated teaching strategies. This not only empowers teachers to design effective individualised learning experiences but also elevates the educational landscape for learners with SID, enabling them to embark on a journey of profound number sense development.

5.5 CONTRIBUTION OF THE STUDY

This study made significant contributions to the field of knowledge across multiple conceptual, theoretical, methodological, and contextual realms. These contributions emanate from the inquiry posed by the research questions, as delineated in chapter 1 (§ 1.3).

5.5.1 Conceptual contributions

Prior to formulating the interview schedules, an extensive review of the literature was imperative. This review aimed to validate the relevance of the data collected through the semi-structured and focus group interviews to explore teachers' PCK in the context of developing number sense for learners with SID. This comprehensive examination of the pertinent concepts articulated within the research – namely teachers, learners with SID, and number sense development – was essential to ascertain that the research outcomes aligned with the research objectives. Teachers' PCK levels was evaluated by applying Shulman's PCK consensus model.

5.5.2 Theoretical contributions

This study contributed to the exploration of developing number sense for Grade 1 learners with SID, with a focus on teachers' PCK. The research framework integrated Piaget's cognitive learning theory, which emphasises developmental stages, and Shulman's consensus model of PCK, which highlights effective pedagogical strategies. Additionally, Mavhunga and Rollick's TSPCK model provided insights into adapting topic-specific knowledge for learners with SID. This comprehensive approach offered a holistic understanding of the complex interplay between pedagogical expertise, topic-specific knowledge and learners' cognitive development, emphasising the multidimensional nature of effective teaching in inclusive education (§ 2.2).

5.5.3 Methodological contributions

A methodological contribution was made in this study. Employing a qualitative research approach and utilising document analysis, semi-structured individual interviews and focus group interviews enabled me to effectively address the "how" research question concerning teachers' PCK.

5.5.4 Contextual contributions

This study made a contextual contribution, as the study focused on Grade 1 learners in schools for learners with SID. The results are limited to a region of Gauteng province, South Africa, and are specific to the challenges that occur in the province.

The primary contribution lies in the development of training sessions, informed by the insights derived from the document analysis, semi-structured interviews and focus group interviews. These training sessions will be designed for application in any school catering to learners with SID and can also serve as a resource for training programmes conducted by provincial education departments. At the conclusion of said study, a comprehensive report containing the research results and findings will be disseminated to all nine education departments.

5.6 LIMITATIONS OF THE STUDY

This study, like any research study, is not without limitations. One key consideration was the possibility of sampling bias, as the participants did not fully represent the broader population of teachers working with Grade 1 learners with SID. The small sample size could limit the study's scope and generalisability. This limitation affects the generalizability of findings, risking that they may not be representative of all teachers working with such learners. The study's limited diversity of perspectives could overlook crucial variations in PCK among teachers. A study with limited generalizability may not accurately reflect the experiences and practices of a broader population of teachers, affecting the applicability of findings to other educational settings and limiting potential for broader educational policy recommendations. To mitigate bias, detailed explanations of participant selection and validation of perspectives could be provided, alongside discussions on how credibility, transferability, dependability, and confirmability of findings were ensured. These strategies would enhance the transparency of research and increase trustworthiness of findings.

Data collection methods, such as interviews and focus groups, also have limitations as regards the depth of participant responses and their possible misunderstanding of questions. Time limitations impacted the study's comprehensiveness and my ability to explore changes over time.

Furthermore, the study was limited in terms of geographical scope, as it focused solely on participants from five schools in a Gauteng region – a decision influenced by the Covid-19 pandemic. Unfortunately, a sixth school did not respond, despite efforts to engage with the school principal and explain the research. It is also worth noting that the data collection methods posed challenges due to the pandemic; one focus group was conducted in person, and another was conducted online. A weak signal could have impacted the quality of the interaction in the latter focus group interview.

Additionally, limitations were faced when it came to classroom observations, as Covid-19 restrictions prevented the researcher from physically entering classrooms, leading to the collection of lesson plans as a substitute for classroom observations. However, this shift may not have fully captured the nuances of classroom dynamics and teaching practices. It is important to

acknowledge these limitations, as they could have potentially influenced the quality of data collected. Despite these challenges, the study still provided valuable insights into teachers' PCK in the context of developing number sense for Grade 1 learners with SID.

5.7 REFLECTIONS ON MY POSITION AS RESEARCHER

As a Grade 1 teacher responsible for learners with SID, I held my own preconceived notions and perceptions regarding PCK and how to effectively teach and develop number sense. However, through the course of this research, I have not only deepened my understanding of PCK within the unique classroom setting of Grade 1 learners with SID, with a specific emphasis on number sense development, but I have also come to realise the intricate complexity of the concept of PCK. I took care to provide clear guidelines to the participants about the meaning of PCK before commencing the research. This experience has underscored the importance of research initiatives like this one, as they play a vital role in contributing to positive changes that can benefit SID classrooms, catering to the diverse spectrum of learners.

Moreover, this research journey has highlighted the significance of having a well-structured research plan and adhering to it meticulously throughout the research process. This level of planning was crucial to ensuring that the study effectively aligned with its research objectives and that the resultant findings could be deemed trustworthy and reliable.

5.8 RECOMMENDATIONS FOR FURTHER RESEARCH

A recommendation for future research is to conduct thorough classroom observations across various settings that cater to learners with SID. Furthermore, participants disclosed that although they possessed standard lesson plan templates, they did not strictly adhere to them. It would be beneficial to investigate the rationale behind their continued use of these standardized formats, even though they were aware that modifications might be necessary. It is possible that these templates function as a foundational framework or point of reference, supplying a sense of structure and uniformity in their teaching approach. This suggests a deliberate effort to ensure that their instruction is coordinated with the prescribed learning objectives and content standards. Analyzing this aspect could shed light on how learning programme alignment influences teachers' lesson planning and teaching strategies.

There are numerous new research opportunities on teachers' PCK when developing number sense for Grade 1 learners with SID. The following questions are examples of such research opportunities:

- What are the key components of teachers' pedagogical content knowledge to develop life skills in Grade 1 learners with severe intellectual disabilities?
- What are the key components of teachers' pedagogical content knowledge to develop reading skills in Grade 1 learners with severe intellectual disabilities?
- How does teachers' pedagogical content knowledge in mainstream schools differ from teachers' pedagogical content knowledge in schools catering to learners with severe intellectual disabilities?

5.9 CONCLUSION

At the start of this research process, the exploration of teachers' PCK in the context of Grade 1 learners with SID was embarked upon with a keen sense of purpose and an inherent curiosity. This journey of inquiry was marked by a steadfast commitment to unravel the complexities of PCK and its role in developing number sense for learners with SID. As the study unfolded, it became evident that the undertaking was not merely an academic endeavour but a means to bridge the chasm between theory and practice and to pave the way for transformative education.

I conclude this research by concurring with Shulman (1986:14): *“Those who can, do. Those who understand, teach.”*

This research highlighted the importance of teachers who not only “do” but truly “understand” the intricacies of effective teaching. It underscores that in the domain of teaching learners with SID, understanding and informed practice go hand in hand, and it is through this understanding that we can pave the path to equitable and meaningful education for all.

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APPENDIX A: DEPARTMENT OF EDUCATION APPROVAL LETTER



GAUTENG PROVINCE

Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	14 October 2021
Validity of Research Approval:	08 February 2022– 30 September 2022 2021/293A
Name of Researcher:	Labuschagne, L
Address of Researcher:	47 Azalea Estate 32 Moepel Avenue Roodekrans, Roodepoort
Telephone Number:	0737653470
Email address:	leresia76@gmail.com
Research Topic:	Developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge
Type of qualification	MEd in Special Needs Education
Number and type of schools:	6 LSEN Schools
District/s/HO	Gauteng West, Johannesburg South, Johannesburg North, Johannesburg West

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

G. Ndlovu 15/10/2021

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Making education a societal priority

Office of the Director: Education Research and Knowledge Management

7th Floor, 17 Simmonds Street, Johannesburg, 2001

Tel: (011) 355 0488

Email: Faith.Tshabalala@gauteng.gov.za

Website: www.education.gpg.gov.za

3. *Because of COVID 19 pandemic researchers can ONLY collect data online, telephonically or may make arrangements for Zoom with the school Principal. Requests for such arrangements should be submitted to the GDE Education Research and Knowledge Management directorate. The approval letter will then indicate the type of arrangements that have been made with the school.*
4. *The Researchers are advised to make arrangements with the schools via Fax, email or telephonically with the Principal.*
5. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher's have been granted permission from the Gauteng Department of Education to conduct the research study.*
6. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
7. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalized in any way.*
8. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher's may carry out their research at the sites that they manage.*
9. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
10. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
11. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
12. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
13. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
14. *On completion of the study the researcher's must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
15. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
16. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

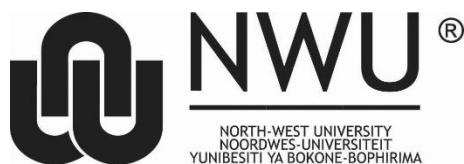


Mrs Faith Tshabalala

Acting Director: Education Research and Knowledge Management

DATE: 15/10/2021

APPENDIX B: CONSENT FORMS – SCHOOL PRINCIPALS



Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: <http://www.nwu.ac.za>

Faculty of Education

(Edu-REC)

Tel: 018 299 4656
Email: Jako.Olivier@nwu.ac.za

Date:

Dear _____

PERMISSION TO CONDUCT RESEARCH IN YOUR SCHOOL: SCHOOL PRINCIPAL

I herewith wish to request your permission for two Grade 1 teachers to participate in this research, which involves exploring teachers' pedagogical content knowledge (PCK) when developing number sense for Grade 1 learners with severe intellectual disabilities (SID). Prior to granting permission, please acquaint yourself with the information below.

The details of the research are as follows:

TITLE OF THE RESEARCH PROJECT:

Developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge

ETHICS APPLICATION NUMBER:

N W U - 0 1 9 0 1 - 2 0 - A 2

PROJECT SUPERVISOR: Mariette Koen

CO-SUPERVISOR: Julia Alet Rens

ASSISTANT-SUPERVISOR: Andri Schoonen

ADDRESS: Faculty of Education

Private bag X6001

Potchefstroom 2521

CONTACT NUMBER: +27 (0)18 285 2278

MEMBER OF PROJECT TEAM MEd-Student: Lerecia Labuschagne

ADDRESS: 47 Azalea Estate, Moepel Avenue, Roodekrans, Roodepoort

CONTACT NUMBER: +27 (0)73 765 3470

FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE

Contact person: Ms Erna Greyling, E-mail: Erna.Greyling@nwu.ac.za, Tel. (018) 299 4656

Grade 1 teachers teaching learners with SID from your school are being invited to take part in a research study that forms part of a Masters study. Please take some time to read the information presented here, which will explain the details of this study. It is very important that you are fully satisfied that you clearly understand what this research is about and how your school might be involved. Also, the participation of your school is entirely voluntary, and you are free to say no to participate. If you say no, this will not affect your school negatively in any way whatsoever. Your school is also free to withdraw from the study at any point, even if you do agree to take part now.

This study has been approved by the Research Ethics Committee of the Faculty of Education of the North-West University and will be conducted according to the ethical guidelines of this committee. Permission has been granted by the Department of Basic Education for the study to commence. Permission was also asked from the School Governing Body, school principal as well as the teachers.

What is this research about?

The intensity of support needed by learners with SID guided me to explore Grade 1 teachers' pedagogical content knowledge (PCK) when teaching number sense to Grade 1 learners with severe intellectual disabilities. Although learners with SID experience challenges, teachers experience challenges when implementing the PCK. PCK covers 'what' to teach and 'how' to teach (Shing, Saat & Loke, 2015:1) and therefore it is important to look at the teachers' Knowledge of Content and Teaching; Knowledge of Content and Curriculum; and Knowledge of Content and Students (Ball et al., 2008:403). There will be 6 semi-structured individual interviews prior to 2 focus groups and it will be conducted with 6 participants in each group. Based on the participants preferences, the interviews will either be conducted face-to-face or on the online platform Zoom.

In this study the following questions will be explored:

Main research question

- How do teachers use PCK when they teach number sense to Grade 1 learners with SID?

Research sub-questions

- What training did teachers receive to use PCK when they teach number sense to Grade 1 learners with SID?
- How do teachers apply PCK when teaching number sense to learners with SID?
- What challenges do teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID?

Participants from the school

Your school has been invited to take part in this research because we believe that the teachers' input would be valuable in exploring their PCK when they teach number sense to Grade 1 learners with SID.

We invite knowledgeable teachers who are teaching a group of Grade 1 learners with SID in a public school for special educational needs in the Gauteng region to participate in the research.

What is expected of the participants?

The following data gathering method will be used:

Semi-structured individual interviews

The participants of school A will be asked to take part in an individual interview about their PCK when developing number sense for Grade 1 learners with SID. The semi-structured individual interview will take 40 minutes and address 12 questions. Depending on the participants' preferences, the interviews will be conducted on Zoom or in-person after school hours to ensure there is no interference with working hours. An agreed-upon time will be confirmed and scheduled with participants telephonically. If Zoom interviews are conducted, no video camera recordings will be done, however audio recordings will be done and participants will be asked to use pseudonyms (false names). All participants will receive their pseudonyms before the scheduled interview and the audio recordings will only be done if participants have agreed to it.

Focus-group interviews

The participants of school A will form part of the first focus-group. The participants will be asked to take part in a focus-group interview to discuss their PCK when developing number sense for Grade 1 learners with SID. One focus-group interview of 40 minutes with 12 questions. Depending on the participants' preferences, the interviews will be conducted on Zoom or in-person after school hours to ensure there is no interference with working hours. An agreed-upon time will be confirmed and scheduled with participants telephonically. If Zoom interviews are conducted, no video camera recordings will be done, however audio recordings will be done and participants will be asked to

use pseudonyms. All participants will receive their pseudonyms before the scheduled interview and the audio recordings will only be done if participants have agreed to it.

Benefits to the school from taking part in this research

The benefits for the participants in this research study are gaining insight and knowledge about developing number sense for Grade 1 learners with SID by exploring their own PCK which can benefit the teachers in instructing the CAPS for learners with SID.

The results will be shared with all the participants because everyone contributed to the findings. The results or findings should be used to benefit all participants and give them the opportunity to share and empower others with the knowledge gained.

The title, abstract and the research report summary will be placed on the GDE website to be accessed by the broader public while the bound hard cover copy will be placed in the GDE Reference Library located at Head Office where it may be accessed by all users of the Library. Only in very special circumstances will the Research Report be loaned out to users of the Library.

The researcher will present a short presentation on the purpose, findings and recommendations of her research to both GDE officials and the schools concerned.

Risks involved for the school taking part in this research

Teachers may feel vulnerable when they share their Knowledge of Content and Teaching, Knowledge of Content and Curriculum, and Knowledge of Content and Students and their personal PCK on 'what' to teach and 'how' to teach it, as well as their personal and emotional experiences and challenges when teaching Grade 1 learners with SID.

The risks will be limited by making sure that teachers are well informed about the nature of their participation and that they are aware of the fact that the aim of the research is not to assess teaching competence but rather to explore their PCK when developing and teaching number sense. All information will also be kept confidential.

If any participant experiences any form of stress after the interview and they experience a need for debriefing, they can contact Ms Heidi Kotze. She is a qualified social worker and she is working at a school for learners with SID. She also has her own practice, Moving Forward, for mediation and family solutions. Each participant will receive a business card with her contact information available.

There are more advantages for the participants in joining this study than there are disadvantages.

Confidentiality and protection of identity

All data obtained during the research will form part of the research and supervisors' content.

The participants will also be informed that all data, shall at all times hold in trust, keep confidential and not disclose to any third party or make any use of the confidential information beyond the focus-group interview for this research study. No information may be repeated to any other person.

Pseudonyms will be used to protect participants' identity.

Only the researcher and the supervisors will have access to the data. All research data will be locked away in locked cupboards within the researcher's office and all electronic data will be stored on the researcher's password protected laptop. Post-transcription of data, all recordings will be cleared from devices. All data will be stored for five years.

Dissemination of findings

The findings will be used for the purposes of writing a Master's dissertation and for the publication of articles in scientific journals.

The results will be shared with all the participants because everyone contributed to the findings. The results or findings should be used to benefit all participants and give them the opportunity to share and empower others with the knowledge gained.

The title, abstract and the research report summary will be placed on the GDE website to be accessed by the broader public while the bound hard cover copy will be placed in the GDE Reference Library located at Head Office where it may be accessed by all users of the Library. Only in very special circumstances will the Research Report be loaned out to users of the Library.

The researcher will present a short presentation on the purpose, findings and recommendations of her research to both GDE officials and the schools concerned.

If you have any further questions or enquiries regarding your participation in this research, please contact the researchers for more information.

Thank you very much for considering this request.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Labuschagne', with a stylized, cursive script.

Ms Lerecia Labuschagne

DECLARATION BY PRINCIPAL/OTHER RELEVANT PERSON:

By signing below, I agree to give permission for the research to take place with the identified participants in the study entitled:

Developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge

I declare that:

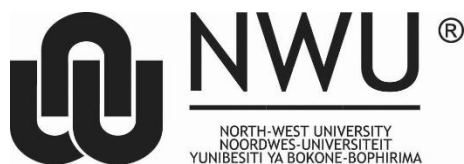
- I have read this information and consent form and understand what is expected of the participants in the research.
- I have had a chance to ask questions to the researcher and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and participants will not be pressurised to take part.
- Participants may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- Participants may be asked to leave the research process before it is completed, if the researcher feels it is in their best interests, or if they do not follow the research procedures, as agreed to.

