FACULTY OF EDUCATION

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THE INFLUENCE OF USING VIDEO-STIMULATED RECALL AS A REFLECTIVE TOOL FOR PROFESSIONAL DEVELOPMENT AMONGST NOVICE MATHEMATICS EDUCATORS

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By

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DECLARATION

I declare that this thesis, **"The influence of using video-stimulated recall as a tool of professional development amongst novice mathematics educators"**, is my own work. It has not been submitted for any other degree or examination at any other institution. The sources used or quoted in the text have been acknowledged and referenced by a complete list of references.

……**08/11/2022**…….

Zanda S. Young **Date**

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Veni Vidi Vici

ABSTRACT

This study investigated the influence of using Video-Stimulated Recall (VSR) as a tool for professional development (PD) among novice mathematics educators. The primary focus was the novice mathematics educators' ability to reflect on their previously video recorded lessons as part of their PD. The main research question that guided the study was: What is the influence of VSR on the teaching and classroom practice of novice mathematics educators using reflective practice? In addressing this question, I focused on the following sub-questions: (1) Have novice mathematics educators been able to develop through the use of VSR as a proposed tool for PD? If so, to what extent?; (2) How does the implantation of reflective practice in relation to VSR affect novice educators' teaching of mathematics in subsequent lessons?; (3) Has the pairing of the experienced and novice educators assisted the latter in moving towards more effective classroom practices? If so, to what extent? The research data were collected across three cycles from three novice mathematics educators, drawn from two high schools in the Western Cape Province of South Africa. The data collection method involved the video recording of novice educators during their normal teaching duties, then replaying the video back to them during the VSR interview where self-reflection was elicited, while they watched the videos. This qualitative study was underpinned by various aspects of intertwined theories. One of them is constructivism, which branches into social constructivism. This is where the zone of proximal development (ZPD) linked to reflective practice is located. It primarily occurred through a sequence of four cognitive stages. The four stages of cognitive awareness were recognised when educators were able to reflectively articulate their teaching practices. Through the awareness model, novice educators became conscious of their own incompetency within certain skills and/or disciplines. The study found that all three novice educators had shown an awareness of their teaching, to various degrees. This enabled them to evoke change through the alteration and/or adjustment of a specific skill and/or discipline, in subsequent lessons. The process of reflective practices allowed the novice educators to be more aligned to effective teaching practices. Although these educators had engaged in reflective practices to enhance their notion of effective teaching practices, some aspects of their teaching were not altered and/or adjusted. Nevertheless, they became cognisant of their teaching and could visually identify where professional, context-specific development could occur. Therefore, it is recommended that VSR be used as a reflective tool for PD among novice mathematics educators, to enhance effective teaching.

Keywords/Phrases

Novice educator, mathematics professional development, self-reflection, video-stimulated recall, video recordings.

ABBREVIATIONS

COVID-19	- Coronavirus
DBE	- Department of Basic Education
DHET	- Department of Higher Education and Training
EEA	- Experienced Educator A
EEB	- Experienced Educator B
HSRC	- Human Science Research Council
LHS	- Left Hand Side
LoLT	- Language of Teaching and Learning
MKfT	- Mathematical Knowledge for Teaching
MKO	- More Knowledgeable Other
NEA	- Novice Educator A
NEB1	- Novice Educator B1
NEB2	- Novice Educator B2
NSC	- National Senior Certificate
PCK	- Pedagogical Content Knowledge
PD	- Professional Development
RHS	- Right Hand Side
SARS-CoV-2	- Sever Acute Respiratory Syndrome Coronavirus 2
SMK	- Subject Matter Knowledge
TIMSS	- Trends in International Mathematics and Science Study
UWC	- The University of the Western Cape
VSR	- Video-Stimulated Recall
WC	- Western Cape
WCED	- Western Cape Education Department
WHO	- World Health Organisation
ZPD	- Zone of Proximal Development

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CHAPTER 1

OVERVIEW OF THE STUDY

1.1 Introduction

Mathematics educators play a significant role in the creation of an environment that epitomises a learning-centred classroom. The Department of Basic Education (DBE) characterises a mathematics classroom as a learning-centred classroom where the notion of 'doing mathematics' is enacted through the interaction between educators and learners (DBE, 2018). Thus, it could be stated that mathematics educators assist learners in understanding mathematical concepts by perpetuating the notion of 'doing mathematics', through the most suitable teaching and learning strategies, to attain the relevant pedagogical outcomes. To efficiently achieve these outcomes, educators should participate in 'effective' Professional Development (PD) programmes in which the notion of 'effective teaching' is unpacked.

The concept of 'effective teaching' is defined as an endeavour which leads to learners enhancing their academic achievements (Arends, Mosimege & Winnaar, 2017). PD in education is recognised as a strategy used to ensure that educators continue to strengthen and expand their knowledge and skills throughout their career, to be able to implement good teaching practices (Mizell, 2010). Therefore, to improve the notion of 'effective teaching', educators need to partake in effective PD programmes. According to Gerber and Pellegrino (2012), the notion of 'effective teaching' involves reflection, which is defined as a thoughtful and constant "examination of teaching practices in an effort to improve instructional practice and foster an environment in which learners become more engaged" (p. 1). This form of deliberate and consistent self-reflection enables educators to adapt and adjust their teaching practices which, in turn, may enable learners to attain a deeper understanding of mathematical concepts.

The Trends in International Mathematics and Science Study (TIMSS) (2012) reveal a positive correlation between learner's academic performance and educators' competence levels in selected classroom practices (Arends, Mosimege & Winnaar, 2017). Therefore, in this study, the act of self-

reflection in relation to the teaching of mathematics enhanced mathematics educators' teaching practices. This was because the participating educators were allowed to view themselves in the video, through a different lens. This prompted these educators to develop new and improved ways of approaching what happens in their classrooms (Sherin & van Es, 2002). Consequently, the notion of educators being able to reflect on their own teaching practices, through the use of video stimulation, allowed for the visual and cognitive identification of teaching errors and/or misconceptions; ineffective teaching practices; teaching practices that could be improved even further; as well as where improved techniques for teaching mathematics could be attempted or incorporated. Thus, insight was gained through the means of the 'Discipline of Noticing', as the educators were able to re-validate when they found themselves noticing aspects of their teaching that they had previously overlooked (Mason, 2021). This enabled them to act and teach differently in subsequent lessons. This is because a video-camera offers educators a video record of classroom interactions, where these educators do not have to simply rely on the memory of what transpired. Instead, they can view the video, numerous times if they wish, to examine what transpired, from different angles and perspectives (Sherin & van Es, 2002). This subsequently led to the alteration and adjustment of their teaching. In addition, educators may have identified ineffective teaching practices, through their video-stimulated reflection, but decided not to alter their teaching practices, due to several reasons.

Gerber and Pellegrino (2012) claim that reflection is essential to exceptional teaching. This is not only because of the personal nature of reflection, but also because of the unique teaching experience of each educator (Gerber & Pellegrino, 2012). This is supported by Rich and Tripp (2012) who conceive reflection as an investigative, self-critical process, wherein educators "consider the effect of their pedagogical decisions on their situated practice with the aim of improving those practices" (Rich and Tripp, 2012, p. 678). For Mason (2011), the notion of standing back and reflecting upon recent actions, as it were, and using this to construct a narrative that is personal in nature, is a crucial component of comprehending, appreciating, and making meaning. For this reason, the notion of reflective practice seems suitable for mathematics educators who strive to create a classroom that displays effective teaching practices.

Hence, this study proposed the use of Video-Stimulated Recall (VSR) as an in-house PD tool to investigate the influence of the resulting self-reflection on the effectiveness of novice mathematics

educators' teaching practices, while contributing to a broader discipline of educator reflection. Moreover, this study was motivated by the perceived need for it, as outlined in section 1.6 about the rationale. The participants of this study consisted of five mathematics educators: three novices and two experienced ones, in two high schools located in the Breede Valley District, in the Winelands Region of the Western Cape Province of South Africa. This chapter provides a background to the study and states the research problem, the purpose, aims, and objectives of the study. An overview of the research design and methodology, the research questions, the significance of the study, the rationale of the research, and the definitions of key terms are also covered. Finally, the chapter outline, the organisation of this study, and its dissemination plan are highlighted.

1.2 Background to the study

Formal mathematics instruction is commonly perceived by educators as a 'ready-made system' with applicability, where the general instruction of mathematics is regarded as a process of breaking up mathematical knowledge into learning procedures and then learning to use it accordingly (Barnes & Venter, 2008). To limit the perception of mathematics as a ready-made system, the practice of teaching mathematics must be aligned with the concept of constructivism.

For Telese (1999), constructivism is considered as a driving force in mathematics education and as a learning theory. Constructivism describes knowledge as being in flux, where an individual constructs knowledge cognitively through the notion of cultural and social mediation (Telese, 1999). For this reason, it may be stated that the process of learning is an activity grounded in social interaction, rather than an abstract concept (Dewey, 1993). Hence, the notion of engaging in discourse through social interactions among mathematics educators forms part of PD. In support of this, Ernest (1998) claims that all knowledge is connected by a shared foundation of human agreement. This is interrelated to the concept of social constructivism (Vygotsky, 1934), because it is constitutive of the notions of dialogue and collaborative learning.

Telese (1999) states that within communities of learning, individuals are engaged in discourse, agree upon the new resulting mathematical knowledge, make revisions, and discuss new theories. The nature of these learning communities is congruent with the process of reflective practice,

achieved through social interaction among peers. Thus, the notions of constructivism and reflective practice are connected by the perception that they share basic ideas about learning and knowledge (Tlali, 2019). This study proposed the use of an in-house PD programme because Farrell and Richards (2005) state that "opportunities for in-service training are crucial to the long-term development of teachers as well as for the long-term success of the programs in which they work" (p. 1). The VSR tool assisted with a retrospective procedure to stimulate the recall of educators' concurrent cognitive activities, which involved replaying videotaped passages of behaviour to the individuals (Lyle, 2003). When the researcher (the observer) selected an episode of the observed novice educator, it was for the identification of the specific needs of the educators being observed, in terms of their Mathematical Knowledge for Teaching (MKfT), where potential development could occur. While the observers (the researcher, the experienced educator, and the observed educator) watched the video, together, a VSR interview in which an introspection of the selected teaching practices was undertaken occurred through the notion of self-reflection. This study advocated using reflective practice among novice mathematics educators as part of an in-house PD programme aligned with the shared nature of discourse, to contribute to effective mathematics teaching.

Sharp (2003) explains that due to the intensely personal nature of reflection and the endeavour to address one's teaching and learning processes, the procedure of reflection is not generalisable, as it derives from a state of self-awareness (Gerber & Pellegrino, 2012). Therefore, as each educator has a unique teaching experience, based on their existing knowledge and distinct teaching environment, their self-reflection differed in nature and varied in context.

For Bryan and Recesso (2006), the aim of video-stimulated reflection is to enable educators to become cognisant as they are able to view their teaching from a different perspective. This entails recognising facets of their teaching that they had not previously noticed. This stimulus enables them to reframe and revise their own beliefs about the process of teaching and learning (Bryan & Recesso, 2006). Hence, the advantage of using VSR in this study is that it ensured that the subsequent lessons were more aligned to 'effective teaching' practices, where the educator's pedagogical skills and knowledge necessitate the teaching of mathematics. However, it is argued that educators experience challenges in embracing the pedagogical and content knowledge necessary for teaching school mathematics (Chikiwa, Graven & Westaway, 2019). Therefore,

Shulman (1986) crafted Pedagogical Content Knowledge (PCK) as a domain of knowledge that encompasses both pedagogical and content knowledges that educators need to teach effectively. Indeed, in mathematics teaching, the domains of PCK and Subject Matter Knowledge (SMK) are necessities. These domains are referred to as Mathematical Knowledge for Teaching (MKfT).

Chikiwa, Graven and Westaway (2019) define MKfT as mathematical skills, habits, and knowledge required in active teaching. Therefore, as part of a PD programme, MKfT conceptualises the knowledge required for teaching mathematics adequately by reducing ineffective teaching practices through the implementation of PCK and SMK via reflective practices. Consequently, the adequate attainment of new MKfT is the result of reflective practice, through self-reflection. Therefore, the nature of reflective practice, as part of a PD programme, is an aspect of this study based on the use of VSR as a reflective tool to assist with the 'effective teaching' of mathematics.

1.3 Context of the study

In this study, the researcher investigated the influence of using VSR as a reflective tool for PD among novice mathematics educators. The study was conducted in two semi-rural high schools within the Cape Winelands region, in the Breede Valley District, in the Western Cape Province of South Africa. The area is divided into five clusters, and the study focused on two high schools in the district, where the participating Schools A and B are classified as Quintile 4 and Quintile 1, respectively. The quintile allocation of schools, which is classified by Statistics South Africa, is determined by the poverty data index at district level. Schools in lower quintiles receive more government support, compared to those in higher quantiles. It is important to note that although School A has a higher quantile than that of School B, School A has limited resources, compared to School B. This is because School B was recently built, to accommodate the needs of the community, which it was previously unable to do.

1.4 Problem statement

Ball, Hill and Rowan (2005) define MKfT as the "mathematical knowledge used to carry out the work of teaching Mathematics, where examples of this 'work of teaching' include: explaining

terms and concepts to students; interpreting students' statements and solutions; judging and correcting textbook treatments of particular topics; using representations accurately in the classroom; and providing students with examples of mathematical concepts; algorithms, or proofs" (p. 373). Therefore, MKfT encapsulates effective mathematics classroom practices anchored by the strong presence of appropriate PCK and SMK.

Although MKfT forms part of the essence of effective teaching practice and is taught during the initial training of educators, discrepancies exist in terms of the implementation thereof, when educators become in-service educators. Chikiwa, Graven, and Westaway (2019) believe that this is due to the lack of continuous support that enables mathematics educators to be effective, after they leave a tertiary institution. Hence, for educators to achieve proficient levels of MKfT, the latter should inform the PD programmes for in-service educators. MKfT facilitates the enhancement of mathematics educators' pedagogical practices. I argue that for MKfT to be adequately integrated, it needs to be incorporated in conjunction with reflective practices. Through the latter, educators can use their own teaching as a guide, to identify aspects that they themselves can alter and/or adjust, for their teaching to be more effective and for their MKfT to be enhanced, where necessary. This study advocated that to enhance effective teaching, PD programmes could incorporate the notion of reflective practice through VSR.

1.5 Purpose of the study

The purpose of this study was to investigate the influence of using VSR as a reflective tool for PD among novice mathematics educators in two schools, across three cycles. The three repetitive cycles involved implementing VSR among purposefully selected educators, where VSR was used as a self-reflective tool to assist in effective classroom practices.

1.6 Rationale for the study

1.6.1 NSC and school results over a five-year period

Table 1.1 shows the trends at 30% and above performance rate in mathematics at Grade 12 level, in percentage form, from 2017 to 2021.

Table 1.1: Trends in Grade 12 mathematics performance at 30% and above, comparing national and provincial results from the DBE 2021 national senior certificate results schools' subject report

Year	National Pass Rate in Mathematics	Western Cape (WC) Pass Rate in Mathematics
2017	51.9 %	73.9 %
2018	58.0 %	76.0 %
2019	54.6 %	70.2 %
2020	53.8 %	71.6 %
2021	57.6 %	73.4 %

Table 1.2 highlights the trends in Grade 12 mathematics results in School A and School B, in percentage form, from 2017 to 2021.

Table 1.2: Trends in Grade 12 mathematics performance at 30% and above, comparing results in School A and School B, from the DBE 2021 national senior certificate results schools' subject report

Year	School A Pass Rate in Mathematics	School B Pass Rate in Mathematics
2017	14.0 %	N/A
2018	71.4 %	N/A
2019	6.3 %	N/A
2020	54.5 %	N/A
2021	38.9 %	18.6 %

Table 1.1 highlights the pass rate (percentage achieved) at 30% and above, for mathematics at Grade 12 level, whereas Table 1.2 shows the trends in Grade 12 mathematics results in School A and School B at 30% and above. From figure 1.1, it is clear that the trends in the mathematics school subject for the schools under investigation had been lower than the national, and provincial results. Hence, the schools under investigation were purposefully selected to determine why mathematics educators often record the worst of learners' deficient performances in the mathematics school subject. Enhancing the notion of educator's self-reflection could improve learners' overall mathematics results once they reach Grade 12. The PD programme was designed to incorporate the notion of self-reflection, to determine the levels of MKfT. This is because many discrepancies exist, among in-service mathematics educators, between what they do and what they

were taught as pre-service educators (Chikiwa, Graven & Westaway, 2019). The notion of self-reflection is crucial to VSR. Mathematics educators were able to use their own teaching practice as a guide, to identify aspects that could be altered and/or adjusted, for their teaching to be more effective and aligned to the enhancement of MKfT.

Figure 1.1 displays the pass rate (percentage achieved) at 30% and above, for Grade 12 mathematics at a national and provincial level, as well as the trends in the Grade 12 mathematics results of School A and School B.