Signed at (place) _____ on (date) ____/____/20____

Signature of School Principal

Researcher

APPENDIX C: CONSENT FORMS – SCHOOL GOVERNING BODY



Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222

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

Faculty of Education

(Edu-REC)

Tel: 018 299 4656

Email: Jako.Olivier@nwu.ac.za

Date:

Dear _____

GOODWILL PERMISSION: SCHOOL GOVERNING BODY/OTHER RELEVANT BODY

I herewith wish to request your permission for [details of participants] to participate in this research, which involves exploring teachers' pedagogical content knowledge (PCK) when developing number sense for Grade 1 learners with severe intellectual disabilities (SID). Prior to granting permission, please acquaint yourself with the information below.

The details of the research are as follows:

TITLE OF THE RESEARCH PROJECT:

Developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge

ETHICS APPLICATION NUMBER

NWU-01901-20-S2

PROJECT SUPERVISOR: Mariette Koen

CO-SUPERVISOR: Julia Alet Rens

CO-SUPERVISOR: Andri Schoonen

ADDRESS: Faculty of Education

Private bag X6001

Potchefstroom 2521

CONTACT NUMBER: +27 (0)18 285 2278

MEMBER OF PROJECT TEAM MEd-Student: Lerecia Labuschagne

ADDRESS: 47 Azalea Estate, Moepel Avenue, Roodekrans, Roodepoort

CONTACT NUMBER: +27 (0)73 765 3470

FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE

Contact person: Ms Erna Greyling, E-mail: Erna.Greyling@nwu.ac.za, Tel. (018) 299 4656

Grade 1 teachers teaching the eight- to nine-year-old learners with SID from your school are being invited to take part in a research study that forms part of a Masters study. Please take some time to read the information presented here, which will explain the details of this study. It is very important that you are fully satisfied and clearly understand what this research is about and how your school might be involved. Also, the participation of your school is entirely voluntary. If you say no, this will not affect your school negatively in any way whatsoever. Your school is also free to withdraw from the study at any given time, even though you agree to take part now.

This study has been approved by the Research Ethics Committee of the Faculty of Education of the North-West University and will be conducted according to the ethical guidelines of this committee. Permission was also asked from the provincial Department of Basic Education, School Governing Body, school principal as well as the teachers.

What is this research about?

The intensity of support needed by learners with SID guided me to explore Grade 1 teachers' pedagogical content knowledge when teaching number sense to Grade 1 learners with severe intellectual disabilities. Although learners with SID experience challenges, teachers experience challenges when implementing the PCK and therefore it is important to look at the teachers' Knowledge of Content and Teaching; Knowledge of Content and Curriculum; and Knowledge of Content and Students (Ball et al., 2008:403). Focus-group interviews will be conducted and semi-structured individual interviews with selected participants on the software programme, Zoom.

Main research question

How do teachers use PCK when they teach number sense to Grade 1 learners with SID?

Research sub-questions

What training did teachers receive to use PCK when they teach number sense to Grade 1 learners with SID?

How do teachers apply PCK when teaching number sense to learners with SID?

What challenges do teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID?

Participants from the school

Participants will be invited to take part in this research as we believe that the teachers' input would be valuable in exploring their PCK when they teach number sense to Grade 1 learners with SID.

We invite knowledgeable teachers who are teaching a group of Grade 1 learners with SID in a public school for special educational needs in the Gauteng region to participate in the research.

What is expected of the participants?

Semi-structured individual interviews

The participants of school A, B and C will be expected to take part in an individual interview about their PCK when developing number sense for Grade 1 learners with SID. One semi-structured individual interview of 40 minutes with 15 questions with the possibility of a follow up interview. The interviews will take place on Zoom and after school hours (14:30). A suitable time will be confirmed and scheduled with participants. Participants will decide for themselves the level of confidentiality and protection of identity. The Zoom camera will be switched off and the participants will be asked to rename their usernames to Teacher 1, Teacher 2 etc. All participants will receive their usernames before the scheduled interview. The interview will be recorded if granted permission from the participants.

Focus-group interviews

The participants of school A, B and C will form part of the first focus-group and school D, E and F will form part of the second focus-group. The participants will be expected to take part in a focus-group interview about their PCK when developing number sense for Grade 1 learners with SID. One focus-group interview of 40 minutes with 15 questions with the possibility of a follow up interview. The interviews will take place on Zoom and after school hours (14:30). A suitable time will be confirmed and scheduled with participants. Participants will decide for themselves the level of confidentiality and protection of identity. The Zoom camera will be switched off and the participants will be asked to rename their usernames to Teacher 1, Teacher 2 etc. All participants will receive their usernames before the scheduled interview. The interview will be recorded if granted permission from the participants.

Benefits to the participants

The benefits for the participants in this research study are gaining insight and knowledge about developing number sense for Grade 1 learners with SID by exploring their own PCK which can benefit the teachers in instructing the DCAPS learning programme.

The results will be shared with all the participants because everyone contributed to the findings. The results or findings should be used to benefit all participants and give them the opportunity to share and empower others with the knowledge gained.

The title, abstract and the research report summary will be placed on the GDE website to be accessed by the broader public while the bound hard cover copy will be placed in the GDE Reference Library located at Head Office where it may be accessed by all users of the Library. Only in very special circumstances will the Research Report be loaned out to users of the Library.

The researcher will present a short presentation on the purpose, findings and recommendations of her research to both GDE officials and the schools concerned.

Risks involved for participants

Teachers may feel vulnerable when they share their Knowledge of Content and Teaching, Knowledge of Content and Curriculum, and Knowledge of Content and Students and their personal PCK on 'what' to teach and 'how' to teach it, as well as their personal and emotional experiences and challenges when teaching Grade 1 learners with SID.

The risks will be limited by making sure that teachers are well informed about the nature of their participation and that they are aware of the fact that the aim of the research is not to assess teaching competence but rather to explore their PCK when developing and teaching number sense. All information will be kept confidential.

If any participant experiences some sort of distress after the interview and they experience a need for debriefing, they can contact Ms Heidi Kotze. She is a qualified social worker and she is working at a school for learners with SID. She also has her own practice, Moving Forward, for mediation and family solutions. Each participant will receive a business card with her contact information available.

There are more gains for the participants in joining this study than there are risks.

Confidentiality and protection of identity

The participants will be informed that any data such as answers, ideas or suggestions contributed by the participants during the focus-group interviews, belong to the researcher and the supervisors.

The participants will also be informed that all data, shall at all times hold in trust, keep confidential and not disclose to any third party or make any use of the confidential information beyond the focus-group interview for this research study. No information may be repeated to any other person.

To ensure the protection of identity of all participants the researcher will refer to the participants as teacher 1 and teacher 2 and referring to [REDACTED] as school A.

All the participants will be in control as they will decide for themselves the level of confidentiality and protection of identity.

Only the researcher and the supervisors will have access to the data. Data will be kept safe by locking hard copies in locked cupboards in the researcher's office and for electronic data it will be password protected. As soon as data has been transcribed, will be deleted from the recorders. All data will be stored for five years.

Dissemination of findings

The findings will be used for the purposes of writing a Master's dissertation and for the publication of articles in scientific journals.

The results will be shared with all the participants because everyone contributed to the findings. The results or findings should be used to benefit all participants and give them the opportunity to share and empower others with the knowledge gained.

The title, abstract and the research report summary will be placed on the GDE website to be accessed by the broader public while the bound hard cover copy will be placed in the GDE Reference Library located at Head Office where it may be accessed by all users of the Library. Only in very special circumstances will the Research Report be loaned out to users of the Library.

The researcher will present a short presentation on the purpose, findings and recommendations of her research to both GDE officials and the schools concerned.

If you have any further questions or enquiries regarding your participation in this research, please contact the researchers for more information.

Thank you very much for considering this request. Can you please communicate your decision to me via e-mail at lerecia7@gmail.com.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Labuschagne'. The signature is written in a cursive style with a large initial 'L' and a trailing flourish.

Ms Lerecia Labuschagne

DECLARATION BY CHAIR OF THE SCHOOL GOVERNING BODY:

By signing below, I agree to give permission for the research to take place with the identified participants in the study entitled:

Developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge

I declare that:

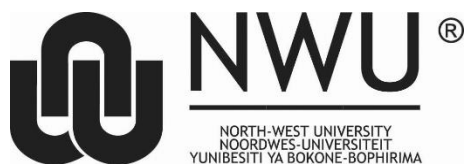
- I have read this information and consent form and understand what is expected of the participants in the research.
- I have had a chance to ask questions to the researcher and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and participants will not be pressurised to take part.
- Participants may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- Participants may be asked to leave the research process before it is completed, if the researcher feels it is in their best interests, or if they do not follow the research procedures, as agreed to.

Signed at (place) _____ on (date) ____/____/20____

Signature of SGB Chairperson

Researcher

APPENDIX D: CONSENT FORM – PARTICIPANTS: TEACHERS



Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222

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

Faculty of Education

(Edu-REC)

Tel: 018 299 4656

Email: Jako.Olivier@nwu.ac.za

Date:

Dear Colleague

INFORMED CONSENT DOCUMENTATION FOR GRADE 1 TEACHERS FOR FOCUS-GROUP INTERVIEWS AND SEMI-STRUCTURED INDIVIDUAL INTERVIEWS WITH SELECTED PARTICIPANTS

I herewith wish to request your permission for [details of participants] to participate in this research, which involves developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge. Prior to granting permission, please acquaint yourself with the information below.

The details of the research are as follows:

TITLE OF THE RESEARCH PROJECT:

Developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge

ETHICS APPLICATION NUMBER

NWU-01901-20-S2

PROJECT SUPERVISOR: Mariette Koen

CO-SUPERVISOR: Julia Alet Rens

CO-SUPERVISOR: Andri Schoonen

ADDRESS: Faculty of Education

Private bag X6001

Potchefstroom 2521

CONTACT NUMBER: +27 (0)18 285 2278

MEMBER OF PROJECT TEAM MEd-Student: Lerecia Labuschagne

ADDRESS: 47 Azalea Estate, Moepel Avenue, Roodekrans, Roodepoort

CONTACT NUMBER: +27 (0)73 765 3470

FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE

Contact person: Ms Erna Greyling, E-mail: Erna.Greyling@nwu.ac.za, Tel. (018) 299 4656

Dear Colleague

You are being invited to take part in a research study that forms part of a Masters study. Please take some time to read the information presented here, which will explain the details of this study. It is very important that you are fully satisfied that you clearly understand what this research is about and how your school might be involved. Also, 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 do agree to take part now.

This study has been approved by the Research Ethics Committee of the Faculty of Education of the North-West University and will be conducted according to the ethical guidelines of this committee. Permission was also asked from the Gauteng Department of Basic Education, School Governing Body, school principal as well as teachers.

What is this research about?

The intensity of support needed by learners with SID guided me to explore Grade 1 teachers' pedagogical content knowledge when teaching number sense to Grade 1 learners with severe intellectual disabilities. Although learners with SID experience challenges, teachers experience challenges when implementing the PCK and therefore it is important to look at the teachers' Knowledge of Content and Teaching; Knowledge of Content and Curriculum; and Knowledge of Content and Students (Ball et al., 2008:403). Focus-group interviews will be conducted and semi-structured individual interviews with selected participants on the software programme, Zoom.

Main research question

How do teachers use PCK when they teach number sense to Grade 1 learners with SID?

Research sub-questions

What training did teachers receive to use PCK when they teach number sense to Grade 1 learners with SID?

How do teachers apply PCK when teaching number sense to learners with SID?

What challenges do teachers experience when applying PCK when teaching number sense to Grade 1 learners with SID?

Participants

You have been invited to take part in this research because we believe you are a knowledgeable teacher who are teaching a group of Grade 1 learners with SID in a public school for special educational needs in the Gauteng region.

What is expected of you as participant?

Semi-structured individual interviews

The participants of school A, B and C will be expected to take part in an individual interview about their PCK when developing number sense for Grade 1 learners with SID. One semi-structured individual interview of 40 minutes with 8 questions with the possibility of a follow up interview. The interviews will take place on Zoom and after school hours (14:30). A suitable time will be confirmed and scheduled with participants. Participants will decide for themselves the level of confidentiality and protection of identity. The Zoom camera will be switched off and the participants will be asked to rename their usernames to Teacher 1, Teacher 2 etc. All participants will receive their usernames before the scheduled interview. The interview will be recorded if granted permission from participants.

Focus-group interviews

The participants of school A, B and C will form part of the first focus-group and school D, E and F will form part of the second focus-group. The participants will be expected to take part in a focus-group interview about their PCK when developing number sense for Grade 1 learners with SID. One focus-group interview of 40 minutes with 8 questions with the possibility of a follow up interview. The interviews will take place on Zoom and after school hours (14:30). A suitable time will be confirmed and scheduled with participants. Participants will decide for themselves the level of confidentiality and protection of identity. The Zoom camera will be switched off and the participants will be asked to rename their usernames to Teacher 1, Teacher 2 etc. All participants

will receive their usernames before the scheduled interview. The interview will be recorded if granted permission from participants.

Benefits to you as participant

The benefits for the participants in this research study are gaining insight and knowledge about developing number sense for Grade 1 learners with SID by exploring their own PCK which can benefit the teachers in instructing the CAPS for learners with SID.

The results will be shared with all the participants because everyone contributed to the findings. The results or findings should be used to benefit all participants and give them the opportunity to share and empower others with the knowledge gained.

The title, abstract and the research report summary will be placed on the GDE website to be accessed by the broader public while the bound hard cover copy will be placed in the GDE Reference Library located at Head Office where it may be accessed by all users of the Library. Only in very special circumstances will the Research Report be loaned out to users of the Library.

The researcher will present a short presentation on the purpose, findings and recommendations of her research to both GDE officials and the schools concerned.

Risks involved for participants

Teachers may feel vulnerable when they share their Knowledge of Content and Teaching, Knowledge of Content and Curriculum, and Knowledge of Content and Students and their personal PCK on 'what' to teach and 'how' to teach it, as well as their personal and emotional experiences and challenges when teaching Grade 1 learners with SID.

The risks will be limited by making sure that teachers are well informed about the nature of their participation and that they are aware of the fact that the aim of the research is not to assess teaching competence but rather to explore their PCK when developing and teaching number sense. All information will also be kept confidential.

If any participant experiences some sort of distress after the interview and they experience a need for debriefing, they can contact Ms Heidi Kotze. She is a qualified social worker and she is working at a school for learners with SID. She also has her own practice, Moving Forward, for mediation and family solutions. Each participant will receive a business card with her contact information available.

There are more gains for the participants in joining this study than there are risks.

Confidentiality and protection of identity

The participants will be informed that any data such as answers, ideas or suggestions contributed by the participants during the focus-group interviews, belong to the researcher and the supervisors.

The participants will also be informed that all data, shall at all times hold in trust, keep confidential and not disclose to any third party or make any use of the confidential information beyond the focus-group interview for this research study. No information may be repeated to any other person.

To ensure the protection of identity of all participants the researcher will refer to the participants as teacher 1 and teacher 2 and referring to The Gateway School as school A.

All the participants will be in control as they will decide for themselves the level of confidentiality and protection of identity.

Only the researcher and the supervisors will have access to the data. Data will be kept safe by locking hard copies in locked cupboards in the researcher's office and for electronic data it will be password protected. As soon as data has been transcribed, will be deleted from the recorders. All data will be stored for five years.

Dissemination of findings

The results will be shared with all the participants because everyone contributed to the findings. The results or findings should be used to benefit all participants and give them the opportunity to share and empower others with the knowledge gained.

The title, abstract and the research report summary will be placed on the GDE website to be accessed by the broader public while the bound hard cover copy will be placed in the GDE Reference Library located at Head Office where it may be accessed by all users of the Library. Only in very special circumstances will the Research Report be loaned out to users of the Library.

The researcher will present a short presentation on the purpose, findings and recommendations of her research to both GDE officials and the schools concerned.

If you have any further questions or enquiries regarding your participation in this research, please contact the researchers for more information.

Thank you very much for considering this request. Can you please communicate your decision to me via e-mail at lerecia7@gmail.com.

Yours sincerely



Ms Lerecia Labuschagne

DECLARATION BY PARTICIPANT:

By signing below, I agree to take part in a research study entitled:

Developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge

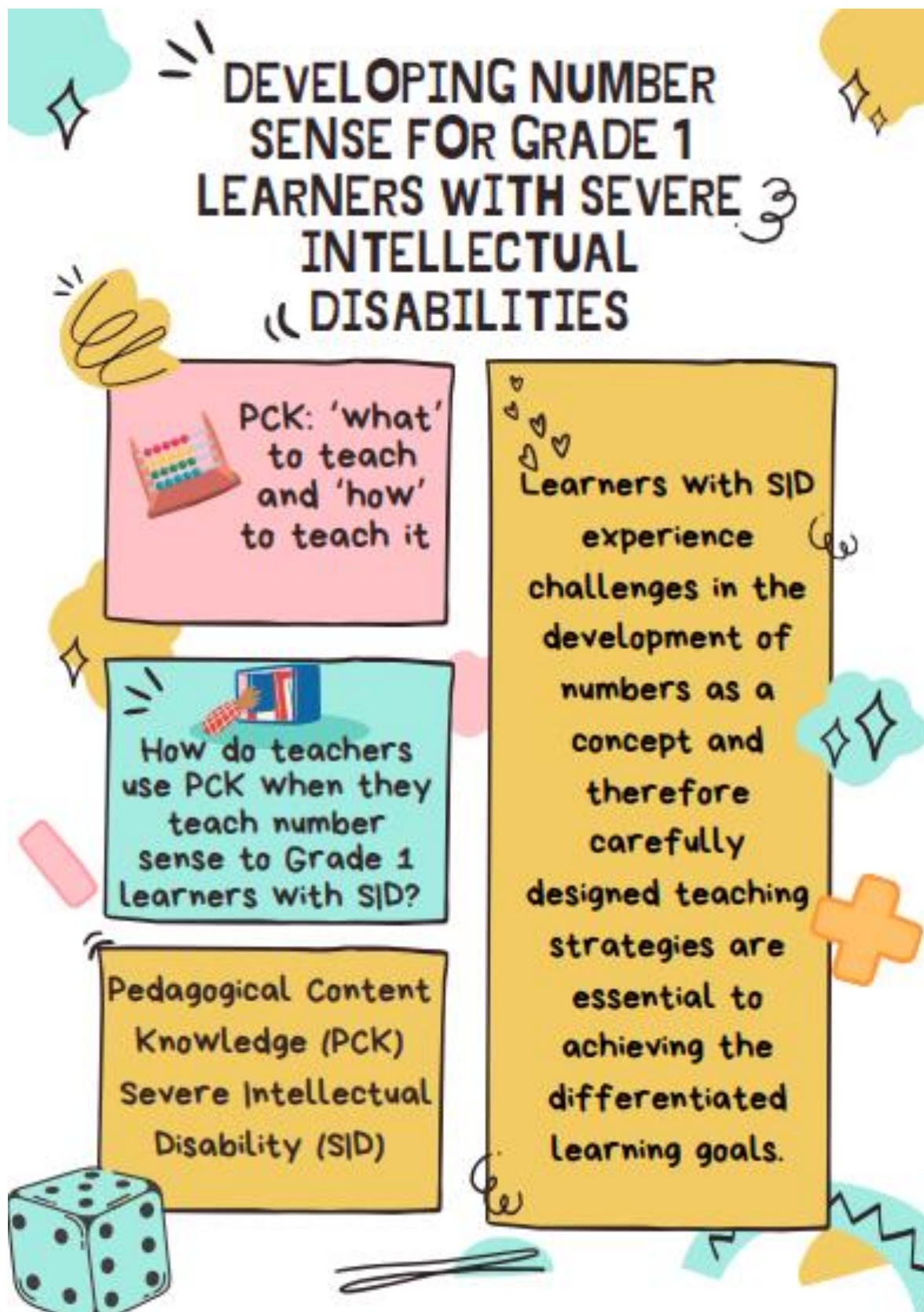
I declare that:

- I have read this information and consent form and understand what is expected of me in the research.
- I have had a chance to ask questions to the researcher and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the research process before it has finished, if the researcher feels it is in my best interests, or if I do not follow the research procedures, as agreed to.
- I grant permission to record the focus-group interviews and semi-structured individual interviews on the online platform, Zoom.

Signed at (place)_____ on (date) ____/____/20____

Signature of participant

Researcher



Developing number sense for Grade 1 learners with severe intellectual disabilities

Ms L Labuschagne is conducting a study on exploring teachers' PCK when developing number sense for Grade 1 learners with SID.

We are looking for Grade 1 teachers teaching learners with SID in the Gauteng province.

For more information about this research study, please contact Lerecia Labuschagne on 0737653470 or lerecia7@gmail.com

What is involved in this study?

After completing a consent form, participating teachers will take part in a focus-group interview.

Points of discussion are the three sub-categories of the PCK:

- Teaching strategies
- Curriculum: (CAPS for learners with SID)
- Learners with SID

APPENDIX F: LESSON PLAN TEMPLATE



Situasie analise / Situation analysis:	
Beskryf kortliks die aantal leerders, klaskamer uitlig, seating position (sitposisie), verskillende gestremdhede in die klaskamer (Learners with SID).	Ontwikkeling ouderdom / Developmental age:
	Kronologies ouderdom / Chronological age:

VAK / SUBJECT:	Wiskunde / Mathematics	LESONDERWERP / TOPIC	
TEMA/THEME (Sien CAPS for Learners with SID)		DATUM / DATE:	TYDSDUUR / DURATION:
LESDOELWIT/ LESSON AIM: Know number symbols, number values and number names (Kies 'n spesifieke getal / Choose a specific number)			
Kennis / Knowledge:	(kies watter) Faktiese kennis / Factual knowledge Prosedurele kennis / Procedural knowledge Meta-Kognitiewe kennis / Meta-cognitive knowledge		
Vaardighede / Skills:	(kies watter) Meta-Kognitiewe kennis / Meta-cognitive knowledge Uitvoer/carry out Uitvoering/executing Gebruik/using		
Teaching Strategies / Onderrigstrategieë:	Noem onderrigstrategie / Name teaching strategy Repetition / Pair Work / Maths Games / Manipulation Tools / Technology ect.		
INTEGRASIE / INTEGRATION: Noem / Mention: integrasie met 'n ander lesonderwerp / integration with other topics. bv. 'patterns, functions and algebra'		BRONNE: Boeke, prente, apparaat ens RESOURCES: Books, pictures, apparatus	
UITGEBREIDE GELEENTHEDE/ EXPANDED OPPORTUNITIES- Low Support Learners (Each learner should be taught and supported according to their level of support needed (low support group). Explain the expanded learning opportunity or activity.		STRUIKELBLOKKE T.O.V. LEER/ BARRIERS TO LEARNING – High Support Learners (Each learner should be taught and supported according to their level of support needed (high support group). Explain the support learning opportunity or activity.	

INHOUD / CONTENT	ONDERWYSER-AKTIVITEITE Teacher activities	LEERDERAKTIVITEITE Learner activities	ASSESSING/ ASSESSMENT (Merk slegs die toepaslike blokkies/ Only tick the applicable blocks)																																																																																							
1. INLEIDENDE FASE / INTRODUCTORY PHASE:																																																																																										
1.1 Konteksskepping / Create context: Skep 'n atmosfeer en konteks vir die les / Create context for the lesson			<table><tr><td colspan="2">1. Metodes/Methods :</td><td></td></tr><tr><td>Self/self:</td><td></td><td>Onderwyser/teacher:</td></tr><tr><td>Mekaar/peer:</td><td></td><td>Groep/group:</td></tr><tr><td colspan="2">2. Tegnieke/Techniques:</td><td></td></tr><tr><td colspan="2">Observasie/observation:</td><td></td></tr><tr><td colspan="2">Opdrag/assignment</td><td></td></tr><tr><td colspan="2">Toets/test</td><td></td></tr><tr><td colspan="2">Eksamen/examination</td><td></td></tr><tr><td colspan="2">Rolspel/roleplay</td><td></td></tr><tr><td colspan="2">Ondersoek/ exploring</td><td></td></tr><tr><td colspan="2">Praktiese take/practical assignments:</td><td></td></tr><tr><td colspan="2">Gevallestudie/case study</td><td></td></tr><tr><td colspan="2">Demonstrasie/demonstration</td><td></td></tr><tr><td colspan="2">Onderhoude/interviews</td><td></td></tr><tr><td colspan="2">Opnames/surveys</td><td></td></tr><tr><td colspan="2">3. Vorm/Form:</td><td></td></tr><tr><td>Basislyn/baseline:</td><td></td><td>Formatief/ formative:</td></tr><tr><td>Diagnosties/diagnostic:</td><td></td><td>Summatief/summative</td></tr><tr><td colspan="2">4. Instrumente/instruments:</td><td></td></tr><tr><td colspan="2">Vraelys/ questionnaire</td><td></td></tr><tr><td colspan="2">Rubriek/ rubric</td><td></td></tr><tr><td colspan="2">Vraestel/questionpaper</td><td></td></tr><tr><td colspan="2">Memorandum/ memo</td><td></td></tr><tr><td colspan="2">Afmekings/ checklist</td><td></td></tr><tr><td colspan="2">Werkkaart/worksheet</td><td></td></tr><tr><td colspan="2">Antwoordstel/ answerpaper</td><td></td></tr><tr><td colspan="2">Observasielys/ observationlist</td><td></td></tr><tr><td colspan="2">Ander (spesifiseer)/ Other (specify)</td><td></td></tr><tr><td colspan="2"></td><td></td></tr></table>	1. Metodes/Methods :			Self/self:		Onderwyser/teacher:	Mekaar/peer:		Groep/group:	2. Tegnieke/Techniques:			Observasie/observation:			Opdrag/assignment			Toets/test			Eksamen/examination			Rolspel/roleplay			Ondersoek/ exploring			Praktiese take/practical assignments:			Gevallestudie/case study			Demonstrasie/demonstration			Onderhoude/interviews			Opnames/surveys			3. Vorm/Form:			Basislyn/baseline:		Formatief/ formative:	Diagnosties/diagnostic:		Summatief/summative	4. Instrumente/instruments:			Vraelys/ questionnaire			Rubriek/ rubric			Vraestel/questionpaper			Memorandum/ memo			Afmekings/ checklist			Werkkaart/worksheet			Antwoordstel/ answerpaper			Observasielys/ observationlist			Ander (spesifiseer)/ Other (specify)					
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1.3 Probleemstelling Problem statement Stel 'n duidelike probleem wat as inleiding dien vir die nuwe inhoud (gewoonlik in die vorm van 'n vraag. / State a problem as introduction to the content of your lesson (usually a question)																																																																																										

2. AANBIEDINGSFASE / PRESENTATION PHASE: ONDERRIG EN LEERFASE / Teaching and learning phase			ASSESSING/ ASSESSMENT (Merk slegs die toepaslike blokkies/ Only tick the applicable blocks)											
2.1 Ontsluiting van nuwe leerinhoud <i>Exposition of new knowledge</i> Nuwe inhoud wat ek gaan aanleer. Skryf volledig uit. <i>New work that you want to present. Write out in full.</i>			1. Metodes/Methods : <table border="1"> <tr> <td>Self/self:</td> <td>Onderwyser/teacher:</td> </tr> <tr> <td>Mekaar/peer:</td> <td>Groep/group:</td> </tr> </table> 2. Tegnieke/Techniques: Observasie/observation: Opdrag/assignment Toets/test Eksamen/examination Rolspel/roleplay Ondersoek/ exploring Praktiese take/practical assignments: Gevallestudie/case study Demonstrasie/demonstration Onderhoude/interviews Opnames/surveys 3. Vorm/Form: <table border="1"> <tr> <td>Basislyn/baseline:</td> <td>Formatief/ formative:</td> </tr> <tr> <td>Diagnosties/diagnostic</td> <td>Summatief/summative</td> </tr> <tr> <td>:</td> <td></td> </tr> </table> 4. Instrumente/instruments: Vraelys/ questionnaire Rubriek/ rubric Vraestel/questionpaper Memorandum/ memo Afmerkllys/ checklist Werkskaart/worksheet Antwoordstel/ answerpaper Observasielys/ observationlist Ander (spesifiseer)/ other (specify) 		Self/self:	Onderwyser/teacher:	Mekaar/peer:	Groep/group:	Basislyn/baseline:	Formatief/ formative:	Diagnosties/diagnostic	Summatief/summative	:	
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Diagnosties/diagnostic	Summatief/summative													
:														
2.2 Toepassing van nuwe kennis/ <i>Functionalisation</i> Na my les gee ek 'n opdrag om te kyk of leerders verstaan het wat ek verduidelik het. Skryf volledig uit wat opdrag behels. <i>After the lesson an assignment is given to determine if the learners understood. Include content of the assignment.</i>			(This section is merged into the previous row's assessment table)											

3. AFSLUITINGSFASE / AFLOOPFASE			ASSESSERING/ ASSESSMENT (Merk slegs die toepaslike blokkies/ Only tick the applicable blocks)	
3.1 Lesafsluiting/ Conclusion of lesson Vra 'n vraag/vrae oor die inhoud of doen 'n aktiwiteit waardeur bepaal kan word of leerders die werk bemeester het. /Ask a question(s) about the lesson content or do a quick excersice to see if the learners mastered the work.			1. Metodes/Methods :	
			Self/self:	Onderwyser/teacher:
			Mekaar/peer:	Groep/group:
			2. Tegnieke/Techniques:	
			Observasie/observation:	
			Opdrag/assignment	
			Praktiese take/practical assignments:	
			Opnames/surveys	
			3. Vorm/Form:	
			Basislyn/baseline:	Formatief/ formative:
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			Memorandum/ memo	
			Observasielys/ observationlist	
			Ander (spesifiseer)/ Other (specify)	
3.2 Huiswerk / Homework Laat leerders iets gaan uitvind by die huis of prente uitknip. Die aktiwiteit moet aansluit by nuwe inhoud. /Let learners do research, or cut out pictures. The activity should have something to do with the new content.				

4. REFLEKSIE OP LES/ REFLECTION ON LESSON (Participant completes this section after the lesson)

4.1 Refleksie/ Reflection

Het jy met die les bereik wat jy beplan het? Waar kan jy verbeter? Wat was die sterkpunte van die aanbieding? Wat sal jy verander? Wat sal jy byvoeg? Did you reach your aim for the lesson? How can you improve your lesson? What would you like to change about the lesson? What did you like about the lesson? What would you add to the lesson?

4.2 Opmerkings/ Wenke ter verbetering / Remarks/ Ideas for improvement

Wat is moeilik (uitdagend) om te onderrig en hoe kan jy dit verbeter? / What is difficult to teach and how can you improve it?

APPENDIX G: SEMI-STRUCTURED INDIVIDUAL INTERVIEW GUIDE FOR TEACHERS

1. Describe the typical profile of Grade 1 learners in your classroom in terms of abilities, developmental level and motivation to learn?
2. How do you organise your classroom and adapt your lesson plans to accommodate all unique needs of learners when teaching number sense to Grade 1 learners with SID?
3. What teaching strategies do you use to teach the sub-set “numbers, number operations and relationships”?
4. Name the resources that you use to teach number sense in your classroom.
 - 4.1 Explain how you use these resources to teach number sense.
5. Which skills did you acquire during initial training to teach learners with SID in the Foundation Phase?
 - 5.1 How did your initial training prepare you to apply these skills in the classroom?
 - 5.2 What gaps can you identify in your training to prepare teachers for teaching learners with SID?
6. What prior knowledge do teachers need to instil before teaching number sense?
7. What challenges do you experience when accommodating the individual needs of Grade 1 learners with SID when developing number sense?

APPENDIX H: FOCUS GROUP INTERVIEW GUIDE FOR TEACHERS

1. Which outcome in the general content focus area of numbers sense development do you find challenging to teach?
2. Why is it challenging to teach?
3. Name the difficulties and knowledge limitations you, as a teacher, experience when teaching the concept of numbers.
4. How do you address learners' prior knowledge in your lesson planning and presentation?
5. What barriers to learning do learners with SID experience in developing a concept of numbers?
6. How do you address and overcome these barriers to learning in your classroom?
7. Why is it important for learners to develop a concept of numbers?