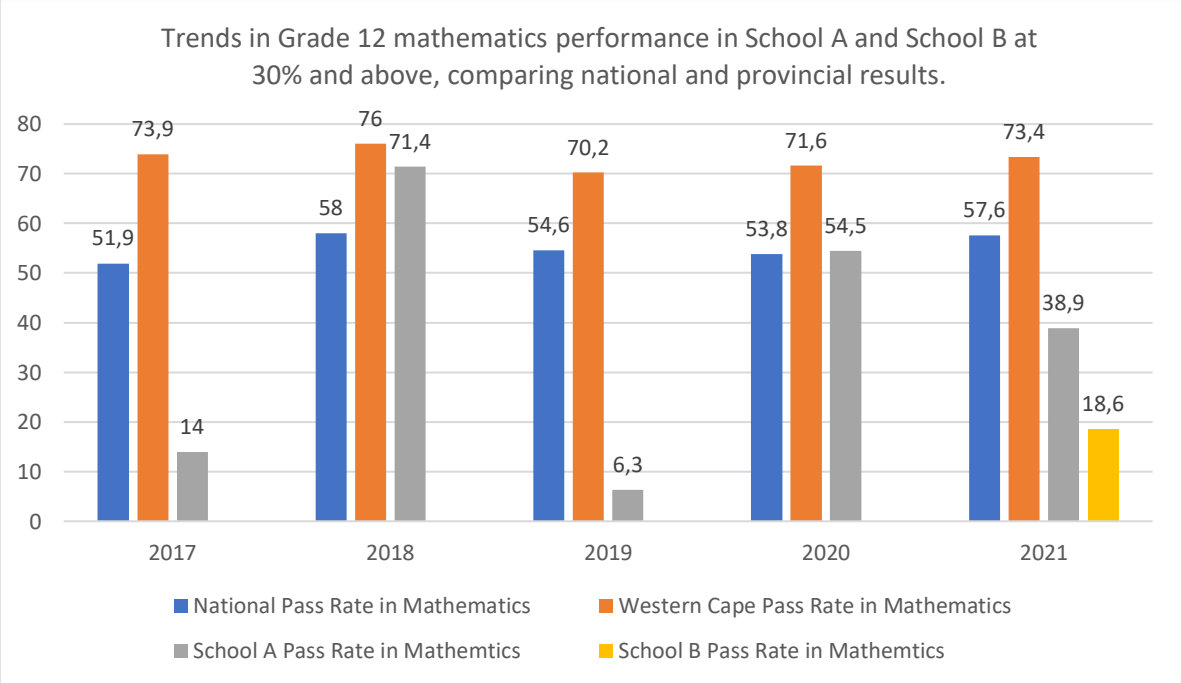


Figure 1.1: Graph indicating the trends in the mathematics results of School A and School B at national and provincial level

Figure 1.1 displays that the national mathematics results had been on a neckline (up then down then up) trajectory since 2017. From the graph, it was apparent that the Western Cape (WC) provincial results in mathematics have been on an upwards spiral, when compared to the national results. The graph also depicts that School A had been on a neckline (down then up then down) trajectory since 2017. School B is newly built; hence, no matric results were available prior to 2021. Therefore, the only possible comparison regarding the matric results of School A and School B can be made for 2021. School B had a lower pass rate of 18.6% in mathematics, compared to School A which had a pass rate of 38.9% at 30% and above, in 2021.

1.6.2 Mathematics education

In the South African context, due to a historical past rooted in a system of unequal education, various interventions have been initiated post-1994, to equip educators with the necessary skills and knowledge required to address the challenges still faced, especially in mathematics education (Adler & Reed, 2002). Nel (2015) claims that a solution to learners' deficient performance in the subject of mathematics is through the improvement of the teaching of mathematics. To achieve this level of teaching, effective PD programmes should be implemented to improve learners' academic performance. This is supported by Nel (2015) who suggests that "one way of improving learners' (Mathematics) pass rates is to up-skill teachers involved in the current system" (p. 7). Thus, the proficiency in the teaching of mathematics through consistently assisting learners to learn by being versatile, within various classroom environments, is related to effective classroom practices (Kilpatrick, Swafford & Findell, 2001). Hence, this study encourages 'effective teaching' practices through the notion of self-reflection, to 'up-skill' mathematics educators' proficiency. The term 'proficiency' creates an interrelation between the development of educators' ability to teach the required content effectively and enabling educators to provide learners with skills to develop an adequate understanding of mathematical concepts which, in turn, could improve their overall mathematics performance. Therefore, the enhancement of educators' knowledge basis through a PD programme may improve their teaching practices, while simultaneously addressing learners' academic performance in mathematics education.

1.7 Research aims and objectives

The project aimed at investigating the influence of using VSR as a reflective tool for PD among novice mathematics educators.

The project was guided by the following objectives:

1. To investigate if and how novice mathematics educators develop through the use of VSR as a self-reflective tool for in-house PD.
2. To examine whether the pairing of a novice and experienced educator, when implementing VSR, assisted the novice educator to enhance the notion of effective classroom practices.

1.8 Research methodology

1.8.1 Research approach and design

The methodological approach used in this research study is qualitative. This is because this study investigated if VSR could enhance effective teaching practices through its use as a self-reflective tool for in-house PD among novice mathematics educators, as part of their proposed teaching and classroom practices. Moreover, the qualitative method was chosen as a paradigm because it encompasses the natural progression of actions, while taking into consideration the diverse views of mathematics educators (Henning, van Rensburg & Smit, 2004). This was especially important during the VSR interviews. This was essential as the qualitative data obtained through the VSR interviews were centred on language, through a constructive dialogue where knowledge was not generalised but rather regarded as contextual. This process is supported by Lor (2011) who states that qualitative research comprises of dialectic interchanges and hermeneutics. An interpretive approach was used as the methodology of this study because it was presumed that the knowledge was subjective and not independent of cognition and reasoning, which resulted in knowledge being gained and meaning being made through the interpretation and analysis of the data collected by the researcher (Shah & Al-Bargi, 2013). Through this research approach, the researcher was able to obtain and provide an understanding of the participants' experiences.

Moreover, due to the qualitative nature of this research, the data collection instruments were designed across three cycles. The information session was conducted prior to the commencement of the three cycles. The data collection instruments used in this study were lesson observations, video recording of the lessons, field notes, biographical questionnaires, reflective journaling, a post-questionnaire, as well as the audio and video recordings of the VSR interviews. The VSR information session was conducted by the researcher and her supervisor, during the first school term in 2022. Thereafter, the three cycles of data collection commenced, during the second and third school terms in 2022.

The first, second, and third cycles involved an observation and a video recording of a mathematics lesson. Hereafter, the data were analysed in preparation for the VSR interview, one to two weeks later. This time period was chosen so that the researcher could thoroughly analyse the data from

the lesson recording. Prior to the VSR interview, the novice educators were asked to write, in their reflective journals, about their perception of how the observed lesson went. This datum was used in conjunction with the VSR interview, to determine whether self-reflection contributed to 'effective teaching' practices. The data regarding the participants' notion of reflection and their states of cognitive awareness were collected through a face-to-face VSR interview. The latter commenced one to two weeks after the lessons had been observed; semi-structured open-ended questions were used. Thereafter, the VSR interview was transcribed, to enable the data analysis. However, due to safety and security measures regarding the current pandemic, telephonic or online means of conducting the VSR interview were to be explored, if necessary. The in-person lesson observations and video-recordings were conducted with the five participants (educators), where the two experienced educators served as active observers, mentors and advisors (one per school), along with the researcher, and the three novice educators were the observed, one in School A and two in School B. The follow-up VSR interviews were conducted with these purposefully selected participants (novice educators) and the experienced educators who were their peers. The findings were analysed through the conscious competence learning model, which is a learning model that assists an individual to learn a new skill. In addition, an inductive approach was used in foregrounding descriptive means to determine whether reflective practice assisted the educators in moving towards more effective teaching practices. Simultaneously, the educator's take-up of reflective practice through VSR was used to determine whether it serves as an assistive self-reflective tool. Consequently, the data collection instruments were designed to be systematic and accurate, which is essential when conducting research.

1.9 Research questions

The main research question investigated in this study was:

> What is the influence of Video-Stimulated Recall on the teaching and classroom practice of novice mathematics educators, through the use of reflective practice?

In addressing this question, I focused on the following sub-questions:

1. Have the novice mathematics educators been able to develop through the use of VSR as a proposed tool for PD? If so, to what extent?
2. How does the implantation of reflective practice in relation to VSR affect novice educators' teaching of mathematics in subsequent lessons?

3. Has the pairing of the experienced and novice educators assisted the latter in moving towards more effective classroom practices? If so, to what extent?

1.10 Significance of the study

The influence of VSR on the teaching and classroom practice of novice mathematics educators, through the use of reflective practice, was evaluated. This was in an effort to determine the value of this form of intervention. This study strove to aid reflection, to improve novice educators' self-reflection and ultimately improve their overall teaching experience. This is because novice educators do not always receive the necessary induction and support in their initial years of teaching. Thus, the results of this study may help to better support novice educators, to enhance their overall teaching of mathematics. This research intends to contribute to the broader repertoire of in-service PD programmes in schools, for mathematics educators, where reflective practice through VSR emerges as a possible teaching tool.

1.11 Definitions of key terms

1.11.1 A mathematics classroom

A mathematics classroom is a learning-centred setting where the notion of 'doing mathematics' occurs through the interaction between educators and learners (DBE, 2018).

1.11.2 Professional development

Professional development (PD) in education is recognised as a strategy used to ensure that educators continue to strengthen and expand their knowledge and skills throughout their career, to implement good teaching practices (Mizell, 2010).

1.11.3 Effective teaching

The concept of 'effective teaching' is regarded as an endeavour that leads to learners enhancing their academic achievements (Arends, Mosimege & Winnaar, 2017). According to Gerber and Pellegrino (2012), the notion of 'effective teaching' involves reflection. This endeavour enables educators to adapt and adjust their teaching practices which, in turn, may enable learners to attain a deeper understanding of mathematical concepts.

1.11.4 MKfT

Mathematical Knowledge for Teaching (MKfT) is defined as mathematical habits, skills and knowledge necessitated in the work of teaching (Chikiwa, Graven & Westaway, 2019). It is also regarded as the "mathematical knowledge used to carry out the work of teaching Mathematics, where examples of this 'work of teaching' include: explaining terms and concepts to students; interpreting students' statements and solutions; judging and correcting textbook treatments of particular topics; using representations accurately in the classroom; and providing students with examples of mathematical concepts; algorithms, or proofs" (Ball, Hill & Rowan, 2005, p. 373).

1.11.5 Reflection

Rich and Tripp (2012) define reflection as an investigative and self-critical process wherein educators contemplate the effect of their pedagogical decisions on their situated teaching practice through retrospection, with the aim of improving those teaching practices.

1.11.6 Video-stimulated recall

Video-stimulated recall (VSR) is "an introspection procedure in which videotaped passages of behaviour are replayed to individuals to stimulate recall of their concurrent cognitive activity" (Lyle, 2003, p. 861). For Bryan and Recesso (2006), the aim of reflections stimulated by video is to ensure that educators become cognisant as they view their teaching from a different perspective, by recognising facets of their teaching that they had not previously noticed.

1.12 Chapters outline

Table 1.3: Chapters outline

Chapter	Headings
Chapter 1	Overview of the study
Chapter 2	Literature review
Chapter 3	Methodology
Chapter 4	Data analysis and discussions
Chapter 5	Conclusion, recommendations, and limitations

1.13 Organisation of the study

1.13.1 Chapter 1: Overview of the study

This chapter provides the introduction and background to the study; states the research problem, the purpose of the study, the rationale for the study, as well as the aims and objectives of the study; and presents the research questions. The research design and methodology are also briefly explained in this chapter. The chapter also covers the significance of the study, the definitions of key terms, and an outline of all the chapters constituting this study.

1.13.2 Chapter 2: Literature review

This chapter focuses on both national and international literature related to the study. The researcher compares and juxtaposes the findings of previous studies, to identify a gap in knowledge. This chapter provides a thorough discussion of the theoretical arguments for which the model under investigation was proposed, in response to the research question. The research methodologies and data analysis methods used in existing studies are presented. The literature review is limited to studies related to the influence of educators' teaching and learning approaches which is foregrounded in cooperative learning facilitated by reflection through the use of VSR.

1.13.3 Chapter 3: Methodology

This chapter discusses the research design and methodology followed in conducting this study. This is followed by an elaboration on the data collection plan and the sampling technique. In addition, the research instruments, namely, field notes, reflective journals, video recording of lessons, video and audio recording of VSR interviews, biographical questionnaire and a post-questionnaire are discussed. Thus, this chapter specifically describes the research design, sampling, and data collection procedures followed. The advantages and disadvantages of each research instrument are also discussed, along with the motivation for selecting each instrument used.

1.13.4 Chapter 4: Data analysis and discussions

This chapter provides a systemic and detailed presentation of the data analysis and the research findings. These relate the data collected from the field notes, lesson observations, video recordings of initial and subsequent lessons, the reflective journals, the video and audio recording of the VSR interview, and the post questionnaire. The findings will be analysed and related to the relevant literature. The patterns and trends will be substantiated, interpreted and analysed, with direct quotes from the data sources, namely, the VSR interviews and the reflective journals.

1.13.5 Chapter 5: Conclusions, recommendations, and limitations

This chapter provides an overview of the study by outlining the major findings emanating from the study and the implications thereof. Moreover, the chapter makes recommendations for future studies and suggestions for teaching and learning in regard to the notion of reflection. Lastly, the limitations of the study are outlined before the conclusions.

1.14 Dissemination plan

I, the researcher, along with my supervisor (project manager) plan to write academic papers on the findings and conclusions of this research project. This will involve presenting at mathematics educators' PD programmes as well as presenting the findings of this project at national and international conferences. The resulting articles will then be submitted to accredited journals, for publication, and to the UWC repository. A copy of this thesis will also be given to the Western Cape Education Department (WCED) as well as the UWC Electronic Thesis and Dissertation Repository.

1.15 References

All acknowledged sources of information are listed and cited at the end of the research report, according to the 6th edition of the APA referencing style.

1.16 Summary of the chapter

This chapter has provided the introduction and background to the study. The research problem has been stated. The chapter has articulated the rationale for the study, the research methodology, as well as the aims and objectives of the study. The research questions have been presented. The significance of the study, operational definitions, the chapter outline, the organisation of the five chapters of this thesis, along with the dissemination plan were covered.

The next chapter provides the literature review on national and international studies related to the notion of reflective practices through VSR, as well as the theoretical framework of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides an in-depth analysis of existing literature pertaining to this study, especially studies regarding the influence of reflective practice. The chapter also discusses the concepts of novice educators, experienced educators, professional development (PD), effective teaching, Mathematical Knowledge for Teaching (MKfT), Video-Stimulated Recall (VSR), and the conscious competence learning model according to Burch (1970), as part of the theoretical underpinning of this study. The previous chapter aligned the notion of 'reflection' as a paradigm in teaching to the initial definition by Dewey (1993). Consequently, this literature review serves to explore and investigate a meta-synthesis of studies conducted by various researchers, to explore how reflective practice, as part of a PD initiative, could be implemented in classroom practices, through the use of VSR. The literature review also addresses the research aim which is to improve mathematics educators' notions of reflection as well as teaching and learning, while simultaneously moving towards effective teaching practices. This is approached through the four states of cognitive awareness identified by Burch (1970).

2.2 Literature review

2.2.1 The concept of 'novice' educators

This study pays specific attention to the notion of novice educators. According to Kim and Roth (2011), novice educators are pre-service educators, neophytes, and beginning educators. Novice educators are also defined as "those who are still undergoing training, who have just completed their training, or who have just commenced teaching and still have very little (e.g., less than two years) experience behind them" (Gatbonton, 2008, p. 162). Therefore, novice educators are those who have little or no expert experience in the teaching profession. Makoa and Segalo (2021) define novice educators as newly qualified educators with a teaching experience of less than five years. For the purpose of this study, the term 'novice educator' refers to an in-service educator with six years or less of teaching experience in the school subject of mathematics. Guided by these

definitions, the study participants who were classified as novice educators were those who had been profiled as having taught mathematics for a period of six years or less, prior to the commencement of this study.

For Ariff, Mansor and Yusof (2016), a novice educator plays a significant role as a transmitter of skills and information to learners; these educators must master the latest knowledge and skills, to adequately discharge their duties. Hence, novice educators should constantly attempt to explore new ways of teaching, to grow professionally. However, this depends on how novice educators use their existing knowledge and skills during the teaching and learning process (Ariff, Mansor & Yusof, 2016). In this study, this is determined through the adjustment of their teaching, where weaknesses are identified during the reflective practice.

Thus, this study gives specific consideration to novice educators, during the first, second and third cycle. Throughout the study, the novice educators were active participants. Their roles were: (1) To teach during the lesson observation, while it was being video recorded and simultaneously being observed by the researcher and one experienced educator; (2) To self-reflect in their reflective journals, after the lesson had concluded; and (3) To be active participants and reflect during the VSR interview.

Sarhandi, Khan, Buledi and Asghar (2016) argue that if PD training is incorporated into the teaching practices, the impact thereof is likely to be significant. For the purpose of this study, I have chosen to focus on novice educators because novice mathematics educators are fairly new to the teaching paradigm and might be more willing to adapt and/or adjust their teaching approach, compared to experienced educators who have become comfortable in their teaching and might be reluctant to learn new ways of teaching.

2.2.2 The concept of 'experienced' educators

Although this study gives special attention to novice educators, during the first, second and third cycle of this study, the experienced educators served as active observers, mentors and advisors to

the novice educators. During the VSR interview, the designated experienced (expert) educator was an active participant along with the researcher. The role of the experienced educator throughout this study was: (1) to observe and take field notes of the lesson, while it was being video recorded; and (2) to be an active participant during the VSR interview. Therefore, the experienced educator served as mentor and advisor to their less experienced counterparts, the novice educators. This was to determine whether the experienced educator and novice educator were able to form a school team (pair), to assist the novice educator in the notion of self-reflection. This may, in turn, contribute to moving the novice educator towards effective classroom practices.

For Findell (2008), an experienced (expert) educator possesses the following qualities: "(1) identifies key ideas, presents them in several ways, and highlights connections among key ideas; (2) makes careful plans, but remains flexible; (3) listens to students and asks questions to help them make sense of their own understanding of key ideas; (4) provides "low threshold, high ceiling" problems; (5) helps students think for themselves; and (6) never stops learning" (p. 11). In addition, research conducted by Orgoványi-Gajdos (2015) claims that experienced (expert) educators display the following attributes, compared to novice educators. These attributes are listed using bullet points.