APPENDIX I: LESSON PLAN ANALYSIS

Lesplan/Lesson Plan (C1)

Situasie analise / Situation analysis:	
10 leerders: Classroom Organisation and Management 5 = cp, 1 = cp + right hemi + epilepsy, 1 = spina Bifida, 3 = Spastic diplegia. Profile 1 leerder word vasgestrap op sy stoel by 'n tafel met voetbankie. 3 rolstoel by verstelbare tafels, 6 stoele en tafels. Classroom Organisation and Management Leerders sit in 2 verskillende groepe volgens vermoëns. (6 en 4 in groepe) Al 10 leerders Sivere Intellectual disabled. Barriers to Learning	Ontwikkeling ouderdom / Developmental age: Grade 1 4-5 jaar Profile Kronologies ouderdom / Cronological age: 8 jaar Profile



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NOORDWES-UNIVERSITEIT
POTCHEFSTROOMKAMPUS

VAK / SUBJECT:	Wiskunde	LESONDERWERP/ TOPIC	Number, Operations and Relationships Ontwikkel van getalbegrip / Development of number sense
TEMA/THEME		DATUM / DATE:	TYDSDUUR / DURATION:
Number range: 1 to 7. Incidental counting using number rhymes and songs, concrete objects counters, counting with body movements. Count in ones, forwards and backwards from any given number between 1-7 CAPS for Learners with SID			45 minute CAPS for Learners with SID
LESDOELWIT/ LESSON AIM: Know number symbols, number values and number names <i>getal 7</i> Developing Number Sense			
Kennis / Knowledge:	Feitlike kennis Prosedurele kennis		
Vaardighede / Skills:	Uitvoering Gebruik		
Teaching Strategies / Onderrigstrategieë:	Herhaling Strategies Visualisering Strategies Numbers songs and rhymes Resources Differensiasie Strategies		
INTEGRASIE / INTEGRATION:		BRONNE: RESOURCES	
Datahantering – collect and sort numbers. Houers met getalle op. Kaartjies met kolle en of getalle op. Moet kaartjies in reg houers plaas. Strategies		getallekaart, getallyn, kalender, konkretetellers, klei, chalk borde, lego Resources	

UITGEBREIDE GELEENTHEDE/ EXPANDED OPPORTUNITIES- Low Support Learners <i>Herhaling. Klap, voete stamp ens. van gegewe getalle, uittel van pomp poms met tweezers Strategies</i>			STRUIKELBLOKKE T.O.V. LEER/ BARRIERS TO LEARNING – High Support Learners <i>Aandagafleibaar, konsentrasie is beperk. Leerder moet numeries korrek tel terwyl juf besig is met iets anders, selfs gesig trek. Handfunksies is beperk – hand oor hand hulpverlening met die skryf van getalle Profile</i>																																																																																						
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1. INLEIDENDE FASE / INTRODUCTORY PHASE:																																																																																									
1.1 Konteksskepping / Create context: <i>Raai hoeveel leerders is in die klas vandag. Tel en kyk wie het reggeraal. Tel van 1-6. Tel van 6-0. Sing number songs and rhymes – hulle geniet dit. Strategies</i>		<i>Probleemstelling Waarneming</i>	<i>Meelewing Interaksie Raai Tel</i>		<table><tr><td colspan="3">1. Metodes/Methods :</td><td></td></tr><tr><td>Self/self:</td><td></td><td>Onderwyser/teacher:</td><td>x</td></tr><tr><td>Mekaar/peer:</td><td></td><td>Groep/group:</td><td></td></tr><tr><td colspan="3">2. Tegnieke/Techniques:</td><td></td></tr><tr><td colspan="3">Observasie/observation:</td><td>x</td></tr><tr><td colspan="3">Opdrag/assignment</td><td></td></tr><tr><td colspan="3">Toets/test</td><td></td></tr><tr><td colspan="3">Eksamen/examination</td><td></td></tr><tr><td colspan="3">Rolspel/roleplay</td><td></td></tr><tr><td colspan="3">Ondersoek/ exploring</td><td></td></tr><tr><td colspan="3">Praktiese take/practical assignments:</td><td>x</td></tr><tr><td colspan="3">Gevallestudie/case study</td><td></td></tr><tr><td colspan="3">Demonstrasie/demonstration</td><td></td></tr><tr><td colspan="3">Onderhoude/interviews</td><td></td></tr><tr><td colspan="3">Opnames/surveys</td><td></td></tr><tr><td colspan="3">3. Vorm/Form:</td><td></td></tr><tr><td>Basislyn/baseline:</td><td></td><td>Formatief/ formative:</td><td></td></tr><tr><td>Diagnosties/diagnostic:</td><td></td><td>Summatief/summative</td><td></td></tr><tr><td colspan="3">4. Instrumente/instruments:</td><td></td></tr><tr><td colspan="3">Vraelys/ questionnaire</td><td></td></tr><tr><td colspan="3">Rubriek/ rubric</td><td></td></tr></table>	1. Metodes/Methods :				Self/self:		Onderwyser/teacher:	x	Mekaar/peer:		Groep/group:		2. Tegnieke/Techniques:				Observasie/observation:			x	Opdrag/assignment				Toets/test				Eksamen/examination				Rolspel/roleplay				Ondersoek/ exploring				Praktiese take/practical assignments:			x	Gevallestudie/case study				Demonstrasie/demonstration				Onderhoude/interviews				Opnames/surveys				3. Vorm/Form:				Basislyn/baseline:		Formatief/ formative:		Diagnosties/diagnostic:		Summatief/summative		4. Instrumente/instruments:				Vraelys/ questionnaire				Rubriek/ rubric			
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1.2 Aktualisering van voorkennis / Actualisation of prior knowledge <i>Elke leerder trek 'n getal. Wys en sê getal. Moet dieselfde hoeveelheid keer hande klap terwyl hy hardop tel. Pak getalkaart uit op die bord. Leerders moet tel soos dit op die bord verskyn. (1-6) Is dit reg of verkeerd? Orden getalle. Tel weer.</i>		<i>Probleemstelling Waarneming/observasie Strategies</i>	<i>Meelewing Interaksie "lees" getal Klap dieselfde hoeveelheid as getal Tel</i>																																																																																						

1.3 Probleemstelling <i>Problem statement</i> <i>Een leerder tel 6 lego blokke uit. Almal tel saam. Ander leerder wys waar 6 op getalkaarte is, ander leerder skryf op die bord getal 6. Leerders wys hoeveel vingers. Leerders tel eie 6 tellers uit. Wys getal 6 op getallelyn. Leerders wat kan skryf, skryf 6 op chalk borde.</i> <i>Watter getal kom na 6.</i> Developing Number Sense	<i>Probleemstelling</i> <i>Waarneming/observasie</i>	<i>Meelewing</i> <i>Interaksie</i> <i>Waarneming</i> <i>Uittel van tellers</i>	<table><tr><td>Vraestel/questionpaper</td><td></td></tr><tr><td>Memorandum/ memo</td><td></td></tr><tr><td>Afmerklys/ checklist</td><td>x</td></tr><tr><td>Werkkaart/worksheet</td><td></td></tr><tr><td>Antwoordstel/ answerpaper</td><td></td></tr><tr><td>Observasielys/ observationlist</td><td>x</td></tr><tr><td>Ander (spesifiseer)/ Other (specify)</td><td></td></tr><tr><td></td><td></td></tr></table>	Vraestel/questionpaper		Memorandum/ memo		Afmerklys/ checklist	x	Werkkaart/worksheet		Antwoordstel/ answerpaper		Observasielys/ observationlist	x	Ander (spesifiseer)/ Other (specify)			
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2. AANBIEDINGSFASE / PRESENTATION PHASE: ONDERRIG EN LEERFASE / Teaching and learning phase			ASSESSING/ ASSESSMENT (Merk slegs die toepaslike blokkies/ Only tick the applicable blocks)		
2.1 Ontsluiting van nuwe leerinhoud <i>Exposition of new knowledge</i> <i>Watter getal kom na 6. Sit 1 groot lego by die 6 legos. Almal tel saam. Klap, stamp voete ens.7. Elke leerder tel 7 verskillende konkrete voorwerpe uit. Developing Number Sense</i>	<i>Probleemstelling</i> <i>Waarneming/observasie</i>	<i>Meelewing</i> <i>Interaksie</i> <i>Waarneming</i> <i>Uittel van tellers</i>	1. Metodes/Methods :		
			Self/self:	Onderwyser/teacher:	x
2.2 Toepassing van nuwe kennis/ <i>Functionalisation</i> <i>Wys getal 7 op getallyn, getalkaarte, maak 'n 7 met klei, skryf op chalk bord, vind getal 7 tussen ander getalle, tel 7 voorwerpe uit. Wys sewe vingers. Wys met vingers wat kom na 6. Developing Number Sense</i>	<i>Probleemstelling</i> <i>Waarneming/observasie</i>	<i>Meelewing</i> <i>Interaksie</i> <i>Waarneming</i> <i>Uittel van tellers</i> <i>Herkenning</i>	2. Tegnieke/Techniques:		
			Observasie/observation:		x
			Opdrag/assignment		
			Toets/test		
			Eksamen/examination		
			Rolspel/roleplay		
			Ondersoek/ exploring		x
			Praktiese take/practical assignments:		
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			Observasielys/ observationlist		x
			Ander (spesifiseer)/ other (specify)		

3. AFSLUITINGSFASE / AFLOOPFASE			ASSESSERING/ ASSESSMENT (Merk slegs die toepaslike blokkies/ Only tick the applicable blocks)			
3.1 Lesafsluiting/ Conclusion of lesson <i>Juf gee 'n getal, leerder klap op die regte getal met 'n plastiekplak. Verbind die getalle in die regte volgorde. (Hoofakt) Orden getalle 1-7 en kollekaarte met eie getalkaarte. Developing Number Sense</i>			1. Metodes/Methods :			
			Self/self:	Onderwyser/teacher:		x
			Mekaar/peer:	Groep/group:		
			2. Tegnieke/Techniques:			
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			Praktiese take/practical assignments:			x
			Opnames/surveys			
			3. Vorm/Form:			
			Basislyn/baseline:	Formatief/ formative:		
3.2 Huiswerk / Homework <i>Ons gee nie huiswerk nie...maar leerder kam 7 klein klipies of stokkies in 'n sakkie skool toe bring.</i>			Diagnosties/diagnostic:	Summatief/summative:		
			4. Instrumente/instruments:			
			Vraelys/ questionnaire			
			Rubriek/ rubric			
			Memorandum/ memo			
			Observasielys/ observationlist			x
			Ander (spesifiseer)/ Other (specify)			

4. REFLEKSIE OP LES/ REFLECTION ON LESSON (Participant completes this section after the lesson)	
4.1 Refleksie/ <i>Reflection</i>	
4.2 Opmerkings/ Wenke ter verbetering / <i>Remarks/ ideas for improvement</i>	

APPENDIX J: TRANSCRIPT OF A SEMI-STRUCTURED INDIVIDUAL INTERVIEW

Participant	Conversation	Coding
Lerecia	Describe the typical profile of Grade 1 learners in your classroom in terms of abilities, developmental level and motivation to learn? <i>Beskryf die tipiese profiel van Graad 1-leerders in jou klaskamer in terme van vermoëns, ontwikkelingsvlak en hul motivering om te leer?</i>	
B1	Goed, ek het kindertjies tussen 8 en 9 jaar oud. Hulle is almal gediagnoseer met ASD en van hulle uhm ADHD ook. So, ons sit met kindertjies wat regtig hoë “support” uhm ondersteuning nodig het. Uhm, so vir my voel dit vir my of hulle almal nogal intense leer behoeftes, maar hulp in leer nodig. As dit jou vraag antwoord.	Learners with SID Profile Barriers to Learning
Lerecia	<i>En dan hulle ontwikkelingsvlak. Is hulle op 'n tipiese ontwikkelingsvlak van 'n 8 tot 9 jarige?</i>	
B1	Uhm, nee meeste van my outjies is op 'n laer, veral intellektuele vlak, uhm, taal veral, taal vermoë, is almal op 'n laer ontwikkelingsvlak as wat hulle ouderdom is. As hulle kronologiese ouderdom.	Profile
Lerecia	<i>En dan hulle motivering om te leer?</i>	
B1	Baie laag, omdat hulle so sukkel om te konsentreer het hulle ongelooflik baie motivering nodig om te leer en natuurlik veral “prompting”. Terug na die taak die hele tyd. Veral in groepaktiwiteite is hulle aandagafleibaarheid veral hoog. So die heeltid moet ons hulle motiveer om op die taak te fokus en uhm ingestel te wees op die op die aanbieding van die les.	Barriers to Learning
Lerecia	<i>Hoe motiveer jy hulle? Watter hulpbronne gebruik julle om die leerders te motiveer?</i>	
B1	Uhm, goed veral gedrag want vir my gaan dit oor om 'n kindjie op 'n plek te kry waar hy rustig is kan hy leer. So, ons het ek het in my klas spesifiek die verskillende sones waarin hulle as hulle hier inkom in die oggende en hulle is wild en woelig dan gebruik ons 'n oomblikkie om net diep asem te haal of die emosionele goeie vlak te kom en dan kan die kindertjies hulle self in die sones kan plaas. En sê nou maar die kind plaas homself in 'n sone waar hy hartseer is of angstig is ensovoort dan bespreek ons dit gou-gou dan gee ons vir hulle kans om uhm hulle self te ontlai basies sodat hulle op 'n vlak kom	Strategies Classroom Organisation

	waar hulle oop is om te leer. En sodat hulle almal net rustig is en dan het ons byvoorbeeld 'n motiveringskaart waar hulle glimlag gesiggie kry wanneer hulle hulself gedra so ons ons het 'n paar goed in plek en dit is net om die emosies in beheer te kry om hulle gereed te maak vir leer. As dit jou vraag beantwoord.	and Management
Lerecia	<i>Ja, ek wil net graag weet oor die sones waarna verwys jy?</i>	
B1	Goed, ons sonekaart werk so. Daar is byvoorbeeld uhm verskillende emosies wat met kleure geassosieer word. Uhm, en dan in die oggende nadat ons ons verwelkoming gedoen het en onself net op dieselfde vlak gekry het. Gee ek elkeen se foto'tjies vir hulle. Dan kan hulle hulself hulle emosie gaan identifiseer. Groen, "the green sone is at peace. I am calm. I am ready to learn". So ons doelwit is dat 'n kind in die groen sone is of selfs in die geel sone. "I am happy and I am happy to be at school". Daai is die areas waar hulle gereed is om te leer. En dan as hy homself identifiseer in 'n area soos die oranje of die blou. Oranje is ek is angstig ek is nie OK nie. Iets het voor skool met my gebeur. En uhm ek het bietjie gedrag "regulation" nodig voordat ek OK is om te leer. En dan sit hy sy foto'tjie daar en dan is daar 'n paar tegnieke. Dan vra ek vir hom hoe kan Juffrou jou help? Wat het jy nodig? Party kry dan 'n "fidget toy" om mee te speel en om self te reguleer. Party mag die "cool down corner" gebruik en net kom uhm met iets sag speel of 'n ding wat geluide maak en dan ook net alles word gekoppel aan gedrag regulasie word met die "timer" gedoen. Jy het net jou 3 min of jou 5 min maksimum om 'n breuk te vat ons noem dit ook 'n brein breuk om 'n breuk te vat uit die situasie te kom en dan moet jy terug kom in die groep. En dan kan jy met jou foto'tjie na juffrou toe kom en se "now I am ready to learn". So ons probeer hulle so reguleer of hulle self reguleer om op 'n goeie plek te kom om te leer. Dis nou maar meer die emosionele ondersteunings kant in die klas. Elke oggend voordat ons begin leer gebeur dit en dan kan hulle ook uhm op 'n fisies ook bietjie water drink en badkamer toe gaan om hulle self op 'n plek te kry om te leer.	Classroom Organisation and Management Resources Classroom Organisation and Management
Lerecia	<i>Dit is baie oulik. En dan hoe organiseer jy jou klaskamer om alle unieke behoeftes van Graad 1-leerders met intellektuele gestremdhede, te akkommodeer wanneer getalbegrip onderrig word? So die fokus van die vraag is getalbegrip.</i>	

B1	OK, goed, wat vir my weereens hier belangrik is selfs voordat getalbegrip aangeleer kan word is dit maar al die tipiese goed van uhm uhm die kind moet genoeg visuele ondersteuning kry in die sin van ons skedule. Dit is vir my verskriklik belangrik. Ek wys vir hom nou ons is nou op Wiskunde. Wiskunde gaan nou gebeur so hy word voorberei ons gaan nou Wiskunde leer. Dan, is hy presies op sy gemerkte plekkie sit hy en hy is gereed om te leer. Dit gaan alles maar net oor daai gereedmaking en daai fokus. En dan word daar baie keer is daar sekere apparaat wat ons gebruik word aan hom geallokeer so alles is gemerk en met ander woorde in 'n klas met kindertjies met outisme voel dit vir my jou visueel support is uhm ontsettend belangrik so die kind weet die healtyd waar is sy plekkie, wat mag hy gebruik en hy weet die healtyd "what is next?". So, uhm, waarmee ek nogal sukses bereik is voorspelbaarheid. Die kind het nie vir 'n oomblik weet hy nie uh die moeilik om 'n les se lengte te voorspel maar hy weet presies as ons klaar "carpet maths" gedoen het gaan ons stasies toe en daar doen hy sy werkkaartjie en as hy klaar is met sy werkskaartjie is dit TEACH tasks. So hy weet presies wat vir hom anderste is daar weer gedragsprobleme of uitvalle of onsekerheid. En die onsekerheid selfs in wiskunde. Uhm uhm hulle is regtig oop vir leer as die onsekerheid en die angstigheid inskop nie. So dit is maar van die strategieë wat ek toepas.	Strategies Classroom Organisation and Management Strategies Classroom Organisation and Management
Lerecia	So as jy 'n getalbegrip les aanbied, hoe begin jou les? Begin die op die mat?	
B1	Ja, so ons het uhm so uhm so 'n pre-lesson waar die voorkennis net uhm versamel word. Waar ons met voorkennis so ons begin met telaktiwiteite eers. Die heel eerste Wiskunde aktiwiteit in die oggende is ons kalender, watter dag dit is, watter dag was gister en watter dag is more. So samevatting van die kalender en weer en dan dae van die week, maande van die jaar en dan telaktiwiteite. So dit is somer baie keer net speletjies uhm "touch body parts when counting" vorentoe, agtertoe, op, af. Partykeer spring ons op die rebounder trampolientjie terwyl ons tel. En dan is dit op die getalkaart tel ons in ons 2's, ons 5'e ons 10'e. So dis ook om net hulle almal op dieselfde stasie te kry en bietjie "pre" kennis te doen. En dan uhm sal ek die nuwe lessie aankondig. Gewoonlik sodra ek die konsep aangekondig	Lesson Plans Developing Number Sense Strategies Resources