- Through underlying functions (called chunking), experts are able to structure information.
- Information can be perceived as meaningful patterns by experts.
- While novices focus on superficial features of problems, experts categorise them according to their deep structures.
- In a specific domain, experts have an elevated level of content knowledge.
- Experts are able to organise their knowledge around crucial concepts and principles.
- For the current situation, experts are able to efficiently retrieve suitable knowledge.
- While novices start to solve problems immediately, experts spend more time on analysing and understanding problems and then solve them quicker.
- While novices use backward thinking processes (from the goal), experts have forward thinking processes (to the goal).
- When approaching a problem, experts are more flexible.
- Experts create a strong connection between the process of self-regulation and metacognition.
- Through the representation of a problem-situation, experts generate more complex and sophisticated ideas.

According to Palmer, Stough, Burdenski and Gonzales (2005, cited in Orgoványi-Gajdos, 2015), researchers are inclined to choose one or more of the following categories, when conversing about educator expertise: "(1) years of experience (in most studies the number of years of experience is usually between 5 and 10 years), (2) social recognition or nomination (teacher certification), (3) professional or social group membership (status as a cooperating or mentor teacher), (4) performance-based criteria (student achievement such as knowledge and love of subject)" (p. 592). In relation to these attributes, for this study, an experienced educator is one with more than seven years of teaching experience in the school subject of mathematics, prior to the commencement of this study. Orgoványi-Gajdos (2015) explains that an educator's work mainly consists of two parts: an interactive phase, which occurs during a lesson; and a planning phase, which includes evaluating the previous lesson. Interestingly, Orgoványi-Gajdos (2015) highlights the differences between expert educators' and novice educators' recalling of classroom events by stating: "(1) expert teachers are able to explain classroom events by recognizing familiar patterns while beginning teachers try to notice the phenomenon's; (2) experts recall on students' behaviour and understanding while novices focus more on their own behaviour; (3) novices recall the physical appearance of students rather than their work-related actions; (4) experienced educators have more and greater recall of classroom events after the lesson than novices" (p. 593). These elements of recall are central to this study because they provide guidelines as to what novice educators ought to notice, compared to what experienced educators may have noticed, should they have been the observed educators.

2.2.3 Professional development

In the South African context, various interventions have been initiated post-1994 in attempts to equip mathematics educators with the necessary skills and knowledge to address the challenges still being faced today (Adler & Reed, 2002), such as poor learner performance. Nel (2015) suggests that a solution to learners' deficient performance in the subject of mathematics is the improvement of the teaching of mathematics. Thus, effective PD programmes could assist in the enhancement of learners' performance.

PD is identified as a construct used to ensure the continuous expansion and strengthening of educators' skills and knowledge throughout their teaching practices, to implement effective teaching (Mizell, 2010). To successfully achieve and maintain an efficient level of teaching, effective PD programmes should be implemented. This is supported by Nel (2015) who maintains that 'up-skilling' educators involved in the current system is one way of improving learners' mathematics pass rates. This is a dual commitment to student learning and educators' PD, which has been identified in effective teaching practices (Seligmann, 2012). Hence, this study encourages effective teaching practices through the notion of self-reflection, to 'up-skill' mathematics educators' proficiency. The term 'proficiency' creates a link between the development of educators' ability to teach the required content effectively and the enablement of educators to provide learners with skills to develop an adequate understanding of mathematical concepts. Therefore, the enhancement of educators' knowledge bases, through an in-house PD programme, may improve teaching practices, while simultaneously addressing learners' poor academic performance in mathematics education.

Generally, an in-house PD programme initiative is able to avoid a one-size-fits-all approach. Farrell and Richards (2005) note that through the long-term development of educators and equally the long-term success of PD programmes in which they work, crucial opportunities for in-service training are available. This is central to the idea that PD should be context-based and customised to the specific needs of the relevant educators. PD programmes in South Africa are mostly completed off-site (off school premises) and are commonly based on the generalised needs of educators. In other words, these programmes are not customised to the specific needs of a particular educator. Through an in-house PD initiative, the training can be customised to educators' unique teaching contexts (environments), which prevents a detached off-site learning approach. This leads to a first-hand teaching analysis according to the specific needs of the participating educators. Hence, through the in-house PD programme proposed in this study, the experienced educators (peers) were able to provide support and guidance. They were also able to identify the unique weaknesses in the novice educators' teaching practices, where their MKfT was used to identify potential development areas. This makes the PD initiative unique to the novice educators' teaching and avoids a one-size-fits-all approach.

2.2.4 Reflective practice

Often, reflection is cited as an element of professionalism linked to effective teaching practice. The concept of reflection arose through the work of Dewey (1933), and "soon afterwards it appeared in the educational sciences as a form of pedagogical thinking" (Gazdag, Nagy & Szivák, 2019, p. 60). Von Glasersfeld (1995) argues that: "from the constructivist perspective, learning is not a stimulus-response phenomenon…It requires self-regulation and the building of conceptual structures through reflection and abstraction" (p. 14). Patil (2013) views reflective practices as a way an individual engages in a process of on-going learning and developmental awareness. According to Galvez-Martin (2003), reflection was defined by Cruickshank and Applegate (1981) as the means through which educators can be assisted, through PD, to be cognisant about what happened, what they could have done to be more effective, what they would change to improve their teaching performance, and why it happened. Stronge (2007) defines reflection as "a careful review of and thoughtfulness about one's own teaching process" (p. 30). Therefore, reflective educators are introspective, as they often seek a greater understanding of their own teaching practices (Stronge, 2007). Nyaumwe and Mtetwa (2011) note that reflection is often identified as a crucial factor that enables educators to make more effective decisions in improving their teaching paradigms. Reflection provides a context for educators to: "(1) use their decision-making skills to analyse the learning environment, (2) assess learner knowledge gaps and how to reduce them, (3) improve questioning techniques, and (4) evaluate the pace of a lesson and suitability of activities to enhance learner understanding" (Nyaumwe & Mtetwa, 2011, p. 147).

Effective and quick decision-making during teaching enables educators "to question the relevance of the content the learners are learning, level of challenge, and decisions on other viable alternative ways of presenting the same content so that all the different ability levels of learners in a class can be challenged to think deeply" (Nyaumwe & Mtetwa, 2011, p. 146). Cognitively, for the educator, this is the transition from a state of *unconscious incompetence* to *conscious incompetence*, through the conscious competence learning model. Thus, the art of reflective practice may be used by educators as a way to evaluate their level of competence and as a means to improve their practice-based professional learning, where they can notice learners' level of understanding. This is consistent with Schon's (1983) definition of reflection-in-action, which affords an individual the opportunity to redesign the task at hand while doing it, thus combining both reflection and action. Reflection-in-action refers to the process of interpretation, analysis, and provision of alternate solutions to the task at hand, when it occurs (Schon, 1987). This form of teaching practice

(reflection-in-action) was used in parallel to VSR, as episodes were purposefully selected based on the potential development they could foster. For Nyaumwe and Mtetwa (2011), reflection-in-action entails scrutinising a teaching episode as it unfolds, assessing its level of effectiveness in terms of learner understanding, and the identification of the theories being used.

Rich and Tripp (2012) construe reflection as an investigative, self-critical process wherein educators contemplate the effect of their pedagogical decisions on their situated teaching practice, through retrospection, with the aim of improving those teaching practices. This sentiment is consistent with Osterman and Kottkamp's (1993) description the notion of reflective practice as a method through which educators can attain a deeper level of self-awareness about the impact and nature of their performance. This level of awareness creates opportunities for PD and growth. In addition, reflection-on-action (post-lesson reflection) involves a recollection of thought on what the educator has done during the instructional episode, to assess how their knowing-in-action produced (un)intended learner outcomes (Schon, 1983). In this study, post-lesson reflections occurred once the relevant educator had finished teaching the lesson, which had been video-recorded and selected episodes were viewed one or two weeks later. This was to ensure that the novice educator could recall and analyse the decisions made and the actions taken, through the VSR interview. In the meanwhile, the novice educator used a reflective journal to unpack how the lesson had unfolded, from his/her perspective, prior to viewing the video recording. The resulting data were used in conjunction with the VSR interview data. According to Nyaumwe and Mtetwa (2011), the "insight derived from post-lesson reflections makes it possible to evaluate the effectiveness or ineffectiveness of implementation strategies of instructional theories, decisions taken, or activities organised for a lesson" (p. 146). This insight could provide educators with pedagogical options in a manner that could provide an understanding of their teachings. The continuous commitment to consciously reflect on their teachings fosters educators professional and personal growth which, in turn, might help them to become better reflective practitioners.

Ferraro (2000) argues that, by gaining a thorough understanding of their own teaching practices, through reflection, educators could be more effective in their teaching strategies. Leachy and Corcoran (1996), cited in Sibam (2018), conceive effective educators as those who are reflective in their values, practices, and beliefs. Hence, this study extends through the conscious competence learning model which states that educators go through a series of cognitive changes characterised

by four stages (levels), when they articulate reflectivity on their practice, through the process of 'noticing'. The essence of the 'discipline of noticing' was defined by Mason (2011) as the fact of arranging oneself in future, so as to not act out of habit but to act 'freshly'. Here a collection of teaching practices was designed to sensitise oneself so as to notice future opportunities (Mason, 2011). This notion of self-reflection might have limited educators to perceive the teaching of mathematics as a 'ready-made system' with common applicability. Hence, reflective practices could play a significant role in improving the PD of educators (Korthagen, 2004; Larrivee, 2008).

Mason (2011) described his first encounter of 'noticing' in relation to viewing a poster and watching an animation and then having to reconstruct what was noticed in each, which led to the gradual development of a descriptive story (*account)* of what was viewed. This annotation was similar to what the educators who participated in this study were expected to do during the first, second and third cycle of the data collection. Mason (2011) notes that during the second viewing of the same story, observations were verified or augmented, hereafter the novice educators would begin to *account for* what they recalled seeing, by explaining how the story developed mathematically. This interpretation provided by Mason in 1981 was reiterated in the second and third cycle of the data collection in this study. The historical context of 'noticing' was quite relevant to this study as the educators were expected to articulate what they are viewing post-lesson, within their reflective journals and within the VSR interview that occurred one or two weeks later. They then had to choose whether they wanted to adjust and/or adapt their teaching strategy, after viewing the purposefully selected episode.

According to Nyaumwe and Mtetwa (2011), throughout post-lesson reflections, educators "spend some time exploring the rationales for their actions and learner responses to them through making careful analyses of what happened, why it happened, and what they could do differently to improve their teaching performance and learner understanding" (p. 146). This coincides with Mason's (2011) claim that using video as a stimulus is an effective tool to prompt individuals to recall, notice and then analyse related incidents, similar to their own teaching. The technique chosen for this study is asking individuals to either choose a noticeable moment and describe it to the colleagues, while reducing all judgments and emotive terms to a minimum, so that the moment could be readily recognised by everyone; or to proceed incident-by-incident and collectively reconstruct what they thought they had seen (Mason, 2007). In Mason's (2007) study, the

participants viewed other practices and had to relate them to their own teaching practices. However, within this study, the researcher used the video-recorded lesson of novice educators. The selected episodes were based on the potential development that could occur. When selecting a segment (episode) that could assist the observed (novice) educator within their teaching, the researcher applied the concept of 'noticing.' Here, the emphasis was on what I, as the researcher, saw and what the novice educators may have seen and could recognise. That was not based on emotive or affective aspects, but rather on behavioural aspects (Mason, 2011). By using this technique, the novice educators "used what they saw on the video as a combination of metonymic triggers into, and metaphoric resonances with, their own past experiences" (Mason, 2007, p. 36). Through this practice, the novice educators are able to use their own teaching practices, through the notion of reflection which enables them to evoke change through the four cognitive stages of the conscious competence learning model: (1) *unconscious incompetence*, (2) *conscious incompetence*, (3) *conscious competence*, and (4) *unconscious competence.*

2.2.5 Video-stimulated-recall (VSR)

For Beutel, McFadden, Nguyen and Tangen (2013), VSR is a "research technique in which the participant view(s) a recorded video sequence of their behaviour and events that took place and are then invited via a video-stimulated interview to reflect on their decision-making processes throughout the videoed event" (p. 1). Therefore, within this study, the process of VSR refers to a collaborative inquiry between the novice educator, the experienced educator, and the researcher; where the dialogue focuses on the novice educator's reflection about aspects of their teaching practice (Powell, 2005). Video-stimulated dialogues enables educators to reflect and articulate their thinking and feelings by defining the context and focus of their inquiry into the participating educators' professional practice (Muir, 2010).

Galvez-Martin (2003) observes that in the majority of schools, self-reflection is not being promoted among educators, and many educators are not interested in reflecting at all. Therefore, the notion of reflection stagnates or completely vanishes, over time. Hence, the notion of VSR, within this study, is used as a proposed tool for PD. This is because the stimulated-recall method allows the participants the opportunity to view themselves in action, through retrospection. The latter becomes a means to assist them to recall their thoughts and actions forming part of their teaching, as it occurs (Beutel et al., 2013). By videotaping the lessons, normal teaching duties and

practices are recorded. Then, selected episodes (segments) are replayed to the novice educator, one to two weeks later, to promote recall for self-reflection. Within this stage, educators' self-reflection is "then elicited through an interview on different aspects of their recorded interactions as they are watching the video" (Beutel et al., 2013, p. 2). The reason for using VSR in this study is to gain insight in terms of why the participants teach mathematics in a certain manner and to identify and explore their developmental prospects regarding MKfT. The video recording was set in the participating educators' classroom, thus promoting in-house PD. In this study, the VSR was based on observing and video recording the lessons, to assist in the development of effective classroom practices through self-reflecting on errors, misconceptions, and weaknesses within the mathematics educator's pedagogy.

According to Muir (2010), VSR refers to a cooperative review between the educator and the researcher, where the dialogue is focused on the cognitive aspects of the educator's practice. This is because VSR is about the recording of lessons and then the viewing of certain episodes (segments) of the lesson by the novice educator and the More Knowledgeable Others (MKOs) (the researcher and the experienced educator). According to Gerber and Pellegrino (2012), the objectivity and permanence potential of video could allow educators to closely and repeatedly examine their classroom practice and sustain PD, in the process. Hence, the notion of VSR through self-reflection provided the novice educators with the opportunity to improve their teaching practices. Therefore, VSR encompassing the notion of reflective practice as dialogue allowed the novice educators to articulate their feelings and thoughts by defining a context-focused inquiry in terms of their professional practice (Muir, 2010). Thus, this study strove to use VSR as a means of contributing to effective classroom practices by using reflective practice as a tool forming part of a PD initiative for novice mathematics educators.

2.2.6 Effective teaching practices

The Human Sciences Research Council (HSRC) (2006) relates the poor preparation on the part of teachers, among other reasons, to learners' poor results. The poor preparation of student (pre-service) educators may lead to the cycle of poor learner achievement. This is perpetuated by the poor teaching practices to which they are exposed (Chikiwa, Graven & Westaway, 2019). This is often due to pre-service educators obtaining limited MKfT during their initial training which, in turn, affects their teaching abilities when they become in-service educators (Chikiwa, Graven &

Westaway, 2019). Hence, Ball (2003) recommends that mathematics educators be provided with PD opportunities that equip them with mathematical knowledge and skills that enable them to teach mathematics more effectively. Therefore, it is crucial to establish effective PD programmes which will enable educators to keep "abreast of ever-increasing educational needs, and the challenges associated with the teaching and learning of Mathematics" (Nel, 2015, p. 9). According to Ball (2003), this will require a sustained and deliberate emphasis on recognising the mathematical knowledge "needed for the teaching of Mathematics, on understanding its' specific uses in teaching, and the careful development of well-designed and taught courses" (p. 8). In support of this, Kilpatrick, Swafford, and Findell (2001) underscore that the mathematics teaching competency is connected to effective classroom practices. These are achievable through consistently assisting learners by being versatile in the classroom.

According to Stronge (2007, cited in Seligmann, 2012), effective educators possess a range of teaching techniques and the ability to select the appropriate teaching method for learners' needs. Hence, effective educators are always seeking better ways to teach, as they invest in their own education. Seligmann (2012) further observes that educators "who engage in reflective practice portray themselves as students of learning. Such teachers continuously practice self-evaluation and self-critique as learning tools...They continuously seek ways to improve lessons and try out new approaches in the classroom to better meet the needs of their learners" (p. 111). Stronge (2007) emphasises the various factors that contribute to one being (or becoming) an effective educator. Within the second edition of '*Qualities of Effective Teachers'* (2007), diverse elements of effective teaching were identified within broad categories. The elements, which are relevant to this study, are included and numerically listed from one to five.

1. Content knowledge and effective teaching.
2. Using classroom management skills (Classroom management).
3. Maximising instructional time (Time management skills).
4. Planning, preparing (and organising) for instruction (Lesson planning and teaching style)
5. Classroom management and organisation (Classroom layout)

I will now elaborate on each of the numerically identified categories from one to five.

1. Content knowledge and effective teaching

Research has extensively investigated the role of an educator's content knowledge in relation to educator effectiveness. For Stronge (2007), "strong content knowledge has consistently been identified as an essential element by those who study effective teaching" (p. 10). Therefore, Subject Matter Knowledge (SMK) positively affects the notion of teaching performance. Researchers define SMK expertise in terms of the inclusion of "the ability to convey and teach content to others, as well as a deep understanding of the concepts and ideas being taught" (p. 10). Therefore, there is an interrelation between educators' development for teaching the required content effectively and the enablement of educators so that they can assist learners with skills to develop an adequate understanding of mathematical concepts.

2. Using classroom management skills (classroom management)

Ahmad and Eka (2020) contend that the management of a classroom plays a significant role in learners' academic achievements. Kunter, Baumert and Köller (2007) note that the concept of 'classroom management' commonly entails all measures taken by the educator to ensure order and effective time usage throughout lessons. Doyle (1986) defines management as the strategies and actions that educators use to solve problems of order in a classroom. A study conducted by Asiyai (2011) found that effective classroom management strategies include effective communication among and between learners and educators, constant engagement of learners in classroom activities, regular use of question-posing by educators, behaviour reward and reinforcement measures, as well as a motivational teaching and learning environment. The conclusion that could be drawn is that the effectiveness of educators' classroom management is a significant predictor of learners' learning abilities and their academic performance. This is supported by Ali (2021) who notes that "classroom management strategies also contribute to effective teaching and learning" (p. 10). Therefore, effective management of a classroom may lead to improved learner performance, as the strategies contribute to effective teaching.