	het of getalbegrip of wat ons vandag gaan doen dan het ek dikwels 'n video'tjie uhm wat ek net vir hulle vir hulle wys rondom dit of 'n storietjie of 'n liedjie oor daai getal. Se nou maar die getal 6 dan doen ons die video'tjie of storietjie en dan as ek die rekenaar afsit en dan doen ons die praktiese werkke op die mat.	
Lerecia	<i>En dan van die mat af beweeg hulle na hulle tafels toe?</i>	
B1	Ja, van die mat af OK uhm dan doen ons dit prakties, konkreet. Ons loop hom of ons spring hom of ons watookal. Dan wanneer hulle na hulle bankies toe gaan differensieer ons. So my groep een, my hoë ondersteuningsgroep doen baie keer konkrete werkies en nie so baie werkkaarte nie of hulle kry maklike werkkaartjies, maar hulle gaan dan ook na hulle werkstasies toe en moet hulle se nou maar getal 6 met klei rol en bou. So hulle kry 'n konkrete werkke by hulle werkstasies waar die ander dan werkskaarste doen. Dis dan die toepassing van my les. Die "application". En dan uhm as hulle daai spesifieke onderwerp klaar gedoen het dan doen ons die TEACH tasks konsep waar hulle die. <i>[Verwys na 'n TEACH stasie toe in die skool].</i> As jy mooi kyk hierso is "start" and "finish". Hierdie kant is my nommers so hy het 1, 2, 3 takies. So as hy klaar is steek hy net sy handjie op en juffrou kom haal sy werkkaart en juffrou kyk of sy werkkaartjie reg is. Dan se ek vir hom "right, go onto your TEACCH tasks". Sodra hy klaar is met nommer een werkke, kom dit by "finish" en wat hierdie behalwe vir die inoefening van die konsep behalwe ek doen byvoorbeeld getalbegrip nommer 6, dan probeer ek van die takies. Dis "Velcro" takies, dis ryg, dis plak, dis knip sulke goedjies, probeer ek daai spesifieke lessie toepas in sy TEACCH tasks ook. Baie van die is net fynmotories of uhm of ryg werkies wat byvoorbeeld "patterns" is. Dis maar inoefening van basiese wiskundige konsepte. Dan hierdie TEACCH tasks uhm die hele doel hiervan is "independence". Dit bevorder onafhanklike leer en onafhanklike werkies sodat hulle by hulle bankies stil sit. As daar tyd is ... dan vat ek one-on-one by die tafel ons oefen daai konsep wat ons vanoggend op die mat gedoen het waarmee die maatjies sukkel. Dan sit ons en oefen dit in of al is dit nou op sy konkrete vlak met tellertjies of met klei of met watookal dan probeer ek uhm een-tot-	Strategies CAPS for Learners with SID Classroom Organisation and Management Developing Number Sense Strategies Resources

	een tyd maak vir dit.	
Lerecia	<i>En wanneer stel julle die TEACCH tasks voor aan die kinders?</i>	
B1	Wat, hoe dit werk. So “TEACCH tasks” kan ook met mat aktiwiteite bekendgestel word, maar “TEACCH tasks” is goed wat hulle goed ken. So dit is apparaat wat, ons het ’n hele “resource centre”, so dit is apparaat wat hulle baie goed ken. Al eintlik vir jare. So ’n TEACCH tasks is ’n takie wat reeds gedoen kan word, dit is nie iets waarmee hy sukkel nie en dit is dikwels nie eers iets wat bekendgestel hoef te word nie. Ek probeer dit in ’n groep bekendstel as ek ’n nuwe “TEACCH task” gaan uitneem wys ek in die groepie hoe dit werk. Dan word hy in sy rakkie gepak. So dan kry een van hulle en ons wissel die tyd in die middag pak ons gou-gou ons wissel net af. En dan skuif ek die een soontoe of daardie een soontoe of ek haal nuwe werkies uit die stoor uit. So “TEACCH tasks” is iets waarmee hy nie moet sukkel nie, want dit gaan ook oor selfvertroue so in die ek voel suksesvol want ek werk onafhanklik.	Strategies Classroom Organisation and Management
Lerecia	How do you adapt your lesson plan to teach number sense to Grade 1 learners with “SID?” <i>Hoe pas jy jou lesplan aan om getalbegrip aan graad 1-leerders met intellektuele gestremdhede, te onderrig?</i>	
B1	Ek dink, ek dink wat ons dikwels doen is ons gaan terug konkreet toe. Ons, ons spesifieke vir kinders met spesiale leerbehoefes weet jy uhm leer ons maar alles op ’n absolute konkrete vlak, eers inoefen en doen en leer en dan beweeg ons ’n bietjie na ’n semi-konkrete vlak toe waar hulle dit bietjie drie dimensioneel en later twee dimensioneel. So ek sal sê my lesplan word dikwels aangepas op daai gebied. Jy kan nie net vir hulle skriftelike werk gee nie, jy gaan regtig maar terug daar waar die gat lê in uhm hulle fondasie onderrig in wiskunde daar waar hy uit gemis het om iets te begryp. So ek dink vir hulle veral omdat hulle ook ongelooflik aandag afleibaar is, is konkreet. Elkeen het sy tellertjies, sy boksie tellertjies by hom of sy sakkie en hy hy moet vat en tel en saamwerk. So dit gaan maar vir my oor, die lesplan gaan terug na die absolute konkrete vlak toe.	Lesson Plans Barriers to Learning Resources
Lerecia	<i>Watter uitdagings ondervind jy wanneer jy ’n les beplan? Jy as onderwyser en wanneer jy dink aan die individuele behoeftes van die</i>	

	<i>leerders?</i>	
B1	Ek dink diversiteit verseker, want differensiasie want ek kan nie want jy moet werklik elkeen ontmoet op sy vlak, want daar is een outjie wat al hoofstroom graad 1 gedoen het wat vir my ver bo die ander is in sy getalbegrip, maar ek moet die heeltid terug gaan na die outjies wat nog daar vashaak. So vir hom gee ek baie moeiliker werkies, maar hy wil nie uit mis op die gewone wiskundige speletjies en matwerk nie so om hom te akkommodeer en besig te hou en om hom nie verveeld te laat voel nie uhm voordat hy aan beweeg na sy moeilike werkskaartjies toe. Dit is nogal vir my uitdagend en om genoeg werk op verskillende vlakke vir elkeen te gee. Hulle te ontmoet waar hulle trek, want baie keer oorsien jy nou ook die outjie wat jy gedink het het dit nog verskriklik nodig op 'n konkrete vlak, maar eintlik vang hy dit nou al. En ek kon hom nou al bietjie moeiliker werk gegee het. So ek dink vir my is die uitdaging om hulle nie te mis waar hulle werklik trek nie en hulle genoeg te stimuleer waar hulle trek en om hulle na die volgende fase toe te vat.	Challenges
Lerecia	<i>Uitdagings wat jy ondervind in die klas?</i>	
B1	Gedrag. Ja, want dit is om hulle almal net eers te reguleer en op 'n plek te kry waar hulle kan kennis inneem. Dis my grootste uitdaging. Eventueel met baie motivering. Gedrag is ons eerste uitdaging en konsentrasie ons tweede uitdaging. Van hulle is op medikasie, maar as jy byvoorbeeld die dingetjie nou wat net op Retalin is, is hy maak ons die oomblik heeltemal mal. So dis nie eers of medikasie jou antwoord is nie en dis ook nie iets wat ek graag aanbeveel nie behalwe as dit uiters nodig is.	Challenges
Lerecia	<i>Is jy aanpasbaar in terme van dit wat jy beplan het en dit wat jy aanbied?</i>	
B1	Verseker-verseker dis vir my moeilik, want daar is 'n stukkies van hierdie kop wat erg linkerbrein is, maar absoluut. Ek dink ons moet die hele tyd net verskriklik bewus wees van het jy die kinders verloor of het jy hulle nou nog by jou want anders is ons uh ons leer vind dan nie plaas nie. So jy moet geweldig aanpasbaar wees. En bereid wees om jou lessie 'n bietjie te buig. Wat wel gebeur dikwels laat ek die lessie wat ek vir vandag beplan het deel ek sommer in twee en dan die res more. Dan skuif ek maar weer op my lesplanne rond, so.	Lesson Plans

Lerecia	<i>En dan voel jy aan die einde, van die aanpassing wat jy gemaak het of jy die uitkomst bereik het? Lesdoelwit.</i>	
B1	Ja en nee. Ek dink daar is dikwels my groot uitdaging om aan te pas. Dis is OK as ek dit laer skuif. Dit is weereens daai differensiasie. "To struddle down a bit." As jy sien my doelwit was graad 1.2 uhm en uh hy is nog nie daar nie dan moet ek maar net weer bietjie "struddle" Graad R toe. Dit moeilik want partykeer dan dink ek ja die DCAPS is heeltemal te maklik vir hulle en die doelwitte is oor en oor dieselfde en dit voel of my kinders nie vorder nie, maar as jy baie mooi gaan kyk is daar tog om dit maar deeglik te doen en maar terug te gaan en termyn na termyn te herhaal.	Lesson Plans Challenges CAPS for Learners with SID
Lerecia	What teaching strategies do you use to teach the sub-set "numbers, number operations and relationships"? <i>Watter onderrigstrategieë gebruik jy om die subversameling "getalle, getalbewerkings en verwantskappe" aan te leer?</i>	
B1	Baie konkreet so ek sal byvoorbeeld kom ons vat 'n les voorbeeld nè. Kom ons vat die getal 6. Dan sal ek begin, soos ek jou gesê het met 'n video'tjie of 'n liedjie wat dalk net 6 as 'n karaktertjie voorstel. En dan doen ons baie keer, ek het sulke materiaal bande dan vorm ons vir 6 op die mat en ons loop hom, ons loop hom. Ons voel hom te eers met ons lyfies of ons kruip hom of ons ry met karretjie so dit is 'n absolute konkrete vlak. Dan sal ons dikwels 'n spelletjie speel soos die "feely bags" of die "blind folds" en dan het ek fisiese nommertjies houtnommertjies wat hulle dan vir my moet probeer 'n 6 vind. Voel hom so dan is dit die verskillende sintuie wat ons in werking sit om vir hulle die ses aan te leer soos byvoorbeeld "touch" en die ander ding wat ek ook nogal doen is in sand. Hulle skryf baie keer in sand of ons maak hom met klei, maar dis nou maar meer as hulle werkstasies toe kom. So op die mat self as ons daai aanbieding gedoen het uhm het hulle hom saam geoefen elkeen het hom se nou maar gewys op die mat of gebou of ses blokkies uitgetel. Ons werk baie met blokkies, met tellertjies die "cubes" of met Lego-blokkies byvoorbeeld, want elkeen kry sy houpie. "So wys vir Juffrou hoeveel is "6". Tel bietjie vir my uit wat is "6". En dan doen ons baie met die "flash cards" uhm watter is "6". Ons speel speletjies met die flash cards so pak dit in rye, sequence. Haal 6 uit, wie is weg? Wys vir my	Strategies Developing Number Sense Lesson Plans

	hoe lyk 6 die getal na hom byvoorbeeld. Kom tel jy vir my ses blokkies uit by nommer ses. So, dis daai praktiese praktiese inoefening van getalbegrip. So, in my klas op die stadium gee ons nogal baie aandag aan bewerkings. Soos in plus van hulle nou uiteindelik so ons plus verskriklik baie so ons doen 'n bietjie getal konsep en ons doen 'n bietjie van die karaktertjies en die syfertjies maar dan begin ons bewerkings doen, maar dit hang baie af van die subverdelings. Basies elke dag doen ons 'n bietjie getalbegrip so ons kyk bietjie en wat is ses en dis wat ons met die getalkaart elke oggend doen is kyk vir juffrou waar staan ses wie staan voor hom, wie staan na hom so hulle kry daai basis in elke dag.	CAPS for Learners with SID
Lerecia	<i>Is daar enige uitdagings wat jy ondervind wanneer jy met verskillende hulpbronne werk? Watter hulpbronne jy kies om te gebruik?</i>	
B1	Ja, meestal het ek my boks wiskunde langs my so ek is redelik "flexible" as ek sien hierdie werk nou glad nie vir hierdie maatjie nie dan gee ek vir hom iets anders, maar dit is 'n uitdaging, want partykeer werk daai hulpbron nie vir wat jy beplan het nie. Ek dink mens lees hulle vinnig en dan kan jy sien en dan kan ek ook sien. Wat ek wel ondervind met ons groep wiskunde besprekings is weereens gedrag. Die een gryp daai een se tellers en die een skreeu en daai een nier bo-oor die ander een se tellers. Ons skool is bevoorreg met die wonderlikste "resource centre". Lerecia, daar is speletjies in bokse wat splinternuut is vir elke wiskunde doelwit.	Resouces Lesson Plans Challenges
Lerecia	<i>Is daar 'n spesifieke program wat jy gebruik waar syfers bekendgestel word as 'n karakter?</i>	
B1	Vir getalle Youtube, want daar is ek weet ek het op 'n liedjie afgekom wat oulik is met die karaktertjies, maar ek hou van Jack Hartman se getalle. Hy het altyd 'n liedjie of 'n oulike versie saam met baie visuele ondersteuning met getalletjies, met karaktertjies en speletjies. Vir getalle nie regtig spesifieke program nie.	Resources
Lerecia	<i>Is die leerders op die ontwikkelingsvlak wat die leerplan stel?</i>	
B1	My graad eentjies op die oomblik is omtrent almal daar, maar dis vir my baie belangriker hulle kan bWie keer tot 100 tel, "route counting" sonder die begrip so vir ons ons doen alles optellings van	Challenges

	“trampoline” spring tot handjies was tel ons. Met die lyfies veral so vir my gaan dit so ek dink meeste van hulle trek nou al daar waar hulle tot 20 kan tel, maar mens gaan maar altyd “gaps hê in die begrip. Van die getal, maar dit bly een van ons leerareas waar ons baie aandag gee.	Strategies
Lerecia	Waarom sal jy se getalbegrip is belangrik?	
B1	Vir my is dit die basis uhm basiese selfvoorsiening. So, dis van met geld werk eendag en te verstaan ‘n brood kos R20 en jy moet kleingeld kry. Daai tipiese lewensvaardighede. Jy moet jouself kan help in terme van uhm net basiese goed in jou huis wat met getalle werk.	Developing Number Sense
Lerecia	Hoe werk die stasies?	
B1	Die stasies help vir konsentrasie en om sy eie veilige spasie te hê sonder om sy maatjie te pla. Groep 1 is my “high support learners” en groep 2 is my “medium to low support learners”. As gevolg van gedragsprobleme het ek hulle uitmekaar geskuif, maar ek weer presies watter leerder is in groep een en watter leerder is in groep 2. Ons lae support groepie het al addisionele wiskunde ook so as hulle klaar is met hulle basiese werkkaartjie klaar is dan laai ek sy boek met daai dag se werkkaartjie ook in sy stasie. Sy hy moet eers sy boek werklike doen voor hy met sy takies begin. Deurlopend sien jy waar trek hy of hy iets vinnig begryp of nie so van my outjies wat ek gedink het is verseker ‘n hoe ondersteuningsgroepie het al na die lae ondersteuningsgroepie al beweeg deur die loop van die jaar wat ek gesien het maar hy begryp so maklik.	Classroom Organisation and Management Lesson Plans Strategies
Lerecia	Which skills did you acquire during initial training to teach learners living with SID in the Foundation Phase? Watter vaardighede het jy tydens jou aanvanklike opleiding aangeleer om leerders met intellektuele gestremdhede, te onderrig?	
B1	Goed, ek het net my graad in fondasie fase gedoen en toe het ek skool gehou en als en toe het ek seker so 8 jaar later het ek toe ‘n nagraadse diploma in remediërende onderrig vir twee jaar. Ek dink, ek dink vir my daai tyd om te begryp ons het ook sielkunde gedoen en ons het ook “neurodevelopmental” goed gedoen wat my so	Training Prior

	gefasineer het, maar ek dink om te begryp hoe 'n kind leer en hoe die brein werk en watter van kleins af watter vlak waarop 'n kind trek hoe hy geleer moet word. Daai was vir my verskriklik waardevol en ons het nogal op universiteit die didaktiek oor die klein kinders ontwikkeling. En ek dink as jy verstaan hoe 'n kind ontwikkel watter vlak en watter tipe metodes jy kan gebruik om daai kind te leer op daai vlak hm dan gaan 'n lig vir jou aan. Want jy kan nie 'n kindjie van 8 kom leer op 8 jarige ek wil amper se neurotypical manier en hy het hierdie klein kinders fases uit gemis dan vat jy hom nou maar net terug na 'n twee jarige leer fase toe en jy leer vir hom getalle op daai manier aan. Ek dink daai was vir my waardevol.	Knowledge
Lerecia	<i>Is dit moontlik om daardie vaardighede in die klaskamer toe te pas indien jy agterkom 'n 8 jarige leerder is op 'n 2 jarige ontwikkelingsvlak?</i>	
B1	Verseker, ek dink so. Dit hang baie af van hoeveel kinders jy in jou klas is en hoe jou klaskamer ingerig is, maar ons probeer regtig dit doen. Ek probeer somer my assistent gebruik en se vandag doen jy net daai met hom. Al is dit heeltemal op 'n 2 jarige vlak uhm anders gaan ons hom nooit kry om saam met die res te vorder nie.	Classroom Organisation and Management
Lerecia	How did your initial training prepare you to apply these skills in the classroom? <i>Hoe het jou aanvanklike opleiding jou voorberei om hierdie vaardighede in die klaskamer toe te pas?</i>	
B1	Ek dink geweldig, Lerecia, ek dink as 'n mens dit nie gehad nie sou ek op die harde manier geleer het, maar ek voel daar is vir my 'n doel hoekom doen ek dit so, want dit maak vir my sin en ek het die agtergrond en daai opleiding. Ons is geleer hoe 'n kind se breintjie werk en hoe is die leervaardighede ontwikkel en hoe ons dit moet toepas.	Prior Knowledge
Lerecia	What gaps can you identify in your training to prepare teachers for teaching learners living with SID? <i>Watter leemtes kan jy identifiseer in jou opleiding om onderwysers voor te berei om leerders met intellektuele gestremdhede te onderrig?</i>	
B1	Uhm, ek dink praktiese ondervinding. Ek onthou ek het by 'n	Prior

	kleuterskool geproef destyds, maar ek het nooit ondervinding gekry by kinders met spesiale behoeftes nie. En ek dink as mens dit vroeg genoeg kry dan gaan dit vir jou 'n wêreld se verskil maak. Die gaping lê dalk in praktiese onderrig, uh ondervinding. Ons het almal kursusse gedoen deur "Autism South Africa" wat die skoolhoof vir ons gereël het.	Knowledge
Lerecia	What prior knowledge do teachers need to instil before teaching number sense? <i>Watter voorkennis moet onderwysers aanleer voordat hulle getalbegrip kan onderrig?</i>	
B1	Ek sou se ons moet definitief 'n basiese voorkennis hê van uhm uhm van Wiskunde in die breë sin van hoe die verskillende vaardighede in die wiskundige begrip op mekaar volg. Wat moet 'n kindjie alreeds kan verstaan voordat jy sekere goed vir hom leer. Soos 'n algemene wiskundige begrip as 'n onderwyseres om te weet uhm ek leer vandag hierdie. Dis wat my lesplan se maar hierdie kind het 'n baie groot gaping in Wiskunde in daai area. So dit voel vir my 'n mens moet bietjie regtig uhm teaching vaardighede vir wiskunde hê.	Prior Knowledge
Lerecia	<i>Wat is belangrik vir 'n onderwyser om te weet van die DCAPS?</i>	
B1	Ek dink, jy moet daai dokument gaan bestudeer. Jy moet jou leerplan ken. Ek moet se die dokument is baie goed nagevors en ek moet se daar is waardevolle inligting veral daai stuk voordat die lesplanne voorgestel word. Daai voorkennis van hoe Wiskunde werk, hoe dit opeenvolg, hoe dit aangebied word in verskillende vlakke en daar is waardevolle inligting. So ek sal se jy moet regtig jouself voorberei en dink jy gee wiskunde en dink jy gaan suksesvol wees nie. Jy moet regtig 'n breë kennis hê van wiskunde. Dit kan 'n lekker sterk been wees om op te staan vir hulle toekoms as hulle daai ding begryp. Ek weet van hierdie kinders wat nie verbaal is nie, van hulle het syfervaardighede wat my mond laat oophang. So ons moet nooit vergeet as jy vir hulle daai geskend van wiskundige vaardighede gee kan dit hulle toekoms oopsluit. As jy die vaardighede vir die kinders reg aanleer op die regte vlak regte tyd sluit jy vir hom sy toekoms oop.	CAPS for Learners with SID
Lerecia	What challenges do you experience when accommodating the individual needs of Grade 1 learners living with SID when developing	

	number sense? <i>Watter uitdagings ervaar jy wanneer jy die individuele behoeftes van Graad 1-leerders tegemoetkom (akkommodeer) wanneer getalbegrip ontwikkel word?</i>	
B1	So sê nou maar dis 'n leerder met groot agterstand in fisiese ontwikkeling so vir hom om net 'n getal te skryf is 'n baie groot uitdaging so hoe akkommodeer ek hom? Hy doen ongelooflik baie van sy werkies verbaal leerders. Ek gaan nou vir jou 'n vinnige voorbeeld van 'n nie verbale leerder gee. So die verbale leerder kry byvoorbeeld kan om rol sy getalletjies uit en bou dit met klei, maar as dit by werkskaartjies kom hy het sulke swak fynspiertjies dat hy skaars 'n pen kan vashou vir hom byvoorbeeld kan hy vir my die antwoorde noem en dan soek hy die antwoord uit en dan plak hy die antwoord op sy werkkaart. So hy hoef nie fisies te skryf nie. En meeste van hulle wat nog nie op 'n kognitiewe vlak is om ietsie te kan lees nie, lees ons vir hulle. As daar byvoorbeeld 'n leerdertjie is wat nie verbaal is nie so ons het so 'n "GoTalker" so ek kan daar vir hom wys om vir my die die kolletjies tel vir getal 6 en as hy op daai prentjie druk dan se dit "six". So ons probeer akkommodeer nie net in terme van gedrag nie, maar ook in terme van uhm uhm kommunikasie of verbale vaardighede in terme van fynmotoriese vaardighede.	Profile Teaching Strategies Barriers to Learning Resources
Lerecia	<i>En sal jy se dat 'n onderwyser gespesialiseerde kennis nodig het wanneer sy met leerder met spesiale onderrig behoeftes werk?</i>	
B1	Verseker! Mens leer die vaardighede aan in die praktyk. Ek voel nog elke dag van my lewe ek leer by die kinders. Ek, ek ek kan nie genoeg leer nie. Ek voel elkeen van ons moet leerbaar bly, maar ons leer by die kinders en uh en elke dag verskil elkeen van hulle en die beste leer veld is in die klas.	Prior Knowledge
Lerecia	<i>En is daar kursusse reeds aangebied vir Wiskunde en is dit van toepassing op leerders met spesiale behoeftes?</i>	
B1	Ja, weet jy watter vrek oulike kursus het ek nou die dag gedoen. Daai van Lego. Ek dink mense begin buite die boks dink en ek dink sulke jong innoverende mense soos jy wat nou op hierdie gebied in Wiskunde begin uhm uhm ondersoek instel en hulle kom agter ons kindertjies met spesiale leer behoeftes het het 'n bietjie meer	Training

	konkrete vaardighede nodig en hulle bou 'n hele kursus rondom Lego blokkies. Hoe “amazing” is dit? So ek weet byvoorbeeld, ek het al ek dink Melodi de Jager het 'n ding gedoen oor getalbegrip. Ons het byvoorbeeld daai kursus gedoen "Graad R sonder werkkaarte" vrek oulik, baie getalbegrip daar in. Hulle het byvoorbeeld emmers gemerk met uhm jou syfertjies op en daai kind moes boontjiesakkies ingooi. Of hulle plak jou getalle teen die muur en dan as jy die antwoord moet se dan gooi jy 6 raak met jou boontjiesakkie. So daar's baie oulike oulike goed daar buite. Dis net om dit te vind. En onderwysers te stuur. Ek weet ons het regtig 'n 'n baie pro selfontwikkeling mentaliteit by die skool. Die skool is selfs bereid as jy 'n oulike kursus kry en jy wil dit bywoon is die skool bereid om jou finansiële te ondersteun.	Strategies
Lerecia	Okay, ek dink dit is dit.	
B1	Ek het baie gepraat nè?	
This marks the conclusion of the interview, and the recording concluded accordingly.		

APPENDIX K: TRANSCRIPT OF A FOCUS GROUP INTERVIEWS

Participant	Conversation	Coding
Lerecia	Which outcome in the general content focus area of numbers sense development do you find challenging to teach? <i>Watter uitkomst in die algemene inhoud fokus area van getalbegrip ontwikkeling vind jy uitdagend om te onderrig?</i>	
E1	Getalbegrip vind ek by die graad eentjies nogal baie moeilik. Hulle kan nie soos uhm soos een-tot-een afparing. Hulle sukkel daarmee so. So getalbegrip is nogal dis as of jy heeltemal konkreet met hulle moet terug gaan. Alles moet met hulle lyfies ervaar kan word. Uhm, jy weet 'n plat nommer doen niks nie. Ek se nou-nou juis vir hulle ek wil nou die vakansie nommerkaartjies maak en vas steek en sê nou maar 'n klippie in 'n sakkie gooi. Een klippie, dat hy kan voel uhm een is ligter as twee, want "more and less". Jy weet al daai getalbegrippe is vir ons kinders ontsettend moeilik. Alles moet fisies wees.	Challenges Barriers to Learning Strategies Resources
E2	Ek is nou so twee jaar by die. Ek het hoofsaaklik by die B fase hoofsaaklik. Ja, so hulle is op verskriklik baie vlakke. Hulle kan glad nie abstrak dink nie. Dit is 'n baie moeilike begrip, getal. Hulle kan byvoorbeeld tel bv. Een, twee, drie. One, two, three, four, five, maar sodra die ding omgekeer word, kan hulle dit nie herken nie en hulle kan dit nie begryp nie. So dit is vir hulle moeilik. Hulle leer soos 'n rympie en dan probeer mens dit prakties maak en dan nog steeds as jy vir hulle se een, party van hulle kan wel soos een uittel. Sodra jy vir hulle se tel, soos hoeveel beads is hierso? "Point one, two, three." Dis een en een, maar baie kry dit nie reg nie. Hulle tel sommer one, two, three, four. Jy weet so. Dis vir hulle baie abstrak. (Dis iets wat hulle gememoriseer het – E3). Dis reg. Ja, 'n mens probeer dit maar prakties vir hulle maak. Alhoewel daar is nog steeds daai kinders wat nog steeds nie daai begrip kan kry.	Profiel Barriers to Learning Lesson Plans
D3	Ek ondervind baie dieselfde as dit wat die ander nou klaar, klaar gesê het. Wat ek ook baie moeilik vind is die skryf van nommers. So ek sal byvoorbeeld vir hulle die rympie leer van "straight line, number one is fun". Dan waar jy begin en hoe jy hom aftrek	Barriers to Learning

	ondertoe, maar die feit dat hulle ook nie links en regs ken nie maak dit ook soveel meer moeilik, want dan sal hulle die drie byvoorbeeld soos amper agterste voor om skryf of die twee anderkant toe. Meer “reversals” en om dit weer reg te kry sukkel jy nou weer ‘n hele ander “ball game”, maar die skryf is vir my die moeilikste.	Strategies
D1	Ek het ook uhm nommers dat hulle die nommers “actually” weet dis ‘n een. Soos die ander reeds gesê het. Hulle ken die rympte, maar as jy drie goedjies voor hulle sit en jy vra vir hulle hoeveel gaan hulle nie vir jou kan se daar is drie nie. Hulle gaan dit nie vir jou kan tel nie. Hulle tel een, en dan somer die tweede enetjie en drie en dan is die vier. So hulle kan nie. Hulle verstaan nie daai konsep nie. Meer en minder. Watter een is meer en watter een is minder. Dit gooi hulle heeltemal uit. Rangordes, eerste, tweede, derde, ons het nog nie eers daarby uitgekom nie. Ja, want uh dit ook ‘n baie moeilike ding. En soos D3 gesê het uh die handskrif dit is net so moeilik, want baie van hulle het ‘n “poor pencil grip” so hulle kan nie eers die potlood vashou nie. Die twee maak hulle soos ‘n “s” en die drie ek weet nie hy het sulke groot gaps tussen in. Jy weet hy is nie soos ‘n drie moet wees nie. Om nie eers te praat van n vyf nie. Die number sense is nie daar nie. Hulle kan vir jou tel en dit, maar number sense, nee.	Challenges Barriers to Learning Developing Number Sense
D2	So, I was also saying like the once actually being able to count that one thing is 1, but we also look at when we pack numbers, and we write numbers and draw the dots we try and let them do it in a specific way like they are on a dice and the posters are up against the wall. But that like visual perception of like putting the blocks where they need to go to make that thing is also just hard for them. Or they can do it but if you ask them how many are there, they can guess but they can’t tell you how many are there. And we are supposed to cover things like doubling and halving, but I mean how do you get them to count two things, but they have to do doubling and halving. It’s like almost impossible to tell them OK what is double this? Oh, no you must put two of the same amounts, but it is almost too out of their frame of reference and too abstract for them to move from counting objects to doubling and halving. And then another thing that I said was that just counting like route counting	Strategies Barriers to Learning CAPS for Learners with SID Challenges

	they need to in term 1 count to ten, but they must also count forward and backwards. Then term 2 is like to fifty and the just is like so big. Most of them is only counting to let's say five, but now they want you to count to ten and backwards. So, it is almost like we are supposed to do with them is just like just a little bit too advance. It's too out of what they know.	
D1	And then another thing the age. They must know their age. I think there is four children in my class that actually know their age. The rest they can tell me (D2: no) their ages.	CAPS for Learners with SID
D2	It's like trying to tell someone you are thirteen and number thirteen is absolutely nothing to you.	Barriers to Learning
E1	Ek wil dalk net sê "for her sake in English". The money, we have to do money as well that is, money is a difficult concept for a normal child to grasp. So uhm even just recognising the money that is also very difficult uhm concept for them. They do not understand the concept.	Challenges
E3	"Some of them struggles with shapes as well." Dit is vir hulle belangrik om vorms te kan herken voordat hulle getalle kan herken. So, party van hulle kan nog nie eers die vorms herken nie, maar dan moet hulle nou die getalle herken en kopieer. Vir party is dit net onmoontlik. Party kry dit 'n bietjie reg, maar dis vir hulle moeilik.	Prior Knowledge
Lerecia	So opsommend, die visuele persepsie van die leerders. Daar is 'n gaping in hulle ontwikkeling in terme van visuele perseptuele ontwikkeling. Why is it challenging to teach? Waarom is dit uitdagend om te onderrig? Is it within the learners itself, is it within the environment we teach of wat maak dit uitdagend?	
E1	Wat dit vir my uitdagend maak is om uhm alles baas te raak wat jy moet kan doen in 'n dag met hulle, want hulle moet byvoorbeeld hulle persoonlike detail kan gee, maar dis iets wat hulle nie kan doen nie. Dis nie dat dit frustrerend is nie, maar dis dat dit ook nie mismoedigend nie, maar jy weet net nie hoe kan jy vir elkeen alles leer sodat hy kan funksioneer op die ou einde nie. Party kan nie eers hulle naampies se nie dat jy dit kan uitmaak nie. So wat as hy nou verlore raak? Dis vir my die uitdaging. Die kinders is vir my 'n	Challenges Profile CAPS for Learners with SID

	uitdaging en dan tyd. En dan die assessering ook. Daar is soveel assessering dat jy “over assess and under teach”, want jy weet jy moet by bly met ISP’s en all die goed. En eintlik is dit belangrik om op die mat te rol met hulle.	
E3	Jy leer hulle vandag iets en dink joh, ek het dit reg gekry. Hulle, hulle verstaan dit en tot more dan weet hulle niks daarvan nie. Hulle vergeet letterlik, so hulle geheue is baie kort.	Barriers to Learning
E2	Jy weet ons kinders kom ook uit ‘n milieu waar hulle nie baie gestimuleer word nie. So by die skool, jy weet die milieu is “fine”. Ons doen met hulle goed, maar baie van hulle kom nie uit ‘n, uit ‘n milieu waar hulle gestimuleer word nie. Ja.	Barriers to Learning
Lerecia	<i>So, van ‘n huishoudelike aspekte is hulle basies milieu gestremd? Nie genoeg blootstelling in hulle huislike omstandighede nie?</i>	
E1	Ja, want weet jy hulle het baie, baie van hulle word net voor die televisie gesit en hulle kyk nou maar die hele dag televisie.	
E3	Ja, en die ouers het klaar opgegee.	Challenges
E2	En die ouers weet nie wat om met hulle te doen nie. Jy weet, uhm, hoe om hulle te stimuleer en so aan nie. Hulle het nie daai kennis nie.	Challenges
E3	Ouers glo hulle kan dit nie doen nie en stuur hulle maar eintlik skool toe dat mens hulle besig hou.	
D3	Vir my ervaar ek presies dieselfde as wat die ander se. Uhm vir my wonder ek ook of dit nie dalk ‘n taal ding is nie. Baie van die kinders waarvoor ons skool hou se eerste taal is nie Engels nie. So en al ons goed is in Engels. So hulle kom met watokal taal, Zulu, Sotho, Twana, Xhosa, kom hulle by die skool aan en hulle hoor Engels net die rukkie in die klas. Soms nie eers op die speelgrond praat hulle Engels met mekaar nie. So vir my is dit die verskillende gestremdhede, maar die taal bykomend bo-op dit nog en soos julle nou sê milieu. Jy hoor hoe hulle alleen by die huis bly en op die ouderdom van tien en elf alleen na klein boeties en sussies omsien. Party weet nie waar hulle volgende bord kos vandaan gaan kom nie. Behalwe net vir milieu gestremdheid is daar soveel sosiale probleme ook by van hierdie kinders.	Challenges
D1	Ja, ek het die ouer kinders. Die 15, 16 jariges. Drie is op die graad 1 vlak. Ek sit met 7 verskillende vlakke. So as ek ‘n werkkaart	Profile

	maak. Daai een kan nie 'n werkkaart kry nie, daai een moet dit konkrete doen. Hierdie een kan 'n werkkaart kry, maar dit moet soos vyf goedjies wees. Daai kan 'n werkkaart kry, maar hulle kan al sommetjies doen. Ons begin nou maar eers met die minus somme. So dit is sewe verskillende werkkaarte vir een klas. Dit is moeilik met al die vlakke in my klas.	Challenges and Lesson Plans
D2	Ja, but I think also some of the stuff just isn't meaningful to them. Like they don't understand it. It just doesn't mean anything. It is just so abstract that I mean it just doesn't sit with them. They need so much repetition there is no time for you to spend the whole year on one thing. Like you need to do a million other things. So, the amount of time that you actually spend on doing this is far too little for them to eventually get it. I mean some of them have been doing this for five years by the time they get to my class, but they still need that repetition all the time or else they actually forget. There are just not enough hours in the day to actually teach how they would need you to teach.	Profile Strategies CAPS for Learners with SID
Lerecia	And the expectations of the curriculum – can you at the end of the term complete all the outcomes or do you feel like you've never reached that goal?	
D2	Uhm, what I've actually started trying to do is kind of focus on the things that you need to assess as of your first priority, but even then, not all the time and you can not really teach to assess. That is not really how it is supposed to work but based on all the expectations I think a lot of people are just teaching to assess. You spend so much time assessing your children when actually you could be teaching them/	CAPS for Learners with SID
E2	Ek wil net sê ek stem so 100% saam met haar. The lady. There isn't enough time. There are so many different things that are unnecessary we don't need. And uhm she said the assessment as well. It is just more and more about the assessment and not about the main important skills you don't get to repeat. Repetition is key. It is the only way you can get something enforced or whatever. I have tried to do the same thing every day for a weeklong and to see whether they can do it at the end of the week but still they everyday as you do it is as if it is for the first time you do it.	Challenges Strategies Lesson Plans CAPS for Learners with SID Challenges