3. Maximising instructional time (time management skills)

Studies have indicated that educators spend about "70 percent of their classroom instruction time on the core curriculum" (Stronge, 2007). Research has also shown that learners' academic achievement is higher in classes where the instructional time is maximised by the educator (Stronge, 2007).

4. Planning, preparing (and organising) for instruction (lesson planning and teaching style)

In this study, the notion of planning and preparing for effective instruction was regarded as the educator's overall planning of a Mathematics lesson. Although a national school curriculum exists, educators are responsible for the way it is delivered. According to Stronge (2007), planning is a thoughtful process that results in educators "being well prepared prior to walking through the classroom door for the day. Organising time and preparing materials in advance of instruction have been noted as important aspects of effective teaching" (p. 57). The positive qualities of this includes the educator's writing of lesson plans for each day of school, and the educator incorporating technology into these lesson plans. For Ali (2021), "lesson planning is a process of setting objectives, activities, and timeline for imparting lessons in a classroom" (p. 8). In this study, the notion of lesson planning was regarded as a tool or source that guides the educator through their teaching process. Stronge (2007) defines the notion of implementing instruction as "an opening night at the theatre, where all the behind-the-scenes work is hidden and only the magic is seen by the audience" (p. 122). Therefore, effective educators master the art of magic effortlessly.

As the notion of planning a lesson was regarded as a tool or source that guides the educator throughout their teaching process, within this study the incorporation of technology is regarded as an extended teaching tool. Angers and Machtmes (2005) indicates that the use of technology in the classroom creates "rich learning environments and experiences with project-based learning activities that shift away from the classroom practice of teacher-centred lessons" (p. 789). Therefore, when educators incorporate technology into their lessons it serves as a teaching tool that they can use to improve their teaching with "new ideas, new lessons, visuals, hands-on activities, and new levels of teaching" (Angers & Machtmes, 2005, p. 789). When educators incorporate technology into their classrooms, flexible and organised planning are crucial elements in this teaching style. However, it is crucial to have a backup plan that is non-technology based, in case of technological failures or equipment problems, so that the educator has his/her backup materials available at a moment notice.

Indeed, Chan (2020) notes that there are crucial aspects of planning, when writing on the whiteboard. Within the educational setting, whiteboards are dry-erase boards, commonly mounted to walls, on which one can use dry-erase markers that are easily wiped clean with a whiteboard

eraser (Wenning, 2005). Although Forrester, McPhail, and Denny (2017) claim that the "essential features of whiteboards are the readily shared space they provide for recording ideas, their ease of use in communicating these ideas, and the flexibility they provide for writing, erasing and modifying responses" (p. 261); Chan (2020) cautions that when one is writing on the whiteboard, one "is to ensure that when one looks at the whiteboard, one can see the logical flow of the lesson with all the essential information on it" (p. 7).

In this study, the notion of organising for effective instruction was regarded as the educator's overall teaching style. Serin (2018) observes that educators have always attempted to search for the ideal teaching style to be implemented in the classroom, for effective teaching and learning to commence. Classrooms, nonetheless, either use teacher-centred or learner-centred teaching and learning approaches. According to Serin (2018), a teacher-centred approach refers to the communication of knowledge to learners in a teaching-and-learning environment in which the educator has the primary responsibility. Serin (2018) finds that, commonly, in a teacher-centred classroom, the educator spends most of their time presenting the day's content to learners, using the overhead projector or whiteboard/promethean board. Within this classroom setting, the learners would be taking notes and asking questions throughout the lesson. For Serin (2018), this process of teaching and learning is not troublesome for the learners and tends to be completed with ease. Thus, within this environment educators are facilitators and active participants in the dissemination of knowledge, whereas learners are passive receivers of knowledge. Conversely, in a learner-centred classroom, instruction is received from the educator as the facilitator, but s/he provides a teaching and learning environment to the learners "in which they construct their skills and understanding" (Serin, 2018, p. 164). Thus, learners play an active role in the teaching and learning process by trying "to make sense of what they are learning by relating it to prior knowledge and by discussing it with others" (Brophy, 1999, p. 49). Hence, it may be argued that a learner-centred classroom is better suited for a mathematics classroom, because learners actively partake in the mathematics while simultaneously constructing their own knowledge.

5. Classroom management and organisation (classroom layout)

According to Stronge (2007), a "classroom reveals telltale signs of its users style" (p. 117). Within this well-organised classroom, the "furniture arrangement and classroom displays often reveals how the teacher uses the space" (p. 117). The positive qualities of this classroom organisation

include the educator positioning chairs in groups or around tables, to promote maximum interaction among learners; the covering of walls with student work and student-made signs; the encouragement of interactions among learners; and classroom arrangements that such that all learners can hear and see the educator.

In keeping with the positive qualities of classroom organisation McCorskey and McVetta (1978) remark that the traditional classroom arrangement typically consists of about five to six perfectly straight rows, each containing chairs placed equidistant from one another, as seen in figures 2.1. According to a survey conducted, over ninety percent of classrooms have this type of arrangement (McCorskey & McVetta, 1978).

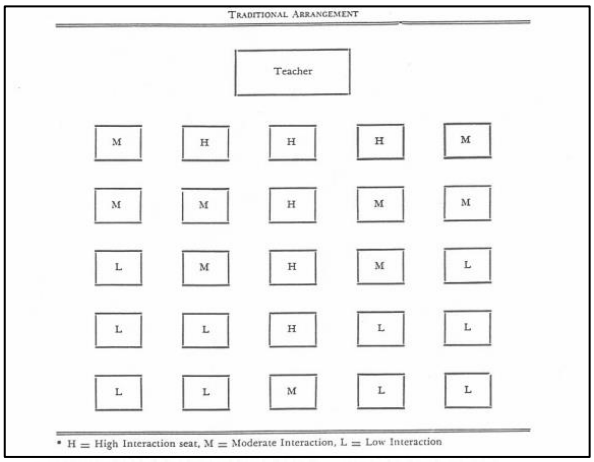


Figure 2.1: Traditional seating arrangement according to McCorskey and McVetta (1978)

McCorskey and McVetta (1978) further stress that the modular classroom seating arrangement, as seen in figure 2.2, is commonly found in lower school levels and specialised classrooms such as science laboratories. Literature states the modular seating arrangements are encouraged for classes in which learner-learner interaction is required. This is because this seating arrangement permits more interaction among groups of learners, while minimising the interference of one group with another. Therefore, if an educator seeks to increase communication in the classroom, the modular arrangements could be chosen, as it is argued that the traditional system is least conducive to interaction (McCorskey & McVetta, 1978).

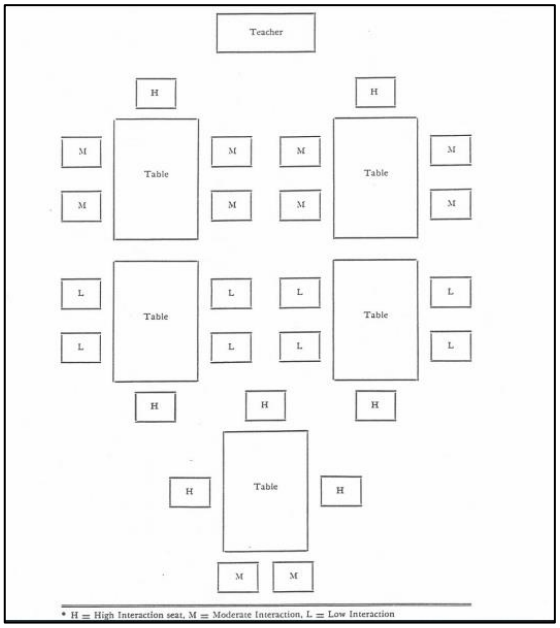


Figure 2.2: Modular seating arrangement according to McCorskey and McVetta (1978)

2.2.7 MKfT in relation to this study

Mathematical Knowledge for Teaching (MKfT) was used in this study to assist with the identification of where potential development could occur, in terms of self-reflection. As previously mentioned, MKfT is defined in terms of mathematical habits, skills, and knowledge necessitated in teaching (Chikiwa, Graven & Westaway, 2019). As MKfT is the knowledge, skills, and habits required by a mathematics educator to conduct the teaching of mathematics, all mathematics educators should obtain an adequate level of MKfT. The latter conceptualises the knowledge required for teaching mathematics by reducing ineffective teaching practices, through the implementation of Pedagogical Content Knowledge (PCK) and Subject Matter Knowledge (SMK). Consequently, throughout this study, the attainment of new adequate levels of MKfT was due to reflective practice. Therefore, reflective practice forming part of a PD programme was a proponent of this study, where VSR was used as a reflective tool to assist in moving towards the effective teaching of mathematics.

SMK and PCK are crucial aspects of MKfT which enables the educator to facilitate teaching and learning effectively. This is supported by May (2017) who indicates that "it is commonly agreed that the demands of teaching require knowledge at the intersection of mathematical content knowledge and knowledge of teaching" (p. 5). According to Taylor and Taylor (2013), studies

have shown that effective teaching requires the integration of content knowledge and the skills with pedagogical knowledge. Similarly, Shulman (1987) notes that PCK can bridge the teaching-practice-and-theory gap.

In this study, these key knowledge branches were explored through the implementation of an in-house PD tool that aligned with a teaching strategy. The attainment of these branches strove to assist educators "to understand the mathematics they are teaching, how learners learn specific contents of Mathematics and how to facilitate that learning process" (Kilpatrick, Swafford & Findell, 2001, p. 10). Hence, the enhancement of mathematics educators' knowledge bases through in-house PD programmes may improve teaching practices and lead to the improvement of learners' overall mathematical skills and understanding.

When learners and educators engage in the notion of 'doing mathematics', they might successfully enact the mathematics lessons and problem-solving strategies learnt, which may facilitate effective teaching. According to Nyaumwe and Mtetwa (2011), effective teaching "entails presentation of concepts using multiple forms that can integrate demonstrations and explanations with pictorial representations in order to make mathematical concepts familiar to the learners' contexts" (p. 145). Therefore, novice educators could intertwine theory and practice, to enact effective teaching through self-reflection, with the assistance of cooperating peers (experienced educators).

The art of reflective practice is enacted when educators are actively thinking about teaching. This involves making decisions and judgements to improve learners' understanding by necessitating thoughtful deliberations on purposeful actions (Nyaumwe & Mtetwa, 2011). This cognitive process of reflection through an in-house PD programme could foster the epistemological enhancement of mathematics educators' knowledge bases. This, in turn, may improve teaching practices and may lead to the improvement of learners' overall mathematical skills and understanding. This could be achieved by using VSR, through a paradigm of reflective practice. To implement the aforementioned teaching and learning method, educators would need to apply their 'take-up' of concepts and skills learnt from their own teaching practices accordingly, to effectively emit change. This is fundamental as the understanding of content knowledge builds on the transition from one aspect to another (Brijlall & Ndlovu, 2019), which could improve

educators' PCK. In this regard, Ball (2003) states that the quality of educators' teaching of mathematics is dependent on their knowledge of the subject. Although MKfT is a fundamental aspect of mathematics teaching because it is recognised "as having to know why procedures work, that certain properties are true, that particular relationships exist, and on what bases" (Ball, 2003, p. 4), inconsistencies often exist when novice educators apply it to their teaching.

According to Ball (2003), the teaching of mathematics involves an understanding and awareness of fundamental mathematical connections. Dewey (1993, cited in Ball, 2003), states that the knowledge one needs for teaching must be organised both logically and psychologically. Thus, a competent level of MKfT is a central element required for effective mathematics teaching. Within this study, after the participating educators' lessons had been observed and video recorded, the video-stimulated interviews focused on how the novice educators self-reflect on their MKfT needs and/or gaps. Hence, the researcher and the experienced educators (observers) served as the MKOs during the VSR interviews, throughout the three cycles. Through these three cycles, the notion of self-reflection occurred through the data collection instrument consisting of VSR interviewing, episodes (segments) of the observed educator's (novice) lessons were purposefully selected and viewed. These lessons were not based on a specific mathematics content area or topic that had been taught, but on the way in which the lesson had been taught. Through this notion, the novice educator was able to visually identify where professional, yet context-specific development could occur, through the use of self-reflection facilitated by the VSR interview.

2.3 Theoretical framework

A theoretical framework is defined as:

> …The foundation from which all knowledge is constructed (metaphorically and literally) for a research study. It serves as the structure and support for the rationale for the study, the problem statement, the purpose, the significance, and the research questions. The theoretical framework provides a grounding base, or an anchor, for the literature review, and most importantly, the methods and analysis… (Grant &Osanloo, 2014, p. 12)

In keeping with the aforementioned definition, the theoretical framework of this research project was informed by a combination of constructivism and social constructivism, where the Zone of Proximal Development (ZPD) is linked to the notion of reflective practice, which primarily occurs through the conscious competence learning model's four cognitive states of awareness.

2.3.1 Social constructivism

The first theoretical framework that underpins this study is constructivism. According to Spivey (1997), constructivists view individuals "as constructive agents and view the phenomenon of interest (meaning or knowledge) as built instead of passively received by individuals whose ways of knowing, seeing, understanding, and valuing influence what is known, seen, understood and valued" (p. 3). Constructivism emerged as a prominent theory in relation to teaching and learning based on the work of Dewey (1952). This was due to the principles associated with the view of knowledge as a process where individuals learn through social interaction (McLeod, 2019) among peers, more specifically through the notion of self-reflection.

Psychologist Jean Piaget (1936) notes that although learners are engaged in active learning, the attainment of knowledge is socially constructed (Donald, Lazarus & Moolla, 2014). This is supported by Koohang, Riley, Smith and Schreurs (2009) who define the constructivist learning theory "as active construction of new knowledge based on …prior experience" (p. 92). This theory of knowledge (epistemology) is based on the concept that individuals are able to construct new knowledge and make meaning of prior knowledge through their own experiences, mental structures, and beliefs. This is achieved through interaction involving the interpretation of events and/or objects (Gogus, 2012). Hence, the notion of active constructivism allows an individual to gain a deeper understanding of cognition through the construct of mediation achieved through the process of social interaction with an MKO. This interaction includes collaboration, scaffolding, peer guidance, and self-reflection. This is due to cognitive development stemming from learning-based social interactions guided by an MKO, which foregrounds a co-construction of knowledge through collaborative dialogue.

Social constructivism "is the view that learning and meaning making are a social endeavour" (Troudi, 2014, p. 4). Donald, Lazarus and Moolla (2014) claim that knowledge is attained through social construction, as it is always in the process of construction and reconstruction, both individually and socially. For Parker (1998), social constructivists view individuals' experiences as historically and culturally mediated through ever-changing social practices (Troudi, 2014). Lam and Li (2013) emphasise that Vygotsky (1978) considered the roles of language and interaction, as well as culture and society as important in comprehending how one learns. This form of construction is achieved through mediated interaction.

According to Vygotsky (1978), mediation through the notion of proximal social interaction is the 'engine' that drives cognitive development (Donald, Lazarus & Moolla, 2014). Hence, mediation is the process through which an individual takes possession of, or appropriates, the cognitive tools that enable the construction of knowledge (Donald, Lazarus & Moolla, 2014). Thus, mediation may lead to higher cognitive functions (Donald, Lazarus & Moolla, 2014). However, this cannot be done alone, the MKO who has already acquired these tools is actively involved in the mediation process. Vygotsky (1978) contends that an individual's level of potential understanding of concepts is clarified through the assistance of a prospective mediator who assumes the role of an MKO, within the ZPD. Donald, Lazarus and Moolla (2014) construe the ZPD as a central space where an individual "cannot quite understand something on their own but has the potential to do so through proximal interaction with another person" (p. 79). Tharp and Gallimore (1988) claim that this is a pedagogical breakthrough in that a culturally more advanced individual is needed to signpost the dialogical or interactive nature of learning. Thus, the notion of mediation assists in understanding the essence of pedagogy as guided assistance. Solving problems in pairs or small groups can promote mutual cognitive development (Donald, Lazarus & Moolla, 2014). Hence, the ZPD provides an area in which an individual receives assistance from an MKO to achieve more than s/he can manage to do alone (Dunne, Craig & Long, 2012). The ZPD is also a form of mediation where an individual's potential understanding of a concept becomes clearer (Donald, Lazarus & Moolla, 2014). Lam and Li (2013) suggest that within the ZPD, "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under…guidance or in collaboration with more capable peers" (p. 2). Thus, meaning is attained through the interactions between, the individuals concerned, where new knowledge is constructed as individuals try to make sense of their experiences.

According to developmental psychologists such as Wood, Brunner and Ross (1976), the notion of learning through the ZPD is accomplished through the developmental process called 'scaffolding', with the assistance of an MKO. Wood et al. (1976) define scaffolding as a developmental process that enables an individual "to solve a task or achieve a goal that would be beyond his/her unassisted efforts" (p. 90). According to Sarker (2019), during the scaffolding process, MKOs support other individuals' learning while they are in their ZPD. However, the support is gradually tapered off or fully withdrawn once assistance becomes unnecessary. This cycle eventually leads the individual to become adroit enough to independently perform that specific task on his/her own.

Naturally, especially in a mathematics classroom, the educator serves as the prospective mediator who assists learners in making connections clearer by engaging within the central space of their development (Donald, Lazarus & Moolla, 2014). However, in this study, the researcher initially serves as the MKO; whereas the experienced educator, an MKO compared to the novice educator, serves as an active observer, mentor and advisor during the three stages. Hence, the researcher and the experienced educator serves as the MKOs. According to Seligmann (2012), educators who partake in reflective practices depict themselves as 'students of learning'. These type of educators "continuously practice self-evaluation and self-critique as a learning tool…as they constantly seek ways to improve lessons and try out new approaches in the classroom to better the needs of their learners" (Seligmann, 2012, p. 111). Hence, the educator being observed (novice educator) takes on the role of a 'learner' throughout this study. This corresponds with the research by Siyepu (2013), which states that the ZPD should be used to link the gap between what a learner (novice educator) can accomplish with and without support. Through this form of teaching and learning, the researcher and the experienced educator facilitated and observed the novice educators' teaching practices, while recording their lessons. This could assist in their conceptual development during the VSR interview, through the notion of reflective practice.

The concept map by Robertson (2021) in figure 2.3, illustrates various intertwined aspects within social constructivism. This includes the social interaction which is fundamental to cognitive development which depends on the ZPD, where instructional support is received from a MKO through facilitation, guidance and/or scaffolding. Figure 2.3 further illustrates the importance of collaboration, the influence of language and the concept of collaborative problem solving.

Throughout this study, it is important to note that the novice educators took on the role of a 'learner' whereas the experienced educator took on the role of the 'educator'. This was due to the experienced educators being a mentor and advisor to the novice educators, where they also provided guidance on how to improve certain aspects of their teaching practices based on what was viewed in their video recorded teachings. The notion of social interaction amongst the 'learner' and 'educator' was accompanied by the personal critical thinking of the 'learner' (participating novice educators), as they viewed their recorded lessons. This fostered an environment of learning. This environment created a social collaborative community.

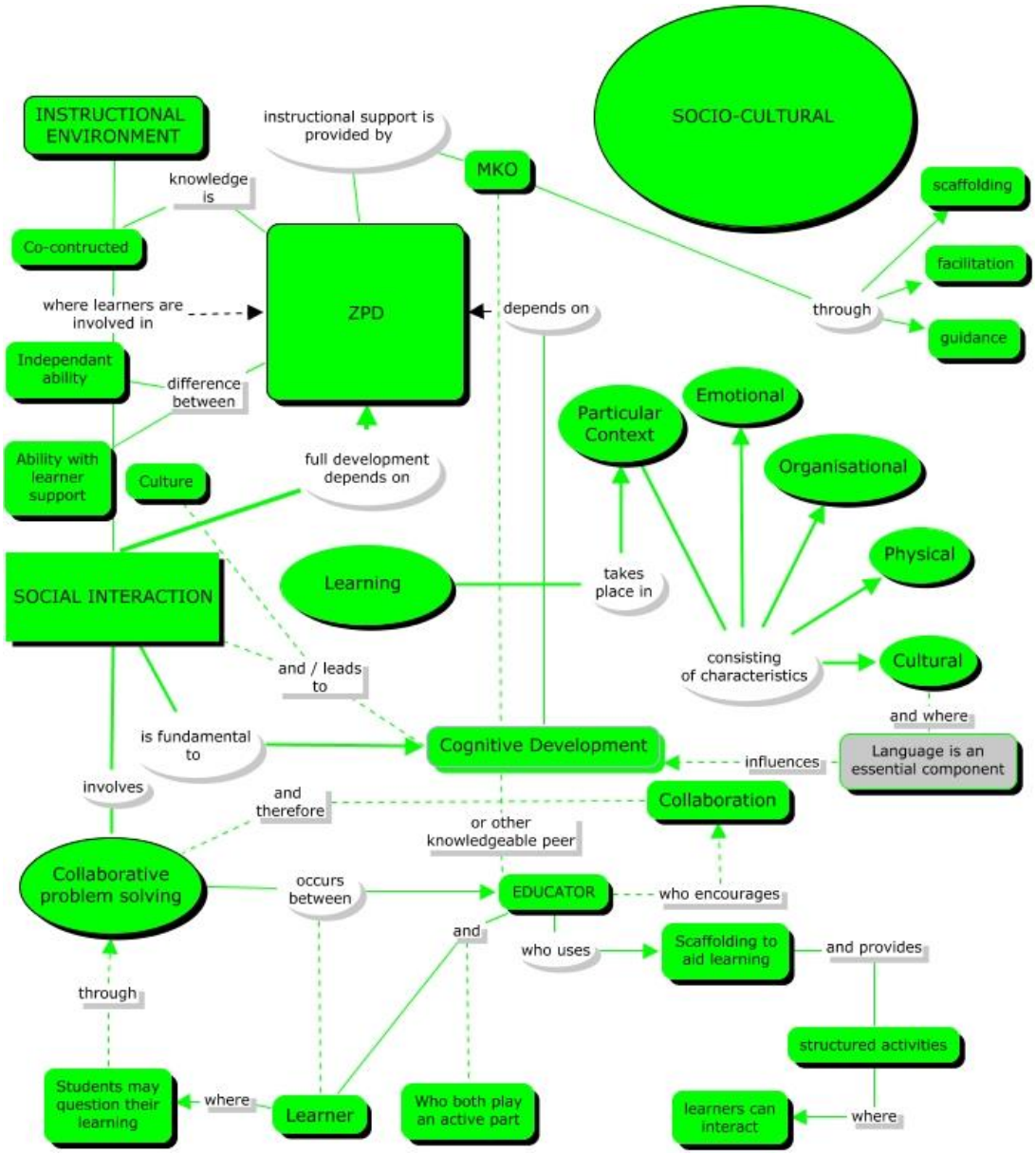


Figure 2.3: Social Constructivism Model by Robertson (2021)

2.3.2 The four states of cognitive awareness in relation to the notion of reflection

According to Nel (2015) "the lessons learnt by teachers from their exposure to reflective practice in their teaching should result in their engagement in new practices" (p. 14). Hence, MKfT is aligned to reflective practice within this study. This is achieved through the four states of cognitive awareness depicted in conscious competence learning model. These stages include: (1) *unconscious incompetence*; (2) *conscious incompetence*; (3) *conscious competence*; and (4) *unconscious competence*.

The conscious competence learning model was originally developed by Broadwell in 1969. In his article titled '*Teaching for Learning'*, Broadwell (1969) examined ways to improve a teaching programme, where he identified the art of teaching as a 'skill'. He noted that people of his time were interested in the concept of 'effective teaching'. However, he claimed that for most individuals, learning how to teach meant seeing, practising, and studying what was done, which was either right or wrong (Broadwell, 1969). Hence, he introduced the four levels of teaching where at the bottom level was the *unconscious incompetent* educator. It is important to note that the selection of participants was not based on a deficit model where the categorical terms such as *unconscious incompetent* categorised the participating educator as being 'less competent'. In contrast the categorical terms depicted in the model described the educators levels of self-reflection. Broadwell (1969) characterised the *unconscious competent* educator as a very deprived educator, who does not know it. This educator continues to teach in the same old way by possibly teaching in a dull, monotonous manner, completely unaware (Broadwell, 1969). Broadwell contended that nothing could be done to improve this educator's teaching until s/he reaches the next level, which is the *conscious incompetent* level. Within this level, the educator is described as an incompetent educator who is seeking assistance "and the chances are pretty good that he will find a way to improve his methods. He is willing to try something new; he is willing to admit that maybe he isn't getting through to his students" (Broadwell, 1969, p. 3). Broadwell (1969) explains that because this educator wants to improve their teaching, we can 'work' with them; and, by showing them the 'tools of the trade', they will start to get results, and they will know why. This means they have been raised to the third level of *conscious competent* (Broadwell, 1969). Within the third level, Broadwell (1969) claims that this educator is good and knows why; they also know what will and will not work for them. This educator has measured, experimented, changed, reviewed, and constantly sought more and better ideas to improve their teaching; this individual knows their capabilities and limitations (Broadwell, 1969). Then comes the final level, the

unconscious competent. For Broadwell (1969), this is a good educator by nature and, somehow, s/he "just always does the right thing, says the right thing and gets the right results. The trouble is, s/he does not know why he does what he does. He is in the small class of people called the *unconscious competent"* (Broadwell, 1969, p. 3). Thus, Broadwell (1969) characterised each level within the conscious competence learning model with a different educator, instead of one educator who goes through all the levels, from the bottom to the top. The present study, however, advocates for the use of VSR where the participating educators go through at least the first three stages within the conscious competence learning model. The educator should be able to notice a skill and/or discipline s/he wishes to improve on, through the notion of reflective practice, for effective teaching to occur.

In addition, the four stages within the conscious competence learning model were further developed in the 1970s by Noel Burch. The model represented by Figure 2.4 highlights the enhanced four phases of the process of learning. This model will be used throughout this study as the main conscious competence learning model.

Figure 2.4: Burch's (1970) four stages of the conscious competence learning model

The notion of reflective practice is further aligned to Schratz's (2006) proposal. According to Geiger, Muir and Lamb (2016), educators' "personal states of awareness are revealed when they articulate reflectively on their practice" (p. 462). Sequentially, the art of noticing and the incorporation of reflective practice as part of a teaching tool, through the use of VSR, could enable the participating educators to align their mathematics teaching to a teaching environment which

may result in learners gaining a deeper understanding of mathematical concepts. Schratz (2006) notes:

> *"When newly gained knowledge, skills and attitudes are mastered to the point of becoming unconscious, they can be perfected and integrated into our repertoire, so that it is no longer necessary for us to consider each step to take. Only then do we reach a certain self-assurance and independence in dealing with such knowledge or skills even in unusual, unforeseen circumstances. Routines emerge which on the one hand build up self-confidence but on the other can easily lead to new forms of unconscious incompetence…in learning that/what we do not know we progress from a state of unconscious incompetence to conscious incompetence"* (Schratz, 2006, p.48).

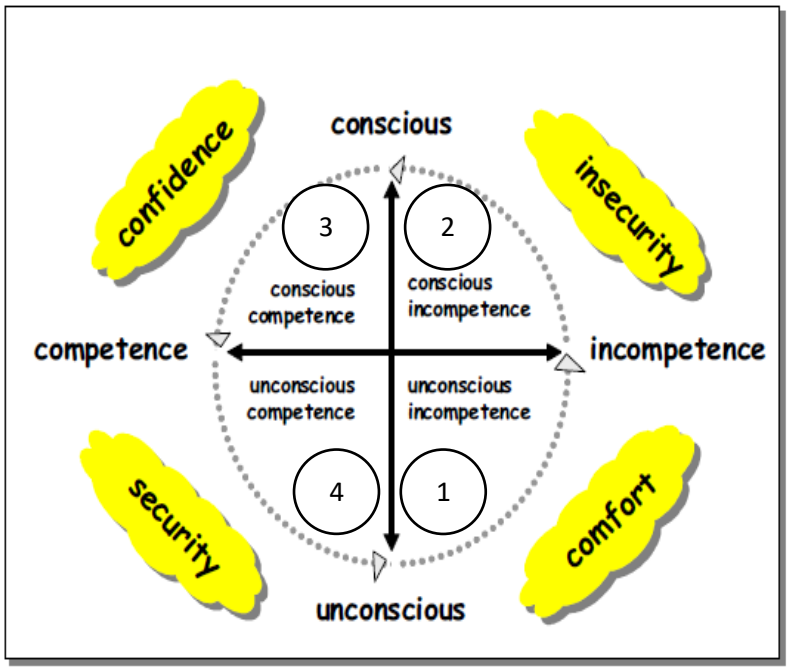


Figure 2.5 : Schratz's model of the conscious competence learning model 2003a, p. 16, after Howell, 1982

As seen in Figure 2.4 and Figure 2.5, when identifying the forms of self-reflection, educators start at level one: *unconscious incompetence*. Here the educators are unaware of the limitations of their knowledge and consider this as a state of comfort. This stage is the first cycle of the data collection. The second level is *conscious incompetence*, where educators become aware of their limitations in terms of a specific aspect of teaching, after viewing the purposefully selected episode (segment). This stage occurs during the VSR interview in the first cycle of the data collection. Here episodes (segments) of novice educators' teaching were purposefully selected for the novice educators, the experienced educators, and the researcher to view. The episodes were chosen based on where

potential development could occur. This led to level three, *conscious competence*. During this stage, the educator addressed their previously identified weaknesses through deliberate action, noticing, and planning. Here the novice educator became more confident in his/her teaching. This may have led to the final level of *unconscious competence*, a state of security. Here, the novice educator may have internalised their new competencies and is able to avail them during their teaching practices.

Through the use of reflective practice, mathematics educators were able to use their own teaching practice as a guide to identify aspects that could be altered and/or adjusted for their teaching to be more effective and aligned to effective teaching practices which, in turn, may have enhanced their MKfT. The four states of awareness were recognised when educators were able to reflectively articulate their teaching practices (Geiger, Muir & Lamb, 2016). Hence, the model proposes that educators undergo a cycle comprising of four phases, where their competence (proficiency) level is in a specific skill and/or discipline, and their consciousness is the self-awareness that evolves over time. When the researcher purposefully selected an episode, through self-reflection, the novice educator may have been in the *unconsciously incompetent* phase. In the latter, educators are unaware of what they do not know and what they are doing, they may have made errors in their teaching, but were unaware of the influence thereof on their learners, in this form of teaching. Thus, educators need to become conscious and aware of their own incompetence, through self-reflection marked by an 'aha' moment (moment of noticing). In this study, the researcher used a VSR interview for the educators to view this stage, where they are to notice aspects to improve on. This is because individuals often only respond to change once they become aware of it. Hence, being in the bottom level is not necessarily permanent, as seen in Figure 2.6.

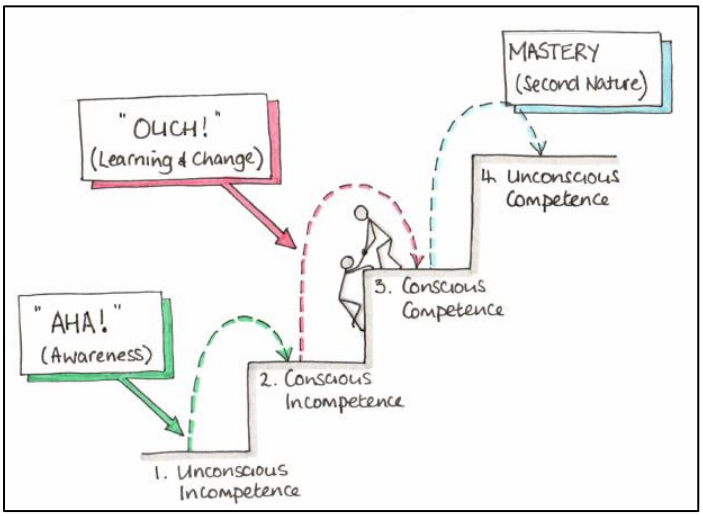


Figure 2.6: The conscious competence model by Richens (2017)

According to Batista (2015), when we have "the opportunity to get useful feedback our awareness tends to outpace our skills, and we become *consciously incompetent.* We still don't truly know what we're doing, but now at least we realize this. We (are) making mistakes, and we see their impact" (p. 1). At this stage, one may need assistance to get over the 'bump'; and once guidance is provided, the educator is able to 'up-skill' and become *consciously competent*. Thus, moving through the distinct phases allows for an awakening of one's teaching. Within the third level, novice educators ought to keep practising, seeking feedback, and striving to master the skill that they found most prominent in the video stimulus. Due to the duration of this study and it being done over three cycles, it would be easy to relate each cycle to distinct stages of the conscious competence learning model. Given that most educators need a few months to a few years to fully master the notion of *unconscious competence*. This is the stage where they do not have to think about their teaching as much as they convey the lessons in an appropriate manner. Consequently, this study focuses on the first three stages. Although the subsequent stages may not have gone smoothly, they will enable the educators to become cognisant of their teaching, to the point where they move towards the phase of *unconscious competence*. This is the ultimate goal of effective teaching.

Thus, this study advocates the use of the Burch (1970) model. For Schratz (2006, cited in Howell, 1982), development means moving from an unconscious level of incompetence to a conscious level of incompetence as well as from a conscious level of competence to an unconscious level of competence. According to Schratz's (2006) systems theory, this psychological shift is crucial "in order to help initiate development, insight into the need for change is an essential factor, so that people themselves can set off their own self steering and self-development processes" (p. 46).

2.4 Summary of the chapter

This chapter has provided an in-depth review of relevant and related literature that has highlighted the theoretical frameworks which underpin this study. The chapter has offered an in-depth analysis of reflective practice, PD, effective teaching, MKfT, VSR, constructivism, social constructivism, and the four cognitive states of awareness. The next chapter will present and discuss the methodology followed in conducting this study.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This study investigated the influence of using Video-Stimulated Recall (VSR) as a reflective tool for professional development (PD) among novice mathematics educators. This chapter discusses the step-by-step method followed throughout the study to answer the research question. For Igwenagu (2016), methodology refers to "the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge" (p. 4). Hence, this chapter outlines the research methodology that guided the data collection, analysis, and the interpretation. A thorough explanation of the research design, the data collection procedure, the data collection method and the sampling procedure is provided. In addition, the concept of trustworthiness and the ethical considerations of the study are discussed. Therefore, this chapter provides pertinent details concerning the research methodology employed throughout this study.

The methodology was designed to address the following research question:

> What is the influence of Video-Stimulated Recall (VSR) on the teaching and classroom practice of novice mathematics educators, through the use of reflective practice?

In addressing this question, I focused on the following sub-questions:

1. Have novice mathematics educators been able to develop through the use of VSR as a proposed tool for PD? If so, to what extent?
2. How does the implantation of reflective practice in relation to VSR affect novice educators' teaching of mathematics in subsequent lessons?
3. Has the pairing of the experienced and novice educators assisted the latter in moving towards more effective classroom practices? If so, to what extent?