E1	It is important that they really go outside more. You know, really use their bodies so that they are really more knowledgeable you know with themselves and aware of their space because uhm actually it feels like the curriculum is forcing them or forcing us to do what they were taking out of mainstream for in the first place because we now have to do a “mini” curriculum of what is being done in mainstream. Because obviously they have come to our school for a reason. They cannot cope with that so now why are we drilling the same thing that they could not do, could not grasp. We should actually be focusing on the skills more than trying to get them to recognise a letter. Most of these kids are mostly on grader R grade 1 level. Instead of putting them all same ages, different abilities into one class. Shouldn't we be doing different abilities together you know the stronger ones pulling them up and going further. You think you can focus on the stronger child but in actual fact you use the stronger child to help the weaker one. It is the same as mainstream and I do not think that is the whole idea of having a school.	Strategies CAPS for Learners with SID Profile
Lerecia	<i>Opsommend, ons ervaar dat die verwagting van ons leerders is te hoog. Die onderwysdepartement verwag te veel van ons en ons verwag te veel van ons leerders, maar ons onderwysers weet eintlik wat goed en reg is vir ons kinders.</i>	
D3	Ja, wat hulle kan doen.	
Lerecia	Name the difficulties and knowledge limitations, you as a teacher, experience when teaching the concept of numbers. <i>Noem die probleme en kennisbeperkings wat jy as onderwyser ervaar wanneer jy die konsep van getalle onderrig.</i>	
E2	OK, ek sê net uhm miskien uh hoe om, ek probeer soveel verskillende goed dis asof hulle nog steeds nie daai abstrak begrip van getalle verstaan nie en ek weet nie of daar 'n ander manier is nie. Miskien kan mense vir 'n mens nog maniere gee hoe om getalle meer prakties vir die kinders te kan verduidelik. Ons vat byvoorbeeld kraletjies of watokal maar dis asof hulle nog steeds nie regtig die begrip het van die getal, wat is 'n getal nie. Die getal 0. "You see I have nothing. Zero. It here, there s nothing." Dit is nog steeds vir hulle so abstrak.	Barriers to Learning Training Resources Challenges CAPS for Learners with SID

E1	Jy weet soos ek werk baie met die unix blokkies en dan het ons byvoorbeeld 'n uh gebruik ek eierhouers jy weet, want dit is 'n makliker manier vir hulle om fynmotories en hulle pak dit in. Uh soos om te kan kyk het almal dieselfde. Wie kort om meer en minder. Maar daar is net soveel maniere wat jy kan uitdink om hierdie konsep te probeer uhm te probeer oordra. Vir my is die leemte in myself om uhm die tradisionele manier van uhm ons weet die kind is konkreet tot op 'n sekere ouderdom, maar hierdie is soos in konkreet konkreet. Nog voor konkreet so ek weet nie hoe om daar uit te kom nie. Bedoel, ons het al al die Pinterest jy weet die sandpapier en al daai goed probeer 'n mens, maar hulle trek maar hulle trek nie regtig nie. Hulle voel dit net eintlik. Daai konsep om dit te internaliseer ek weet nie hoe om daai brug te bou.	Resources Strategies Strategies Challenges
D3	Vir my is die grootste ding, jy weet nie wat hulle weet nie so en veral die outistiese kinders wat nie met jou terug praat nie of al die "non-verbal" kinders. So uhm jy weet hulle wys vir jou 1 en 2 en 3 en 4, maar jy weet nie wat hulle rêrig erig weet en verstaan nie. So ek kan vandag begin en 'n hele week lank een doen of 'n hele maand lank 1 doen, maar ek weet nie of hulle rêrig verstaan wat 1 is nie, want sodra ek se "tel een blokkie op" sal een kind byvoorbeeld 'n hele hand blokkies gryp en dan kan ek dadelik sien maar hy weet nie 1 nie en hoe om dit vir hulle te leer is ek weet nie regtig moeilik. Ek het 20 jaar terug geswot en wat ek toe geleer het is eintlik nie meer relevant nie. Ek het geswot in 2003-2007 en dit was toe uitkoms gebaseerde onderwys. Ek weet nie die CAPS en hierdie is eintlik glad nie vat toepassing op wat ek geleer het of wat ek nou moet doen nie. So ja, daar is definitief vir my ek wil amper se 'n "gap" in my, nie in my "degree" of graad nie, maar ja dit wat ek geleer het en dit wat ek moet toepas daaglikse basis is glad nie vir my dieselfde nie.	Challenges Profile Strategies Prior Knowledge
D1	Ja, ek stem saam met dit. Daar is baie kursusse wat mens kan bywoon wat mens goedjies wys, maar dit werk nie altyd vir jou klas nie. Ek se altyd die begin van die jaar is soos 'n geskenkpakkie. Jy weet nie wat jy kry nie. Jy vat omtrent 'n hele termyn om net uit te vind hoe moet ek hierdie goed oordra aan die kind. Wat gaan vir hierdie kind werk en dit is nogal moeilik. Dit vat baie tyd wat jy	Training Profile Challenges

	eintlik kon onderrig moet jy nou uitvind hoe gaan ek die kennis nou oordra, want wat vir hierdie groepie geld hierdie jaar geld definitief nie vir volgende jaar nie. So ons maak ons eie hulpbronne en sulke goedjies, want wat jy vandag gebruik gaan jy dalk volgende jaar nie weer gebruik nie. En dan is dit nou weer alles van voor af maak vir die nuwe groep. Dit vir my is nogal 'n groot ding.	Resources
D2	“Ja”, and I also think there are so many different levels in one class of where each child is at. So, there is almost a gap in you almost have two hands but there are so many of them that need such different like teaching styles and methods from you like I have children in my class that can work so independently like really complex stuff and then I have other children who are still, we are trying to get them to understand the concept of 1 block. And I mean there's a gap in how to actually teach all those different levels at the same time. I mean you can't sit them teaching them “take one block” when some of the other children can do plus sums, but I mean there's only so much one person can do. There's a gap in how to make it applicable for everybody whilst still accommodating everyone.	Challenges
Lerecia	How do you address learners' prior knowledge in your lesson planning and presentation? <i>Hoe spreek jy leerders se voorkennis aan in jou lesbeplanning en aanbieding?</i>	
E1	Kyk, ons het mos 'n basislyn assessering gedoen so ons het 'n goeie idee watter kinders met watter begrip kan werk. So nou is my klas in drie ability groups gedeel. Sodat ek uhm basies moet 'n mens dan elkeen se uhm se uhm sy vlak aanspreek binne daai groep. So ek probeer soos ons maar in die oud dae die groot groep leer jy dan die nuwe konsep. En dan vat jy jou swak jou swak groep bly by jou, maar jou sterk groep gaan dan aan met hulle werk. Uhm jy weet sodat die swak groep kry dan eintlik drie keer die inligting voordat jy met hulle iets konkreet doen. So dit is absoluut uhm gedifferensieerd. So in ons beplanning maak ons reeds voorsiening vir die differensiasie.	CAPS for Learners with SID Profile Lesson Plans
E3	Uhm ek het nie iets om by te voeg nie, maar ek besef net dat ons op die “prior knowledge” moet konsentreer.	Prior Knowledge

Lerecia	<i>En sal julle se dit is maklik om te bepaal wat die leerders se voorkennis is wanneer hulle in die klaskamer kom? Kan julle maklik optel dat hierdie kind het die begrip tot die getal 5 of is dit uitdagend?</i>	
E3	Nee, ek tel redelik gou op watter vlak elke kind is uhm ek weet nie of dit ervaring is nie. Mens kan gou-gou agterkom die vlak van elke kind. Ons groepe is ook nie so groot dat mens partykeer kinders oorsien nie. <u>Ons het klein groepies van 13, 14 kinders so mens kan gou-gou optel en bepaal wat is elkeen se vlak en daarop konsentreer.</u>	Prior Knowledge Levels/Support Groups
Lerecia	<i>En wanneer jy fisies 'n les aanbied hoe sal jy begin om hulle voorkennis te toets?</i>	
E1	Ons speel met hulle nommer speletjies ook wat hulle voorkennis toets. En uhm ook om agter te kom wat hulle al kan doen en hoeveel hulle al weet.	Strategies
E3	En mens ken jou kind later. Jy weet net deur met hulle interaksie te hê dan kom jy klaar agter van die goed wat die kind kan doen. Informele kommunikasie en so aan. En ons het natuurlik die "baseline" wat ons ook gebruik in die begin van die jaar wat ons ook ons basis help.	CAPS for Learners with SID
E1	En wat ook lekker werk is met jou "problem solving" jy weet mos maar jou probleemoplossing doen so as jy daarmee begin en dit gaan rondom jou konsep waarmee jy besig is dan kan jy agterkom vinnig watter kinders het 'n idee van hoe om uhm daai probleem op te los en dan kan jy volgens dit so hulle voorkennis bepaal.	Strategies
D3	By ons in ons uhm lesbeplanning doen ons ook die drie groepe presies soos wat hulle nou van gerpraat het. So jy beplan basies vir jou laag, middle en hoë groep. Party se group one, group two and group three. Ander se low, middel, high. Maar om hulle voorkennis ja hulle voorkennis te toets is baie uitdagend veral na 'n vakansie. So ons het 'n summative assessment wat ons van 'n vorige juffrou af kry, maar baie keer sal jy sien na 'n vakansie die kind het bietjie van hulle kennis verloor. En dan moet jy weer terug gaan "back to the basics" amper. Om weer op te tel wat hulle die vorige jaar gedoen het voordat jy kan aangaan met dit wat jy nou moet doen.	Lesson Plans Prior Knowledge
Lerecia	<i>En in 'n tipiese les, as jy 'n getal aanbied, hoe sal jy bv. Die getal</i>	

	<i>drie, hoe beplan jy vir jou laag, middel en hoe groep? Watter tipe werk gee jy vir hulle?</i>	
D3	Ek sal vir die laag groep sal ek dan nou 3 goedjies uitpak. Drie konkrete blokkies of drie sweeties. En vir die middel groep sal ek dan nou se sit 'n prentjie van drie by drie blokkies. So ek sal byvoorbeeld se 'n driewiel prentjie sal ek se, sit die drie blokkies op die drie wieletjies. En vir die hoe groep sal ek uhm 'n werkkaart gee wat hulle dan nou basies moet uitknip en 'n prentjie van drie blokkies by die getalnommer drie sit, maar met die lae kinders doen ek gladnie werkkaarte nie. So eerder middel en hoog sal werkkaarte doen basies "sorting and matching". Sit dit op 'n dice en pak drie knopies uit op 'n papiertjie soos 'n "dice", maar die lae groep gladnie werkkaarte nie. Dis basies maksimum "support" vir die lae groep en "minimum support" vir die high groep.	Strategies
D1	Ja, in ons beplanning doen ons laag, medium, hoog, maar ek gaan nou nie in my beplanning sit "hierdie week doen ek nommer 3 nie", want ek het kinders wat op nommer 30 is. Ek het kinders wat nog nie op nommers is nie. Kinders wat op nommer 5 is. Kinders wat op nommer 6 is. So my klas het elkeen 'n boek. Uhm, kom ons se Jannie is op nommer 3. Jannie se hele boek gaan oor 3. Jannie moet vir my 3 kolletjies kan teken soos 'n dice. Jannie moet vir my kan se watter nommer kom voor drie en watter nommer kom na drie. Hy moet vir my die drie kan verdeel tussen drie kinders. Hy moet alles met die syfer 3 kan doen. Sannie langs hom is op letter ag syfertjie 6. Sy gaan nou weer alles oor 6 doen. En in die werksboekie wat ons het, is daar meer, minder. Is een minder as drie. So op die ou einde van die dag. Ons het die kurrikulum gevat. ons het boeke saam gestel en alles wat in die kurrikulum is, is in die boeke ook. Elkeen in my klas, soos ek gesê het daar's so baie vlakke. Elkeen het hulle eie boek. As ek sien 'n kind wat nie wat is voor en na nie, dan sal ek stop en almal wat op daai boek is dan gee ek gou vir hulle klassie in dit, want ek kom agter dit is waarmee hulle sukkel.	Lesson Plans CAPS for Learners with SID Strategies
Lerecia	<i>So, in jou klas, is dit meer "self-directed learning", elke kind is m.a.w besig met 'n ander boek op dieselfde tyd. Hierdie spesifieke boeke, het jy nou genoem, het jul saamgestel deur die kurrikulum</i>	

	<i>te gebruik as riglyn.</i>	
D1	Ja, dit is uh allerhande werksvelle van vorige jare. Daar is ou goed daar in, daar is nuwe goed daar in. Die juffrou wat dit vir ons gedoen het ek dink dit het haar seker dertig jaar gevat om die boeke saam te stel en nog steeds is sy nie tevrede met die boeke nie. Nog steeds elke dag word daar verander aan die boeke. Hierdie bladsy hoort nie hier nie en hierdie bladsy hoor eintlik daar. So dit is 'n working progress wat net nooit ophou nie.	CAPS for Learners with SID
Lerecia	<i>So wanneer 'n leerder dan in jou klas kom stuur die vorige jaar se onderwyser vir jou n opsomming om te se watter leerder is besig met watter boek.</i>	
D1	Ja, die boek se nommer is daar, maar ook hierdie kind het "number concept" tot by nommer 3, maar dan toets jy weer die kind, want hulle verloor dit deur die vakansie. So, van hulle moet jy weer bietjie terug gaan met die nommers en dan weer van daar af begin, maar hulle sal vir jou se hierdie kind ken vorms, hierdie kind ken geel en blou. So jy weet min of meer waar die kind is, maar eers as hulle in jou klas kom, moet jy soos twee boeke terug beweeg. En al doen hulle dieselfde boek vyf keer oor dit is maar OK, want jy kan nie aangaan met nommer 4 as jy nie nommer 3 kan baasraak nie. So dit is oor en oor en oor.	Challenges Prior Knowledge
Lerecia	<i>En dra julle as onderwysers by tot die ontwikkeling van hierdie boeke?</i>	
D1	Ons mag "input" gee, maar ja. Die boeke het eintlik behoort aan 'n juffrou en sy het nou besluit sy deel dit net van haar klas af op boontoe, want daar is 'n manier ook om die boeke te gebruik. Jy kan nie net 'n boek vir die kind gee en se gebruik dit nie. So sy leer die kinders hoe om dit te doen. Nommer een soos op 'n "dice" in die middel van die blokkie wees. Twee moet in die hoekies wees en so jy kan nie net die boek vir die kind gee en se gaan aan nie. Teen die tyd wat hulle by my kom weet hulle al hoe die boeke werk. As daar staan "draw" dan weet hulle, hulle moet die kolletjies teken as daar staan dan weet hulle. So hulle kan half op hulle eie werk, maar ja hulle doen nie altyd nie.	Strategies
D2	"Ja", I found we do the baseline. We get it from the teacher before and they give us a summative assessment. We test them but half of	CAPS for

	the time they get to you it's a new class, it's a new environment they don't really know you or your expectations. So I've found that the baseline I don't actually look at it for like the first week of school uhm we kind of just go from the beginning and we revise, recap and see how they go because I've found if you look at it after the holiday they are not where they were last year. You kind of plan to start over.	Learners with SID
Lerecia	Do you also experience in your daily planning that you also start on a clean page?	
D2	Yeah, and I also find sometimes in your planning, you can plan to do five different things in the week but you get to the end of the week and you are still on the first thing that you planned for, because you thought they would grasp the concept quicker but they didn't. You thought they would gone move on but on your planning you said you would move on to whatever concept but you actually staying on that concept for far longer than you thought.	Challenges
	What barriers to learning do learners with SID experience in developing a concept of numbers? <i>Watter hindernisse tot leer ervaar leerders met EIG in die ontwikkeling van 'n konsep van getalle?</i>	
E1	Hulle sukkel byvoorbeeld ook as die getalle nie in 'n volgorde is nie dan herken hulle ook nie die getalle nie. Die "sequencing". En om dan hulle weer reg te sit, die getalle weer in orde te kry is ook vir hulle 'n probleem. As jy byvoorbeeld vra watter nommer kom voor 4 dan kan hulle dit nie doen nie. Hulle kan 1, 2, 3, 4 tel, maar hulle weet nie watter nommer kom voor 4 of watter nommer kom na 4 nie.	Challenges
E2	Die getalle, eerstens wat ek ook gesê het die abstraktheid om 'n getal te verstaan. Regtig die konsep van wat 'n getal beteken. En dan ook uhm om die getalle selfs te skryf, te herken omdat baie van hulle nog nie eers vorms kan herken nie. Dan ook natuurlik jou groter as, jou kleiner as en ook maar voor en agter. Groter as nommers, Kleiner as hulle nommers. Hulle kan nie verstaan as ek vra "which number is bigger or which side has got more".	Challenges
D3	In my klas voel ek dat amper alles 'n hindernis is van die tel goed, die tel is nie so moeilik nie. Hulle kan dit doen, maar soos voorheen	

	gesê dit is 'n rympie wat afgejaag word. Hulle tel 1, 2, 3, 4, 5 en party van hulle kan terug tel, 5, 4, 3, 2, 1, maar as ek nou vra op die einde wat kom na drie of voor drie of skryf vir my die nommer 3 uhm is dit asof ek "blank stares" kry, want hulle weet nie wat eintlik van hulle verwag word nie. Veral met van die kinders veral met die outistiese en downsindroom kinders copy hulle maar eintlik net wat jy doen so ek sal die goed vir hulle pak as 'n voorbeeld, maar hulle "copy" jou basies net of "match" wat jy doen. So as ek 1 gaan pak, gaan hulle 1 pak as ek 3 pak gaan hulle 3 pak. Sonder om regtig te weet dat dit die nommer 1 is of die nommer 3, want hulle kyk maar wat jy doen en dan doen hulle dit ook. So en baie keer veral as ons tel dan sal ek vra dat die kinders vir my wys met hulle vingers so een 1 vinger, twee, 2 vingers, maar weereens hulle kyk wat doen jy of 'n maatjie en hulle doen dit wat die maatjie doen. So baie keer dan wys ek 5 en dan se hulle sommeer drie. So dit voel vir my soms alles is 'n hindernis. Ja, en uhm hulle kan nie van konkreet af oorgaan abstrak toe nie. Dis hoekom ek ook gesê het ek doen nie met my lae kinders "worksheets" nie, want hulle krap in elk geval net op die "worksheet". Dis nie "worth it", as ek dit amper so kan stel om dit vir hulle te gee nie, want dis nie waardevolle inligting daarop kry nie.	Barriers to Learning Profile Challenges
D1	Ja, dae van die week is vir my ook. As ek vir hulle vra watter dag is dit, hulle het geen idee nie. Baie en min, al doen jy dit op 'n konkrete vlak en ja dis asof hulle dit net nie verstaan nie.	Challenges
Lerecia	<i>So basies sal jy se die samevatting van die gestremdheid, die ontwikkeling in die brein, veroorsaak dat alle areas 'n hindernis tot leer is?</i>	
D1	Ja, ons hou net aan probeer. Een dag snap hulle dit dalk net!	
D2	I said that one of the things was that it is so abstract so for them to have that bridge between concrete, between what is meaningful like all the abstract concepts. I mean the concept of more and less is very abstract, but I've found that the language we use is also a barrier. Sometime they actually don't know what you are asking from them. "Tell me what is more?" OK, but to them "more" doesn't mean anything. So to try and bridge the gap for language is also very hard. I said things like their carry over, integration of things.	Barriers to Learning Challenges