3.2 Research paradigm

Research is considered to be the combination of reasoning and experience; as such, it could be the most successful approach to the discovery of certainty, particularly in science (Borg, 1963, cited in Cohen, Manion & Morrison, 2007). Shah and Al-Bargi (2013) explain that the process of conducting research is methodical and systematic; and that the phenomenon under investigation addresses an issue, solves problems and answers a particular question, all of which assist in making a contribution to the existing knowledge. Thus, research leads to the attainment of new knowledge within various fields such as mathematics. According to Yilmaz (2013), there are two significant ways of conducting research in social sciences, namely, quantitative and qualitative research methodologies. This study focused on the qualitative research approach which involves an "exploration, with the aim of gaining an understanding of reasons, opinion, and motivations for a given research theme" (Dizha, 2021, p. 42). Hence, the researcher used qualitative research to provide an understanding of the phenomenon under investigation, by analysing the participants' responses, experiences and views.

3.2.1 Qualitative research

The methodological approach used throughout this research study was qualitative. This was because this study investigates whether VSR could be used as a reflective tool for PD among novice mathematics educators, as part of their teaching and classroom practices. The reason for not choosing the quantitative research approach was that it is regarded as a deductive research approach whose prominent feature is the fact that data collection and analysis are conducted using mathematically-based methods focusing on polls or surveys. Ultimately, numerical data are gathered and generalised across groups of individuals (Almalki, 2016). Qualitative research methods are generally regarded as inductive because reality is construed in terms of social constructs. This is because the variables under investigation are complex, difficult to measure, and interwoven. Hence, the data collected consist of the views of insiders. This method emphasises the understanding and exploration of the meanings ascribed to a social problem (Almalki, 2016). According to Blink (1993), qualitative researchers are interested in individuals' experiences, beliefs' and meaning systems, from the perspective of these individuals. Therefore, the methods used in qualitative research are more subjective in nature, compared to quantitative research which

includes empirical calculations and statistical analysis. In addition, the phenomena under investigation, in qualitative research, are viewed holistically, in their social contexts (Blink, 1993).

Qualitative data consist of language-orientated information construing knowledge as contextual and inclusive of interviews and experiences obtained from research. Thus, the qualitative research methodology comprises of dialectic interchanges and hermeneutics (Lor, 2011). The qualitative method was chosen because the paradigm encompasses the natural progression of actions (Henning, van Rensburg & Smit, 2004), where the use of language and utterances are crucial, especially during the VSR interview. According to Mohajan (2018), qualitative research is where the researcher gains insight into a given situation and generally explores meanings. This is essential as the qualitative data obtained through VSR interviews were centred on language, through constructive dialogue where knowledge was not generalised but rather regarded as contextual.

In addition, an interpretive approach (paradigm) was used in this study, as it was presumed that knowledge was subjective and not independent of cognition and reasoning. This means that knowledge is gained, and that meaning is made through the interpretation and analysis of the collected data by the researcher (Shah & Al-Bargi, 2013). Through this research approach, the researcher was able to access and provide an understanding of the participants' experiences.

3.3 Research design

The research design of a topic explains the type of research undertaken. In a qualitative study, various research designs (approaches) are available. These include phenomenology, ethnography, inductive thematic analysis, grounded theory, case study, discourse/conversation analysis, narrative analysis, and mixed methods (Guest, Namey & Mitchell, 2013). Given that a qualitative case study examines a phenomenon within its real-life context, this study adopted a case study approach.

3.3.1 Case study approach

According to Creswell (2016), case study "research involves the study of an issue explored through one or more cases within a bounded system (i.e., a setting, a context)" (p. 73). Creswell (2016) explains that, here, the investigator explores the bounded system (a case) or multiple bounded systems (cases) over a period of time. This is done through a detailed and in-depth data collection process which involves multiple sources of information. These include interviews, observations, documents and reports, and audio-visual material that led to reporting a case description and case-based themes.

3.3.1.1 Types of case study

Three types of qualitative case study exist in terms of the intent of the researcher, namely, the single instrumental case study, the collective or multiple case study, and the intrinsic case study (Creswell, 2016). These study types are recognised by the size of the bounded case, or the intent of the case analysis. A bounded case depends on "whether the case involves one individual, several individuals, a group, an entire program, or an activity" (Creswell, 2016, p. 74). In this study, the researcher focused on a collective case study (or multiple case study) approach. This is because the researcher focused on an issue and selected multiple case studies (three) to illustrate it. The researcher purposefully selected multiple cases to show different perspectives on the same issue. Creswell (2016) explains that this design "uses the logic of replication, in which the inquirer replicates the procedures for each case" (p. 74). Due to the qualitative nature of this research, the researcher was reluctant to generalise from the one classroom to the next. However, Creswell (2016) advises that to best generalise between cases, the researcher needs to choose cases that are representative or inclusive.

3.3.1.2 Qualitative case study approach in this study

The data collection occurred in three related case studies. In the first, second and third study, one novice educator and one experienced educator participated in a series of lesson observations, related video recordings, and VSR interviews, in all three cycles. The researcher, as the main facilitator of these case studies, prompted the novice educators with open-ended, semi-structured questions, during the VSR interview. For example, after watching the video episode, the researcher would ask questions such as "Now that you have watched the video, how do you think this part of

the lesson went along?' or 'What did you notice?'. A total of nine VSR interviews occurred across the three cases, where each lesson was video recorded and each VSR interview was video, and audio recorded.

Prior to the commencement of the study the researcher approached the school principals of both School A and School B and enquired about the availability of the novice and experienced educators within the school. Here it was determined that each school had a varying number of available educators. For example, School A had six experienced educators but only one novice educator at the commencement of this study. Therefore, one experienced educator along with the novice educator volunteered to partake in this study as they were to form a pair. Contrary to School A, in School B there were quite a number of novice educators and very few experienced educators. Here two novice educators volunteered to partake in the study whereas the Head of Department (HOD) within mathematics volunteered as an experienced educator who formed a pair with each novice educator. Therefore, School A contributed one novice educator and one experienced educator, whereas School B had contributed two novice educators and one experienced educator. This was based on the number and availability of novice and experienced educators per school. Therefore, the research was designed around this criterion. Hence, the sample size in this study was small, with a total of five participants.

Moreover, this study adopted a design where attention was given to a wide variety of data collection instruments. These included obtaining data from lesson observations, interviews, and documents (reflective journals and field notes). It is important to note that interviews played a crucial role in this study, in its exploration of the unique aspects of each case in great detail (Guest, Namey & Mitchell, 2013).

Furthermore, as seen in Figure 1.1, the participating schools were purposefully selected due to their poor performance in Grade 12 mathematics, at 30% and above, in the five years that preceded the commencement of this study. The participating schools were also chosen due to their accessibility to the researcher. From the graph represented by Figure 1.1, it is clear that the mathematics trends in the schools under investigation have been lower than the national and provincial results. Although participation of the educators was voluntary, the schools were purposefully selected based on their Grade 12 results over five years prior to the commencement

of this study. Therefore, enhancing mathematics educators' self-reflection could possibly improve learners' overall mathematics results when they reach Grade 12. This, in turn, would improve the schools' pass rate in mathematics at a Grade 12 level. This is supported by Nel (2015) who suggests that "one way of improving learners' (Mathematics) pass rates is to up-skill teachers involved in the current system" (p. 7). Therefore, self-reflection is a possible avenue to up-skill educators' teaching practices.

3.4 Research data collection cycles

Due to the qualitative nature of this research, the data collection was designed across three cycles preceded by an information session. The VSR information session was held, in the first school term of 2022, by the researcher and her supervisor. The data collection occurred across three cycles, during the second and third school terms of 2022. The data collection instruments used within this study were classroom lesson observations, video recording of the lesson observations, field notes, reflective journals, the VSR interview audio and video recordings, as well as a post-questionnaire for the novice educators. The lesson observations and video recordings were undertaken by the researcher. The field notes were drafted by the experienced educators and the researcher. The reflective journals were completed by the novice educators, after their lessons had been observed. The VSR interview audio and video recording was done by the researcher, while the-post questionnaire was completed by the novice educators.

The first cycle of data collection included the experienced educator making field notes, while observing the novice educator' lesson. The researcher video-recorded the lessons of the participating novice educators and made field notes post lesson observations. Hereafter, episodes (segments) of the observed lesson were purposefully selected for self-reflection through a VSR interview. This was to foster potential development in the novice educators. The face-to-face VSR interview commenced one to two weeks after the lesson had been observed. The interview unfolded by asking open-ended, semi-structured questions which were also audio-and-video recorded. As previously mentioned, the time period of one to two weeks was so that the researcher could thoroughly analyse the data obtained from the lesson recording. The reason for the audio-and-video recording of the VSR interview was to obtain crucial information linked to body language and utterances that transpired. Thereafter, the VSR interview was transcribed to thoroughly analyse the data. This was because transcriptions provide an accurate account of what

transpires during an interview. This approach was chosen to ensure that the research question was addressed, as it allowed the novice educators to self-reflect, to adapt and/or adjust their teaching strategy in subsequent lessons, should they choose to do so. Figure 3.1 provides a general classroom layout illustrating how the video recording and classroom lesson-observation data were collected. This layout includes the learners and the novice educators desks as well as the positioning of the cameras in the classroom. Video camera one was operated by the researcher and was positioned at the front of the classroom, where the educator usually stands to teach the lesson. The second video camera was placed at the back of the classroom on a tripod stand, to gain an overall sense of the dynamics of the classroom. Using two video cameras was originally suggested by O'Brien (1993) and was further recommended by Beutel et al. (2013), to record educators' overall teaching practices.

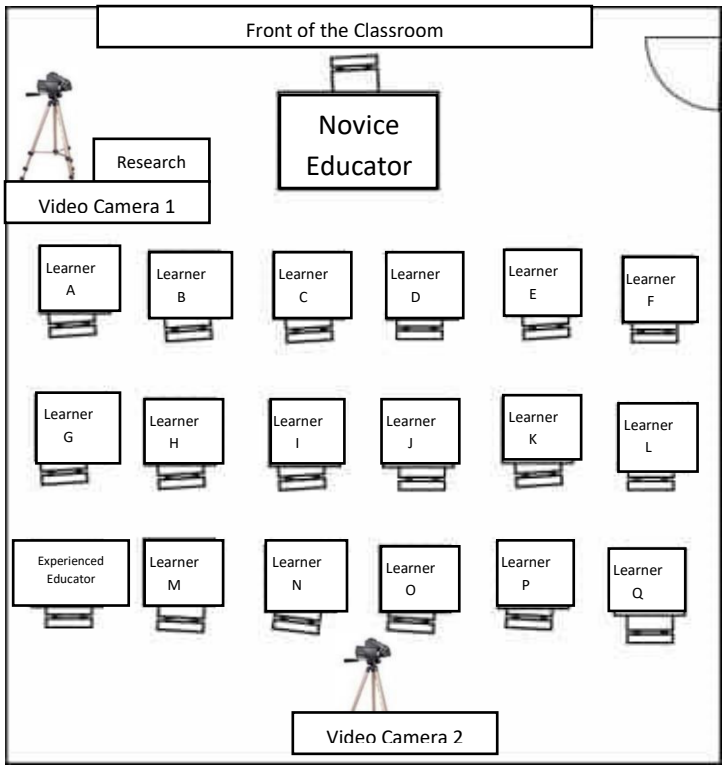


Figure 3.1: General classroom layout

The in-person lesson observations and video-recordings were conducted with the five participating educators, three novices and two experienced educators, within two schools. The novice educators' lessons were video recorded, and the experienced educators served as active observers, mentors and advisors in the VSR interview. The follow-up VSR interviews, as illustrated in Figure 3.2, were conducted with the three novice educators, one in School A and two in School B.

The VSR interviews consisted of a series of semi-structured, open-ended questions derived from the previously recorded video lessons, for the researcher to prompt the participant (novice educator) to self-reflect on what s/he had viewed. For example, the first VSR interview was based on the selected episodes (segments) of the first lesson observation; the second VSR interview foregrounded particular episodes (segments) of the second lesson observation; and the third VSR interview was based on specifically chosen episodes (segments) of the third lesson observation. The prospective questions, during the VSR interview, revolved around (1) the facets of PD; (2) the four states of cognitive awareness; and (3) the implementation of reflective practice and whether it assisted educators in their teaching and learning process. The completion of the VSR interview concluded each cycle. In other words, the completion of the first VSR interview closed the first cycle of the data collection. This led to the second and, subsequently, the third cycle, where the previously selected novice educators were again observed and video recorded, in the second and third VSR interviews. The latter were based on these novices' take-up of reflective practice through VSR, to determine whether self-reflection served as an assistive teaching tool. Throughout this process, the experienced educators served as active observers, mentors and advisors. The second and third cycles of this study were thus repetitions of the first cycle, as illustrated in Figure 3.3.

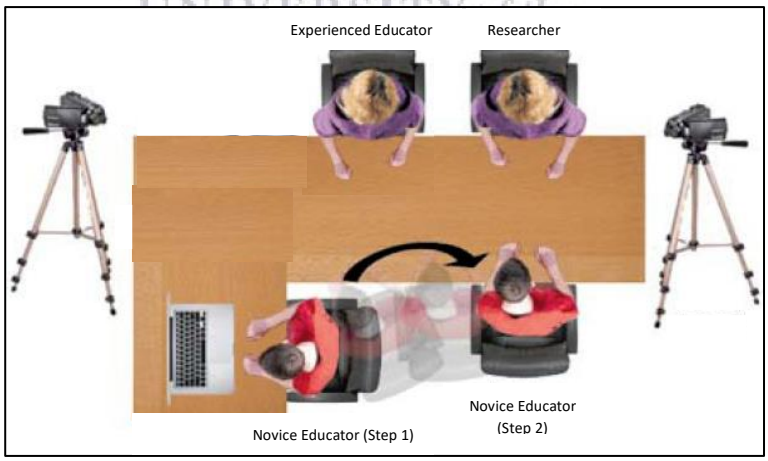


Figure 3.2: Video-stimulated interview based off Huang 2014

The overall findings were analysed through the Burch (1970) model. An inductive approach and descriptive means were used to determine whether reflective practice contributed to more effective teaching practices. Simultaneously, the novice educator's take-up of reflective practice through VSR was used to determine whether it served as an assistive teaching tool. Hence, the data

collection process was designed to be systematic and accurate, which is essential when conducting research. Figure 3.3 depicts how the research was designed and how the data were collected.

Figure 3.3: Research Design Diagram

3.5 Research data sources and sampling

Given that the research design involved a case study approach, the participants were selected based on a unique criterion. The investigation focused on a small number of individuals (participants). The latter were based on a voluntary approach, where the novice educators volunteered and were selected by the researcher because they had six years or less of experience in the teaching of

mathematics. Conversely, the experienced educators had more than seven years of teaching mathematics. Throughout this study, it was imperative that the novice and experienced educators were comfortable with each other, to create a safe environment within the three data collection cycles. This is because they were to create a community of practice, forming a team (pair) aimed to assist the novice educators in moving towards effective classroom practices.

The data were collected, across three cycles, with the participating mathematics educators in two high schools situated in the Breede Valley District, Western Cape Province of South Africa. The data analysis involved an interpretive theoretical approach to make sense the data collected from the participants. During the first cycle, the data were collected by means of field notes, a lesson observation, a reflective journal, and a video-recording of the mathematics lessons. These data were analysed and interpreted as soon as they were collected, to structure and prepare for the VSR interview. Thereafter, the VSR interview occurred, one to two weeks later. During the interview, the researcher and the experienced educators asked the novice educators video-stimulated questions. The completion of the VSR interview concluded the first, second and third cycles. During the first, second and third cycles, the experienced educator was an active participant observer, mentor and advisor. The data were collected by the researcher, through the annotation of the video-recorded interviews and the reflective journals.

Sequentially, the second and third cycles involved a repeat of the first cycle. The aim was to determine the novice educators' take-up of what was identified in the first and second cycles. Here the experienced educators once again served as active participants. This was to determine whether or not it influenced the notion of 'effective teaching', as well as whether this tool can be used as an in-house PD initiative. The episodes selected during the first, second and third cycles entailed purposefully chosen content (episodes) to prompt the novice educators to engage in reflective practices.

The phenomenon investigated was novice educators' take-up of self-reflection as part of a teaching strategy to contribute to the notion of 'effective teaching'. To maintain a small sample size, three (novice) educators were purposely selected to participate in the interviews during the first, second and third cycles. The VSR interview questions were designed to attain information about the

novice educators' perspective regarding the influence of VSR through the notion of reflection and whether their take-up contributed to 'effective teaching' practices.

3.5.1 Study sample and sampling procedures

Table 3.1 presents the pseudonyms assigned to the participating educators and schools. The use of pseudonyms within this study was to protect the identity of the schools, educators and learners. This allows the schools and educators to remain anonymous throughout the study. The pseudonyms of the participants were designed around the names: 'novice educator' and 'experienced educator'. The pseudonyms of the schools were designed around the alphabetical order of the school's name. Hence, 'Novice Educator A' is a novice educator from School A and is referred to as NEA 'Novice Educator B' is a novice educator from School B and is referred to as NEB. 'Experienced Educator A' is an experienced educator from School A and is referred to as EEA and 'Experienced Educator B' is an experienced educator from School B and is referred to as EEB. The main difference in the naming of the participants from School A and B was the inclusion of the numerical value 1 and 2 in the naming of the novice educators in School B. This inclusion was due to there being two novice educators participating in the study.

In addition, the participants in this study had varying years of teaching experience in the Senior Phase (SP). The SP in school Mathematics is regarded as teaching either Grade 7, Grade 8 or Grade 9. Throughout this study NEA had taught a Grade 8 class, NEB1 had taught a Grade 9 class and NEB2 had taught a Grade 8 class. All the participating novice educators had six years and less of teaching experience in the school subject of mathematics where the experienced educators had more than seven years of teaching experience in the school subject of mathematics.

The sample size and participants in this study are depicted in Table 3.2. As previously mentioned, the sampling procedure was based off a voluntary approach. Where in School A one novice educator volunteered to partake in the study, whereas in School B two novice educators had volunteered to partake in this study. This was based on the number and availability of novice educators per school. Therefore, the research was designed around this criterion. Hence, the sample size in this study was small, with a total of five participants. The schools under investigation were purposefully selected based off the school's poor performance in the Grade 12 final examination

prior to the commencement of this study, as seen in Table 1.2. Therefore, by enhancing the notion of educators' self-reflection, it could be possible to improve learners' overall mathematics results once they reach Grade 12 in these two schools.

Table 3.1: Pseudonyms assigned to the participating educators and schools

Assigned Pseudonyms		
School Name	**Educator 1 (Novice)**	**Educator 2 (Experienced)**
School A	Novice Educator A (NEA)	Experienced Educator A (EEA)
School B	Novice Educator B1 (NEB1)	Experienced Educator B (EEB)
	Novice Educator B2 (NEB2)	

Table 3.2: Participants in different cycles

Cycles	**School**	**Participants**	**Sample Size**	**Criteria**
Cycle 1 (Record and Interview)	School A	NEA EEA	Two	Must be novice and experienced educators teaching high school SP Mathematics in the province of the Western Cape, within the specific district being investigated.
	School B	NEB1 EEB	Two	
		NEB2 EEB	Two	
Cycle 2 (Repeat of cycle 1, Record and Interview)	School A	NEA EEA	Two	Must be novice and experienced educators teaching high school SP Mathematics in the province of the Western Cape, within the specific district being investigated.
	School B	NEB1 EEB	Two	
		NEB2 EEB	Two	
Cycle3 (Repeat of cycle 1,	School A	NEA EEA	Two	Must be novice and experienced educators teaching high school SP Mathematics in the

Record and Interview)	School B	EEB1 EEB	Two	province of the Western Cape, within the specific district being investigated.
		NEB2 EEB	Two	

3.6 The timespan between different lesson observations of each novice educator

Table 3.3: The timespan between different lesson observations of each novice educator

	NEA	NEB1	NEB2
Lesson 1 (commencement of cycle 1)	27-07-2022	03-05-2022	23-08-2022
Lesson 2 (commencement of cycle 2)	24-08-2022	24-05-2022	30-08-2022
Lesson 3 (commencement of cycle 3)	31-08-2022	02-08-2022	06-09-2022

3.7 Data collection instruments

In this study, the researcher used seven research instruments, namely, field notes, video recordings of the lessons, reflective journals, video recording of Mathematics lessons, a video and audio-recorded open-ended semi-structured VSR interview, a biographical questionnaire and a post-questionnaire. An information session was conducted by the researcher and her supervisor, before the commencement of the three cycles of the data collection, in the first, second and third school terms of 2022. The video lesson recordings and the VSR interviews were conducted, with the three novice educators (one in School A and two in School B), by the researcher. These occurred during the first, second, and third cycles where the experienced educators were active participants in the VSR interview. The researcher also video recorded these lessons and interviewed the novice educators, to determine the value of self-reflection and establish whether or not it served as an assistive teaching tool. The following section discusses the data collection instruments in more detail.

3.7.1 Information session

The information session was conducted by the researcher and her supervisor during the first school term in 2022. The following persons were present during the information session: the school principal of School A, the school principal of School B, the two Mathematics Heads of Department (HOD) of each school, the participating novice educators, the experienced educators, and the representatives of the School Turnaround Foundation (STF) programme from School B. Here a PowerPoint presentation was used to thoroughly explain VSR to each of the participating schools, using the following definition by Beutel et al. (2013):

> "Video stimulated recall is a research technique in which subjects view a video sequence of their behaviour and are then invited to reflect on their decision-making processes during the videoed event" (p. 1).

During the information session, the attendees were informed of the three cycles that the study used. Hereafter, they asked questions pertaining to the study and raised any queries or concerns they had regarding the study and their autonomy.

3.7.2 Field notes

According to Phillippi and Lauderdale (2018), field notes are generally recommended as a means of documenting the contextual information needed within qualitative research. Initially, field notes were considered private, personal thoughts, ideas and queries within a researcher's observations and interviews. As such, they were not believed to be useful in an analysis. However, it is presently understood that field notes are an essential component of rigorous qualitative research (Phillippi & Lauderdale, 2018). Hence, most qualitative research techniques encourage researchers to take down field notes, to enhance their data and provide a rich context for data analysis. This can be useful in subsequent analysis, such as a secondary analysis or a meta synthesis (Phillippi & Lauderdale, 2018). In this study, the experienced educators, as the More Knowledgeable Other (MKO), took field notes during the novice educators' lessons. However, in some instances, the experienced educators could not be present at the novice educators' lesson observations. Consequently, the researcher, as an alternative MKO, took the field notes. Table 3.4 identifies the common functions of field notes.

Table 3.4: Functions of Field Notes in Qualitative Research by Elo and Kyngas (2008); Emerson, Fretz, and Shaw (2011); Mulhall (2003); Rodgers and Cowles (1993); Sandelowski (1994); and Tsai et al. (2016)

Functions of Field Notes in Qualitative Research
• Prompt researcher(s) to closely observe environment and interactions • Supplement language-focused data • Document sights, smells, sounds of physical environment, and researcher impressions shortly after they occur • Encourage researcher reflection and identification of bias • Facilitate preliminary coding and iterative study design • Increase rigor and trustworthiness • Provide essential context to inform data analysis

The use of field notes provided textual information used within the open-ended, semi-structured questioning, during the VSR interview, which assisted in understanding the participants' meaning. This is because "in-depth field notes released directly from the researcher…can be useful in assessing transferability of findings from one location to another, both in combining research and implementing evidence into care" (Phillippi & Lauderdale, 2018, p. 382).

3.7.3 Reflective journal

Reflective practice requires taking thoughtful retrospective steps to partake in daily learning and to recognise one's responsibility towards one's lifelong learning (Ngololo & Kanandjebo, 2021). For Guce (2017), in the learning of mathematics, researchers have been increasingly interested in the role of reflection and writing. Guce (2017) further explains that reflective writing is used as a means by which one can express one's thinking. Addison (1995) contends that for one to write about a topic, through reflective practice, one must be able to reconstruct one's knowledge of the topic in a form that is understandable by someone else reading the material. Therefore, through reflective journaling, educators have the opportunity to reflect on their own teaching and learning, to improve their classroom practices, lesson planning, assessment styles, and all components involved in the process of teaching and learning (Ngololo & Kanandjebo, 2021). Within this study,

reflective journaling was used by novice educators after their lessons were video recorded. The findings were used in conjunction with the VSR interviews.

3.7.4 Video recording of the lessons

According to Beutel et al. (2013), researchers often integrate and apply technology in their investigation, as the world becomes increasingly digitalised. Although various technological data collection methods exist, this study focuses on the VSR method. This technique allowed the participants to view themselves in-action, through a retrospective means, to assist them to recall their thoughts of events and/or behaviours as they occurred.

The VSR technique provided the participants (novice educators) with a chance to view themselves in action, as a means of helping them to recall their ideas of events as they occurred (Beutel et al., 2013). This data collection method involved video-recording the educators during their normal teaching duties, then re-playing the video recordings back to them. In this way, they could recount their own behaviour through self-reflections. The latter were elicited by using an open-ended, semi-structured interview based on different aspects of their interactions that were recorded as they were watching the video (Beutel et al., 2013). The reflective on-action process allowed these novice educators to use their own teaching as a guide to alter and/adapt their teaching, should they wish to do so.

3.7.5 Video-Stimulated Recall (VSR) interviews

DeMarrais (2002) defines an interview as "a process in which the researcher and participant engage in a conversation focused on questions relating to a research study" (p. 55). Kval (1994) construes qualitative research interviews as "attempts to understand the world from the subjects' point of view, to unfold the meaning of peoples' experiences, to uncover their lived world prior to scientific explanations" (p. 1). Beutel et al. (2013) note that the existence of an increasing number of researchers using VSR interviewing as a research method because it produces insightful and useful data for examining the way individuals experience a specific event of an educational interaction. The data collection in this study occurred in three phases (cycles): one cycle entailed an observation and recording of novice educators' first lesson, followed by VSR interviewing, and

reflective journaling. The second and third lesson observations and recording sessions of the novice educators' lessons, followed by VSR interviewing and reflective journaling, completed the second and third cycles. These amounted to three observation sessions followed by VSR interviews and reflective journaling. These occurred with three novice educators, in all three phases. Prior to the commencement of the data collection, an information session was held with the researcher and her supervisor. Here, the educators' espoused beliefs about learner autonomy were probed. The resulting data were analysed. This assisted in providing a framework for educator's normal duties regarding their teaching practice, during the observation sessions. These video recordings provided a basis for the VSR interviews. During the VSR interviewing, the educators watched the videos of their teaching practices and were prompted by the researcher and the experienced educators, through questions about their decision-making process as they carried out their normal teaching duties. According to Beutel et al. (2013), "verbal prompts were used by the researcher where needed to encourage the participants to reflect more deeply about what they were watching themselves doing" (p. 3). The purpose of VSR in this study was to use self-reflection to gain insight into why the participating educators taught or acted in certain ways.

3.7.6 Biographical Questionnaire

A biographical questionnaire was used in this study to obtain and compile the following information from the participating educators: (1) how many years they have been teaching in total by the end of the year in which this study was conducted, (2) how many years of teaching experienced they had exclusively in Mathematics education, (3) which phase they taught (4) what their teaching qualifications were, (5) what rank they held at the school e.g. Head of Department (HOD) and, (6) were they involved in any school professional development programmes. The biographical questionnaire provided a general profile of the educators within the dimensions mentioned. The questions within this questionnaire were constructed based on the researcher needing to determine the information mentioned. The questionnaire was operationalised when it was given to the educators prior to the commencement of the study.

3.7.7 Post Questionnaire

A post questionnaire was used in this study to in order to reveal what the experiences of the novice educators were after the completion of the third cycle. The post questionnaire aimed to reveal the novice educator's personal experiences, opinions and personal accounts of the study and the

prospect of using VSR in future studies. The questions posed included: (1) Going through this process of VSR, do you think this tool can serve as part of an in-house Professional Development (PD) programme? If yes/no, please elaborate, (2) Have you as a novice educator noticed any positive or negative developments within your teaching, in this short timeframe, with regards to the process of self-reflection after the influence of VSR? If yes/no, please elaborate, (3) How has the implantation of VSR influenced your subsequent (following) lessons, after the first video stimulated interview? and, (4) Has the formation of a school team (pair) assisted in the notion of moving towards more effective classroom practices? If yes/no, please elaborate. All the information obtained from the post-final-interview questionnaires provided general feedback of the educators experiences throughout the study. The questions within this questionnaire were constructed based on the researcher needing to determine the information mentioned. The post questionnaire was operationalised when it was given to the novice educators after the completion of the study.

3.8 Data analysis

This study used an interpretive theoretical approach along with the Burch (1970) model, to analyse the data collected from the participants. Thanh and Thanh (2015) note that the interpretive approach theoretically allows researchers to view the world through the experiences and perceptions of the participants. Therefore, by using the interpretive approach, the researcher's aim to explain the subjective reasons and meanings behind social actions could be achieved. The Burch (1970) model was used to determine whether (*un*)*consciousness* and (*in*)*competence* change was evoked through self-reflection, to foster the move towards more 'effective teaching' practices. This method was deemed be suitable for this study because its major focuses included understanding, describing, and interpreting novice educators' actions, within the observed video-recorded lesson. This assisted in answering the research question on whether PD occurred through self-reflection. The data were collected through field notes, reflective journaling, a post-questionnaire, and VSR interviews in which the video was analysed, interpreted, and transcribed. The research instrument designed for the first, second, and third cycles was a semi-structured, open-ended VSR interviews conducted face-to-face. Online and telephonic methods were to be used if needed, due to the prevailing safety and security measures regarding the Covid-19 pandemic.

3.9 Trustworthiness

The concept of trustworthiness, in research, is used to describe the sincerity of the results of a study. In this study, trustworthiness was ensured by the researcher's choice of data collection methods suitable to the qualitative nature of this research. Therefore, the trustworthiness of this study was closely linked to the implementation of the interpretive approach which used two types of triangulations, namely, data triangulation and methodological triangulation. The data triangulation consisted of using different sources of information (the novice and the experienced educators), and the methodological triangulation used different methods to collect the data (lesson observations, post-lesson reflective journals, biographical questionnaires, field notes, and post-lesson VSR interviews). Through the use of these instruments, credibility was ensured in the conclusions drawn.

3.10 Ethical considerations

This study followed the relevant procedures outlined in the University of Western Cape's policy on research ethics (2014). The rights and privacy of the participants in this study were duly respected. Ethical clearance and participation consent were sought from the relevant authorities and persons, namely, the University of the Western Cape (UWC), the Western Cape Education Department (WCED), the school principals (or governing bodies), the participating educators, the learners, and the learners' parents and/or guardians. Moreover, the participants were thoroughly briefed ahead of the data collection. Additionally, all the participants were required to complete a consent and assent form which outlined the processes according to which the study was to be conducted, as well as the notion that participation was voluntary. The participants were assured that they could withdraw from the study at any time, without any negative consequences. All the research participants' identities were kept anonymous through the use of pseudonyms in the research report. It was indicated that the data would be kept in a locked and secure place and on a password-protected computer, to ensure confidentiality. Only the researcher and her supervisor could access the data. The latter would be discarded five years after the completion of the study. As the data collection in this study was to commence during the Covid-19 pandemic, all relevant protocols and regulations were strictly adhered to. This included the observance of social distancing, the wearing of masks, and having hand sanitisers available in all the venues where the information session and the interviews were conducted.

3.11 Summary of the chapter

This chapter discussed the methodological framework implemented in this study. The discussion encompassed an elaboration on the research design, sampling size, data collection procedure, data collection instruments, and data analysis techniques. This chapter also described the research instruments used in this study. Each instrument was explored in detail. The trustworthiness of the study and the ethical considerations were covered. The next chapter provides the analysis of the data and the discussion thereof.

CHAPTER 4

DATA ANALYSIS AND DISCUSSIONS

4.1 Introduction

The previous chapter elaborated on the research methodology adopted for this study and the research processes employed throughout the research. This included the data collection method and analysis methods. The methodology emphasised the systemic ways of providing answers to the research questions. This chapter discusses and presents the patterns and trends that emanated from the analysis of the data collected. The analysis of the data is presented and substantiated by relevant literature and the provision of direct quotes from the transcribed data. In addition, graphs, tables and figures are used to illustrate the patterns, to consolidate the data and provide a clear depiction of the findings of the study. The data presented address the following research question:

> What is the influence of Video-Stimulated Recall (VSR) on the teaching and classroom practice of novice mathematics educators, through the use of reflective practice?

The data analysis undertaken in this chapter helps to address the following sub-questions:

1. Have novice mathematics educators been able to develop through the use of VSR as a proposed tool for PD? If so, to what extent?
2. How does the implantation of reflective practice in relation to VSR affect novice educators' teaching of mathematics in subsequent lessons?
3. Has the pairing of the experienced and novice educators assisted the latter in moving towards more effective classroom practices? If so, to what extent?

4.2 Data collection instruments and data analysis procedure

The data were collected from two participating schools, namely, School A and School B. this was achieved using the following data collection instruments: a biographical questionnaire, field notes regarding the three cycles of lesson observations of each of the novice educators, three lesson observation sessions with a video recording of each lesson, collaborative VSR interview sessions, and a post final interview questionnaire completed by the novice educators. Each cycle of the video

recording of a lesson was followed by a VSR interview aimed to determine the educators take-up of self-reflection through VSR. The data collected were analysed using the Burch (1970) model, based on an inductive approach foregrounding descriptive means. The themes that emanated from the data included (1) whether or not VSR could serve as proposed tool for in-house PD; (2) whether novice educators were able to develop, within this limited timeframe, through the process of self-reflection influenced by VSR; (3) how the implementation of VSR influenced novice educators' subsequent lessons; and (4) has the incorporation of a school team (pair) assisted the novice educator in moving towards more effective classroom practices. As this study foregrounds the notion of effective teaching, the following subthemes emerged from the data:

1. Lesson planning
2. Teaching style
3. Classroom management
4. Classroom layout
5. Time management

In addition, the influence of VSR on the teaching and classroom practice of novice mathematics educators, through reflective practice, was also investigated. The collected data described the following aspects:

1. The educators' classroom practices in terms of mathematics teaching.
2. The educators' classroom conduct, while being video recorded.
3. What transpired through self-reflection in the VSR interview.
4. How self-reflection contributed to 'effective teaching' practices.

The analysis is presented and substantiated by means of direct quotes from the transcribed VSR interview and the reflective journals. As mentioned before, graphs, tables, and figures were used to illustrate the patterns, to consolidate the data, and to provide a clear depiction of the findings of the study.

4.3 Findings and discussions

As previously indicated, the data were collected from two participating schools, namely, School A and School B as well as three novice educators identified as NEA, NEB1, NEB2 and two

experienced educators referred to as EEA and EEB. In each of the participating schools, the following data were collected: biographical data of the participants, three video recorded lesson observations, three post-lesson VSR interviews with the novice educators in the first, second and third cycles, and a post-final-interview questionnaire completed by the novice educators. Throughout the three cycles, the experienced educators actively participated in the VSR interviews to form a mathematics team (pair) with the novice educators. This section discusses the data in detail and links them to the relevant literature, striving to illuminate how the findings assert themselves within the overall body of knowledge. The data indicate the existence of four prevalent key themes across the data, including five subthemes. Full discussions of the findings of this research are provided in section 4.3.2.

4.3.1 Biographical data of participants

The participants in this study had varying years of teaching experience in the Senior Phase (SP) of Mathematics. Both novice educators (six and less years of teaching experience in mathematics) and experienced educators (more than seven years of teaching experience in mathematics) participated in this study. It is important to note that the researcher was only informed about the NEB1's educational background after collecting the biographical data. It was discovered that NEB1 was still busy with his BEd degree in Mathematics and Natural Sciences, making him a first-year novice educator and a fourth and final year BEd student. Although NEB1 was yet to graduate, he still falls within the parameters of this study. Table 4.1 summarises all the information obtained from the biographical questionnaires.