	Sometimes they can do it in one situation but take them out of that situation somewhere else and they can't carry over the knowledge into the new situation. So they seem like they are very inconsistent, but actually they can not carry over the information into a new environment or situation.	
D1	Dan kry jy die kindertjies wat dit "actually" kan doen, maar hulle het 'n "fear of failure". Hulle sal sit, hulle sal nie aangaan tot jy by hulle is en dan kyk hulle vir jou. En dan kyk hulle vir jou om te se "dis reg, wat jy doen is reg. Gaan net aan." So hulle is regtig bang om 'n fout te maak. En dan probeer hulle eerder nie. Hulle sal sit en wag. Hulle wil nie voel hulle "fail" nie en dan probeer ons maar eerder nie.	Barriers to Learning
D2	It's almost like there's no self confidence at all.	Barriers to Learning
Lerecia	How do you address and overcome these barriers to learning in your classroom? <i>Hoe spreek jy die hindernisse tot leer in jou klaskamer aan en hoe oorkom jy die hindernisse tot leer?</i>	
E3	Ons maak gebruik van nommer speletjies en dan het ek nommer kaarte vir elke individu het ek 'n stel nommer kaarte gemaak wat ons gebruik om ons speletjies mee te speel om antwoorde mee te gee. Ek sal byvoorbeeld, hulle pak die kaarte uit dan sal ek vir hulle vra "Wat kom na twee?" En dan moet hulle die drie vir my wys. Party kry dit reg, die meeste kry dit nie reg nie. Ons speel sulke nommerspeletjies met hulle en dan moet hulle. Ons maak ook gebruik van baie "repetition".	Strategies
E2	Ja, ek maak ook baie keer gebruik van klei, "playdough" want dit werk ook lekker. Breek in soveel balletjies of uhm bou die nommertjies met die klei en so aan. Ons het tellers met verskillende goed: vrugte en vervoer. Ons kan verskriklik baie aktiwiteite met daai tellers doen. So "sharing" en alles ook. So jy gee vir hulle "counters" en dan moet hulle dit deel.	Resources Strategies
Lerecia	<i>En integreer julle baie sensoriese aktiwiteite in julle lesse wanneer getalle ontwikkel word?</i>	
E2	Ja, dis ook waar die klei lekker is, want selfs voor die tyd doen ons met die klei vingers sterker te kry byvoorbeeld "squash" die klei, rol	Resources

	die klei ens. En dan ook natuurlik sand, skuurpapier en rys en so verskillende teksture wat mens gebruik. Of jy plak dit of jy teken met jou vinger in dit.	
Lerecia	Stel julle die nuwe hulpbronne oor 'n tydperk bekend aan die leerders?	
E3	Ja, 'n mens vat maar een ding op 'n slag en dan kom mens agter watter kinders is tas sensitief oor 'n spesifieke gevoel of tekstuur.	Profile
Lerecia	En die tegnieke wat julle gebruik het julle dit geleer op universiteit grade, diplomas ensovoorts of is dit maar terwyl julle in die onderwys self is? Indiensopleiding om hierdie verskillende tegnieke te gebruik.	
E2	Baie van dit het ek soos geleer. Ons het selfs take en goed gedoen oor skierpapier en so aan. Baie van die ander goed het 'n mens maar deur ervaring en dan kry mens net hierdie idee . "WOW" dit kan dalk werk of as 'n mens byvoorbeeld sien. Ek het nog nie regtig vreeslik baie kursusse gesien wat dit behandel nie, maar wat mens op Pinterest byvoorbeeld sien. Dis 'n kombinasie wat 'n mens geswot het en 'n mens se ondervinding en ons is maar die heeltyd kreatief. Ons het 'n kursus gedoen Lego "blocks" en daar is ook verskriklik baie idees wat 'n mens kan uh elkeen het 'n sekere hoeveelheid Lego blokkies en daarmee kan mens verskriklik baie aktiwiteite doen. "Memory games".	Training
D2	So, we do a lot of stuff so for our barrier for language we use sign language and pictures and line drawings and videos and everything. So we have quite a lot of multi-model classrooms. They teach a lot at university, but I find a lot of what I've learned then concepts still applies but how we do it is quite different. Things like uhm for visual perceptual problems we all use the same fonts carried over throughout the school because the children's' ability to carry over that information like they know. They cannot identify if it doesn't look the same. So, what we've experienced we all use the same font uhm and our fonts are made bigger. We do a lot of visual perceptual activities and a lot of that. A lot of repetition and a lot of positive reinforcement to also try and boost their self-confidence.	Strategies Classroom Organisation and Management Challenges
Lerecia	Do you make use of technology in your classroom?	

D2	“Ja”, quite a bit. “Ja”, we also have a FM system. The FM system blocks out certain noise to make your voice more clear. So the children with foreground background hearing difficulties your voice is made louder over the noise of the class and outside and things like that. We have learned along the way from our speech therapist that half of what we say if not like more the children actually don’t hear and it is not a hearing problem it is a processing thing. And we do a lot of games on the whiteboards with easy teach, carrying over the numbers, counting the pictures and things like that.	Classroom Organisation and Management Barriers to Learning Strategies
Lerecia	You have mentioned processing and it goes hand in hand with memory. So, is there a specific technique or activity that you do in the classroom to help with processing?	
D2	Uh, not specifically, but to find the time I think it is quite difficult. To make time for just that like listening and processing. Ja, it is kind of integrated into everything else.	Strategies
Lerecia	And do you have the confidence to know how to integrate these skills in your different activities?	
D2	No, I would say no actually. It might sound terrible but actually no, uhm I think it is definitely something that you possibly need a lot of experience more than training. Uhm they can tell you what to do but to actually put it into practise in your classroom is quite hard. So I think it comes with more experience I think.	Prior Knowledge Challenges
D1	“Ja”, uhm ek is nie bang om vrae te vra nie so ek gaan gewoonlik na die ouer juffrouens toe en se ek het nou hierdie kind in die klas en ek sukkel om dit te doen help my en ja die goed wat hulle se en dan dink ek by myself hoe het ek nooit daaraan gedink nie. Op die ou einde leer ons bymekaar.	Strategies
	Why is it important for learners to develop a concept of numbers? <i>Waarom is dit belangrik vir leerders om 'n konsep van getalle te ontwikkel?</i>	
E3	Ek weet nie of daar 'n meer professionele antwoord is nie, maar ek besef nommers is so integrale deel van die lewe en uhm ek, wat ek altyd vir hulle se is dat jy jou skoennommer moet ken. Watter size skoene jy dra. Jy moet weet as jy “tuckshop” toe gaan wat gaan jy betaal. Jy werk met nommers, hoeveel kan dit jou kos. Jy moet jou verjaardag datum ken, jy moet die datum ken, elke dag die datum	Developing Number Sense

	ken. Dit is nommers, nommers, tyd is nommers. Jou ouderdom is nommers, Nommers is deel van die lewe.	
Lerecia	<i>En sal jy se dit is belangrik spesifiek vir die tipe leerders wat ons onderrig?</i>	
E3	Ja, uhm ek dink dit help hulle baie om meer in te skakel in die lewe om meer die lewe te lewe.	Developing Number Sense
E2	Ek wil net vinnig sê ons het 'n volwasse sentrum en van ons leerders gaan ook byvoorbeeld soontoe dan werk hulle.	
D3	So, what I have wrote down especially if they have to learn a telephone number uhm if they are lost somewhere. They need to be able to say this is my mom's number. Hulle moet nommer getalle hê of dit is belangrik vir hulle om soos in 'n noodsituasie. Eendag as hulle groter is om te kan werk met geld. Hulle gaan eendag uhm soos "activities of daily living" moet doen. Hulle gaan 'n brood by 'n winkel moet koop. Ek voel ook baie keer gestremde mense word ingedoen deur ander uhm ja, net omdat hulle gestremd is. Dit is nogal vir my 'n groot ding dat hulle moet leer van nommers.	Developing Number Sense
D2	Ja, uh our children use public transport by themselves, so they need to know which bus or whatever they need to get into how much money they need to give them, how much money to get back uhm they need to have some level of independence in their own lives. I mean I know some of our children won't generally end up doing that sort of thing, but for the children who can they need to know what to do. I mean even telling the time. If you need to be somewhere at 2 o'clock you need to be able to look at a watch, look at a clock and say, "ah I need to go now". I think it all comes down to living a more independent life or having some level of daily living ability.	Developing Number Sense
D1	Ek dink daar is van die kinders in my klas wat nog nooit eers in die winkel was nie. Vir hulle glo ek nie hulle hoef van geld en so aan te leer nie. Ek glo en ek hoop maar dat daar altyd iemand wees wat dit half vir hulle kan doen, maar tot vir hulle om net klere te kan was. Sit vir my al die wit goedjies bymekaar, sit vir my al die donker goed bymekaar. Weet net daai basiese goedjies. Net gaan dek vir my die tafel, ons is 5 mense in die huis so ek moet nou 5 borde	Developing Number Sense

	gaan uithaal. Elke bord moet 'n glas jy weet net daai goedjies dalk nou nie ja die basiese goed.	
Lerecia	<i>Is die DCAPS vir julle nuttig? En bied dit genoeg riglyne vir julle om te weet hoe om die nodige aanpassings te maak en waarnatoe julle werk op die ou einde?</i>	
E2	Ons doen mos maar eintlik graad 1 met kinders wat al in graad 4 of 5 moet wees. En steeds is daar dinge wat nie vir ons kinders werk nie, wat ons moet aanpas. En wat daar nie, nie voorsiening voor gemaak is wat ons uh 'n behoefte aan het nie.	Profile CAPS for Learners with SID
E3	Ja, en daar is wat ek vind 'n daar is nie genoeg aandag gegee aan basiese goed veral die "high support" kinders uh hulle moet hulle self net leer hoe om meer aanvaar te word in die samelewing. Ek dink ons moet meer let op om die kinders "skills" te leer om eendag te kan gebruik as hulle klaar is met die skool.	CAPS for Learners with SID
Lerecia	<i>Is dit vir jou maklik om te bepaal wat is belangrik en wat is nie belangrik vir ons kinders nie of voel dit soms of jou verwagting te laag is?</i>	
E2	Weet jy ek dink dit kom met ervaring. Hoe langer 'n mens jy weet by die skool skool hou kom mens definitief agter wat die kinders kan doen en wat hulle nie kan doen nie en hoe 'n mens jy weet hulle net bietjie kan druk jy weet dat mens hulle bietjie meer kan stimuleer en so aan. Ja, ek dink dit kom nogal met ervaring dat 'n mens begin agterkom wat 'n mens kan doen met die kinders en hoe om hulle 'n bietjie verder te druk.	Prior Knowledge
D1	Voordat ek by die skool was, was ek by 'n ander skool ek weet nie niemand het vir my gesê hier is 'n kurrikulum gebruik hom nie. En vir almal wat ek gevra het "nee jy doen maar wat jy wil in die klas". So toe die DCAPS nou uiteindelik kom toe is ek soos in die sewende hemel so ek het "actually" nou riglyne. En toe skuif ek na 'n ander skool toe wat "actually" 'n kurrikulum gehad het wat uitstekend gewerk het en toe moes hulle die DCAPS begin gebruik het en ek voel die kurrikulum wat hulle gehad het is eintlik baie beter gewees as die DCAPS. Jy sal nie glo hoe baie verwys ons nog terug na daardie kurrikulum toe nie omdat die DCAPS sulke	CAPS for Learners with SID

	baie gate in het nie.	
D2	I just find our old curriculum “ja” it worked as a process of how you go through the year. So it started at a certain place and you build on that where as I find with DCAPS you do this and then you have to do something like on the complete opposite end of what you were doing then it is count here, do this, assess this and then you are like how are you assessing more and less when I’m route counting to ten uhm so I find it like jumps too much and you don’t actually have a sequence of where you are going. So by the end of the year you kind of done all these random little bits of everything and assess stuff that is so meaningless. I mean some of our children they want us to assess identification and stuff. So I find in some places it is so basic and in other places it is so difficult and there is no middle ground for the children who really are struggling. I feel like the DCAPS is literally doing to them what the CAPS did but it is just a tiny bit easier.	CAPS for Learners with SID
D1	Hoekom moet ons ‘n ding assessee wat die kind nog nie voorheen gedoen het nie en dan later die jaar doen jy dit weer en dan word die kind nie geassesseer nie? As mens mooi gaan sit en jy werk perfek uit dit is wat die kind in daai week moet doen, dit is wat die kind, nog voordat hulle dit geleer het word hulle geassesseer. Toe hulle dit begin doen, toe begin ons sien flip hulle spring van die konsep na daai. Ek weet nie daar is sulke gate orals.	CAPS for Learners with SID
D2	And I find it is like somebody sat in there and decided to combine a curriculum but that person had never been in a SID classroom for children who are so different from each other in their abilities never mind from the curriculum. So it is almost like somebody didn’t have enough insight what actually happens inside our classrooms when we actually teach and what our children are actually like.	CAPS for Learners with SID
This marks the conclusion of the interview, and the recording concluded accordingly.		

APPENDIX L: ETHICS CONFIRMATION LETTER



Private Bag X1290, Potchefstroom
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Senate Committee for Research Ethics
Tel: 018 299-4849
Email: rikosinathi.machine@nwu.ac.za

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the **Education Sciences Research Ethics Committee (EduREC)** on 24 June 2021, the Education Sciences Research Ethics Committee hereby **approves** your request for extension as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-SCRE) grants its permission that, provided the special 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: Developing number sense for Grade 1 learners with severe intellectual disabilities: exploring teachers' pedagogical content knowledge			
Study Leader/Supervisor (Principal Investigator)/Researcher: Prof MP Koen			
Student / Team: L Labuschagne (MEd student - 25070436), Prof JA Rens, A Schoonen			
Ethics number:	N	W	U
	-	0	1
	9	0	1
	-	2	0
	-	A	2
	Institution	Study Number	Year
	Status		
<u>Status:</u> S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation			
Application Type: Single Study			
Commencement date: 30/06/2022	Risk:	Low	
Expiry date: 30/06/2023			
Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.			

Special in process conditions of the research for approval (if applicable):

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 study leader/supervisor (principal investigator)/researcher must report in the prescribed format to the ES-REC: - annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, 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 study leader/researcher must apply for approval of these amendments at the ES-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 an external audit. - The date of approval indicates the first date that the study may be started. - In the interest of ethical responsibility, the NWU-SCRC and ES-REC reserves the right to:
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APPENDIX M: LANGUAGE EDITING CERTIFICATE

Dr. JACKIE DE VOS 

Academic copy editor / Akademiese teksredakteur

BA (Psychology & Communication studies), BAHons (Psychology) (NWU)
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 Jackie de Vos

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EDITING

23 November 2023

To whom it may concern

This letter serves to confirm that the following dissertation was proofread:

Developing number sense for Grade 1 learners with severe intellectual disabilities: Exploring teachers' pedagogical content knowledge

The onus is on the client(s) to work through the proposed track changes and to accept or reject proposed changes. Clients might amend content after the editing process. Clients should make certain that all sources/references have been cited and that they and their supervisor(s) are satisfied with the manuscript before submitting for examination.

APPENDIX N: TURNITIN CERTIFICATE

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