Table 4.1: Summary of the data obtained from the biographical questionnaire

	NEA	NEB1	NEB2	EEA	EEB
How many years have you been teaching in total, by the end of this school year? (Years in total)	3	1	6	20	24
How many years of teaching experience do you have, exclusively in SP mathematics?	3	1	2	19	24

Which education phase do you teach? (SP)/FET)	GET (SP)	GET (SP) and FET	GET (SP)	GET (SP) and FET	GET (SP) and FET
What are your teaching qualifications?	BEd major in Mathematics, Economic, Management Sciences, and Mathematical Literacy	Fourth year Student: BEd major in Mathematics and Natural Sciences	BSc Chemical Sciences, and PGCE major in Mathematics and Science	Higher Diploma in Education (HED 4 years), major in Mathematics and Life Science	BSc Phycology and Education Diploma
What position (rank) do you hold at school?	Post Level 1 Educator	Post Level 1 Educator	Post level 1 Educator	Post level 1 Educator	Post level 2 Educator
Are you involved in a school professional development programme?	No	Yes	Yes	Yes	Yes

4.3.2 Data analysis and discussions

Although the participating educators responded instinctively to the video-recorded lessons, probing was needed through the notion of scaffolding. The researcher, the novice educator and the experienced educator were active participants in the VSR interview. This subsection of the data analysis describes the data obtained from the lesson observations, VSR interviewing, and the reflective journals of each of the participating novice educators, for each of the three cycles. This included field notes from the researcher and the experience educators. Differences were noted in the educators' reactions to lesson observations in the VSR interviews. NEA, NEB1 and NEB2 were taken aback by what they viewed in the lesson observations, during the VSR interview, especially because they thought that the lesson had gone 'well' immediately after the lesson observation, as noted in their reflective journals. Given that the data emanated from various sources, they were organised to assist with sense-making, highlighting the key points. The data highlighted four prevalent key themes and five subthemes.

4.3.2.1 Analysis of NEA Data

4.3.2.1.1 Cycle 1 - Lesson observation, VSR interview and reflective journal of NEA

NEA's first lesson was on algebraic equations. This lesson was conducted with a Grade 8 class. The learners partially participated throughout the lesson. The lesson was arranged in such a way that the educator taught the concepts first, then allowed the learners to do the first activity. This activity was based on addition and subtraction within algebraic equations. The completion of the first activity was followed by the educator's corrections on the whiteboard, which enabled the learners to mark their own work. The lesson concluded with a second activity requiring the learners to solve algebraic equations involving multiplication and division. The teaching of concepts lasted for approximately ten minutes. The remainder of the forty-minute lesson was used for the class activities and the marking of the first activity. During this time, NEA walked around the classroom to support the learners with any questions they had pertaining to the classroom activity. The researcher and the experienced educator were present throughout this lesson. The experienced educator was taking field notes about the lesson, while the researcher was video recording the lesson. The figures display examples used in the lesson where NEA engaged with the mathematics lesson and encountered various states of awareness when viewing the video lesson, during the first VSR interview.

NEA used the following concept of a balancing scale to introduce algebraic equations:

Sketch 1 | Sketch 2 | Sketch 3

Positioning her body as a pivoted horizontal point of a balancing scale, NEA used her arms to display sketches one and three, as unbalanced algebraic equations, whereas sketch two was demonstrated as a balanced algebraic equation.

NEA then stated: "*In an algebraic equation there is a left-hand side (LHS) and a right-hand side (RHS)*".

NEA wrote the following on the board:

$LHS = RHS$

$4 + x = 10$

NEA then stated the following: "*Previously we learnt in algebra what a variable, constant and coefficient is*".

NEA then asked the learners: "*Looking at the sum, what is the variable? Think carefully about it*".

NEA then answered the posed question herself by saying: "*Remember constants is a numeral that has no alphabet, coefficient is a value in front of your variable, then when looking at the equation what is your variable*? "

A learner responded with: "x"

NEA agreed with the answer then said, prior to solving the equation: "*We need to look at 'commutative properties', which is where you switch two values. So, we are now going to put first plus four then leave a space open then the equal sign then ten*".

NEA then switched x and 4 around:

$x + 4 = 10 \ldots\ldots\ldots (line\ 2)$

NEA then said: "*In order for us to get x on its own were going to look at what is the inverse of plus 4*?".

Without allowing the learners to answer, NEA then filled in minus four on either side of the algebraic equation on the whiteboard. She then stated: "*What you do on your LHS you do on your…*". The learners completed by saying: "*RHS*".

$x + 4 - 4 = 10 - 4 \ldots\ldots\ldots (line\ 3)$

$x = 6 \ldots\ldots\ldots (line\ 4)$

NEA then showed the learners a method to evaluate whether their answers are correct, through substitution:

$$4 + x = 10 \ldots\ldots\ldots (given\ equation)$$

$$Where\ x = 6:\ \ 4 + 6 = 10 \ldots\ldots\ldots (line\ 2)$$

Figure 4.1: NEA Lesson, 1 Example 1

In relation to the example, in Figure 4.1, EEA noted that NEA had introduced the lesson well by explaining to the learners what an equation is, through the depiction of a scale. EEA stated in her field notes that NEA had a "*good introduction through the reference of a scale*" (EEA, Field notes 1, 2022). According to Milkova (2012), one is to "develop a creative introduction to the topic to stimulate interest and encourage thinking" (p. 38). By using the concept of a 'scale', NEA had immediately engaged the learners in the conception of what a balanced equation was, at the start of the lesson, by means of an interesting prospect. Although NEA had immediately engaged learners, after watching the video of lesson one, she stated that:

> *"In all honesty I feel that my introduction to* (the lesson) *could have been boarder, instead of only focusing on a scale… I could have given an example to how equations really work"* (NEA, Interview 1, 2022).

In addition, NEA stated, in her reflective journal, that:

> *"I would not say that it was a good introduction because I could have given more examples or demonstrated physical examples"* (NEA, Reflective Journal, Lesson 1, 2022).

In relation to the excerpts, the researcher and the EEA were under the impression that NEA had started to teach the content in the previous lesson. But this was not the case. In the previous lesson, the learners were only told to summarise and write down the notes, from their textbooks, because NEA claimed that this style of teaching works best for her and the learners. She stated that:

> "*…I just told them to sum up and then I will explain afterwards. Instead of explaining first* (and) *then they* (the learners) *take their own time to finish writing. That is what the children* (learners) *do. And then they take their own time to finish writing… then it takes me longer to finish* (teaching the lesson)" (NEA, Interview 1, 2022).

Later, during the VSR interview, the researcher clarified with NEA whether she prefers to give learners time, in class, to take down notes, prior to the content being taught. NEA substantiated her reasoning thus:

> *"…They* (the learners) *know that they need to complete* (the notes) *in that specific timeframe because I need to explain…(*If) *I explain prior to the notes then they take their time to finish writing because they think that ma'am is going to explain the work afterwards. Because that is what I saw when I came back from maternity leave. I saw that if I explain first then allow them to write then they take their time to finish writing* (the notes). *So, I switched it around. I first let them write then I explain then I gave them an exercise, then I do the exercise with them* (corrections). *And so, the cycle continues*" (NEA, Interview 1, 2022).

With regards to the excerpt, NEA had moved to the *conscious incompetence* level, pre-watching the video. She subsequently moved towards the *conscious competence* level, post watching the video, in terms of teaching styles, according to the Burch (1970) model. This is because she had already developed a teaching and learning style that best suited both her and her learners.

In relation to the excerpt, EEA asked NEA whether the notes the learners took down included examples. NEA answered affirmatively to this question. EEA then made the following recommendation:

> *"… I suggest those examples that they wrote down that you do that with them first* (when you start the lesson). *Because they have completed the written work in class then the* (previous) *period ends. Then when you start* (the next lesson) *you first go back to 'okay what have we written down prior'.* (You check by asking yourself) *do you* (the learners) *know what we have written down… a child sometimes just writes down what is needed to finish another writes and analyses, but everyone does not write and analyse… But what they have written down prior we need to look at because they have varying levels* (of understanding)*… one will understand what they have written down and the other one not*" (EEA, Interview 1, 2022).

Here, EEA was assisting, guiding and mentoring NEA with regards to lesson planning. She had suggested that NEA first explain the notes that the learners wrote in the previous lesson, to check their understanding. This form of teaching and learning might create a link between the previous lesson taught and the new lesson to be taught.

In addition, EEA stated, during the VSR interview, that she liked how NEA "*used different colours in order for learners to see* (and understand the concepts taught). *With the testing part especially"* (EEA, Interview 1, 2022). The use of colour was noted in example 1 of lesson one, as underlined in green in line three. According to Olurinola and Tayo (2015), "one of the most interesting and challenging questions in contemporary memory research is on ways to enhance human memory performance. Many variables have been advanced as contributing to the retrieval operations and such include colour" (p. 1). Colour is thought to be one of the most important visual experiences for human beings (Olurinola & Tayo, 2015). This is because colour plays a significant role in enhancing memory performance. Therefore, for learners to be motivated to learn from their educational experience, colour must be recognised as a strategy to facilitate the teaching and learning process. NEA was thus in the second level of the awareness model, *consciously incompetent*, in terms of lesson planning. This is because she used colours when explaining the concept of inverses to the learners. Although NEA had used colour in lesson one, she had not used any in lessons two and three. Therefore, the use of colour in the lesson observations of NEA stagnated.

Moreover, during the lesson, when NEA reminded the learners: "*Previously we learnt in algebra what a variable, constant and coefficient is*" (NEA, Lesson 1, 2022), as underlined in red in Figure 8, in lesson one, example 1, she did not visually depict this prior knowledge to the learners. However, she stated, post-lesson one, that "*Learners need to visually see the concepts that they are being taught*" (NEA, Post Lesson 1, 2022). This method of teaching signals that NEA was at level one of the conscious competence learning model, as she was *unconsciously incompetent*. This educator was comfortable in this stage, and she was completely unaware of the impact of her teaching style on the teaching and learning of mathematics.

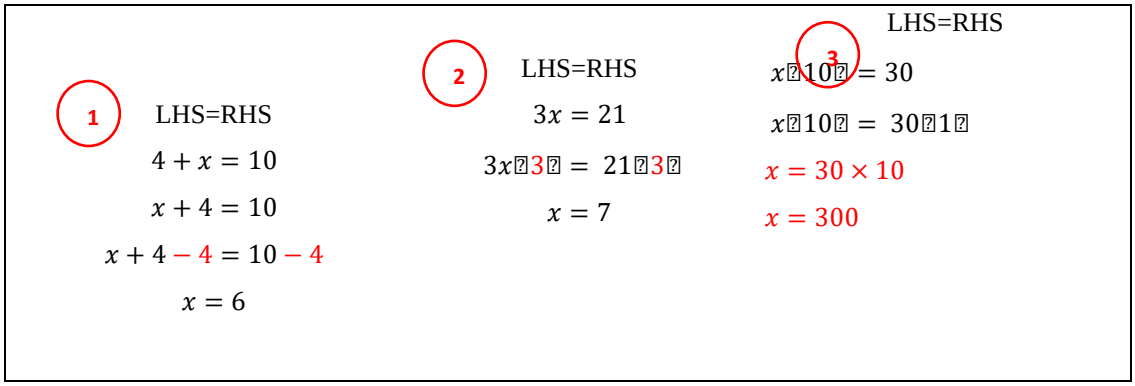
During the first activity, the learners were given ten minutes to solve five mathematical problems relating to the examples the educator explained on the whiteboard. Hereafter, NEA did corrections on the board, without involving the learners. This teaching approach highlighted one of the teacher-centred teaching and learning approaches identified by Serin (2018). EEA stated, post-lesson one, that "*When the answers are done on the board, allow learners to participate more"* (EEA, Interview 1, 2022). This teaching style would allow NEA to shift her teaching style more towards it being learner-centred. When EEA noticed this phenomenon, she enquired: "*Can I maybe make a*

suggestion. Involve your rows (the learners seating arrangement)" (EEA, Interview 1, 2022). Here, EEA suggested to NEA to involve her rows of learners, to create a classroom that involves the learners. This results in a classroom that is more learner-centred.

Furthermore, when the researcher asked NEA what she noticed regarding her teaching thus far, in lesson one, she stated that:

> "*I do not give a lot of eye contact to the class… where we* (as educators) *need to give eye contact to the learners, and we have to write on the board* (simultaneously)*. I still find that difficult to do… I still find that very difficult to work* (teach) *like that…*" (NEA, Interview 1, 2022).

In relation to the excerpt, Kochoska and Gramatkovski, (2015) note that the art of eye contact is very tricky to master, although it is crucial for effective communication. Moreover, regarding classroom management, the notion of eye contact plays a significant role. This is because "eye contact is perhaps the most powerful way we communicate" (Kochoska & Gramatkovski, 2015, p. 1). This is congruent with Butt, Sharif, Muhammad, Fanoos and Ayesha's (2011) statement that within the classroom, the educator's eye contact is crucial, as it is used as non-verbal cue. It is claimed that eye contact, in addition to classroom management, directly affects the teaching and learning process. Although the notion of eye contact can significantly assist the work of learners and educators, as it fosters a better understanding between them, NEA struggled to implement this form of teaching. She was thus in the *unconscious incompetent* level of the Burch (1970) model, in terms of eye contact, prior to watching the video. Nonetheless, she moved to the *conscious incompetent* level, after watching the video regarding the teaching style. This is as she became aware of the importance of eye contact concerning the teaching style.



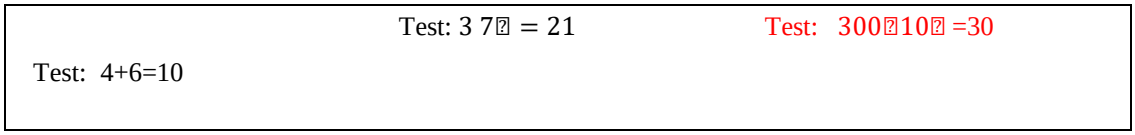


Figure 4.2: NEA Lesson 1 Example 2

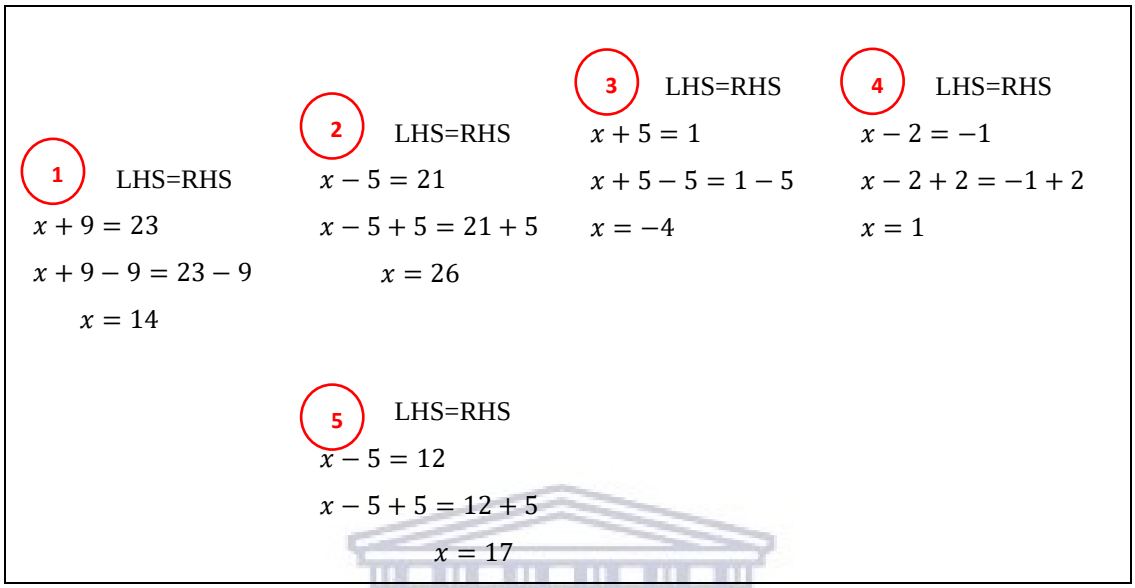


Figure 4.3: NEA Lesson 1 Example 3

In relation to Figure 4.2, EEA states, in her lesson one field notes:

> "*Number problems on the whiteboard as shown in textbook"* (EEA, Field notes 1, 2022).

When NEA noticed Figure 4.2 and Figure 4.3, she stated:

> "*It is skew* (the writing on the board), (because) *I need to literally stand on my toes to write high on the board"* (NEA, Interview 1, 2022).

According to Chan (2020), when writing on the whiteboard, one "is to ensure that when one looks at the whiteboard, one can see the logical flow of the lesson with all the essential information on it" (p. 7). Although this was the case with NEA, she forgot to number the equations accordingly. She noticed that her writing on the whiteboard was skewed. NEA recognised her whiteboard handwriting and was thus in the *unconscious incompetent* level. However, after viewing the video of lesson one, she moved towards the *conscious incompetent* level of the awareness model (Burch, 1970), in terms of whiteboard writing.

Furthermore, the researcher asked NEA what she noticed about her teaching. She stated:

> "*In all honesty I think, it is too fast* (the pace of the lesson). *I could* (have) *asked them…who got the sum correct or what did they not understand in the sum. So, I think I (*am) *moving too fast* (through the lesson)" (NEA, Interview 1, 2022).

In relation to the excerpt, it was evident that NEA had moved from the *unconscious incompetence* level of the awareness model towards the *conscious incompetence* level (Burch 1970), in terms of the pace of her lesson, through the use of VSR. She identified her error consisting of her teaching being too fast, through the concept of 'noticing'. Through VSR, NEA was able to notice that the pace at which she was teaching was too fast and moved toward the *conscious incompetence* level (Burch, 1970), regarding lesson pacing linked to lesson planning.

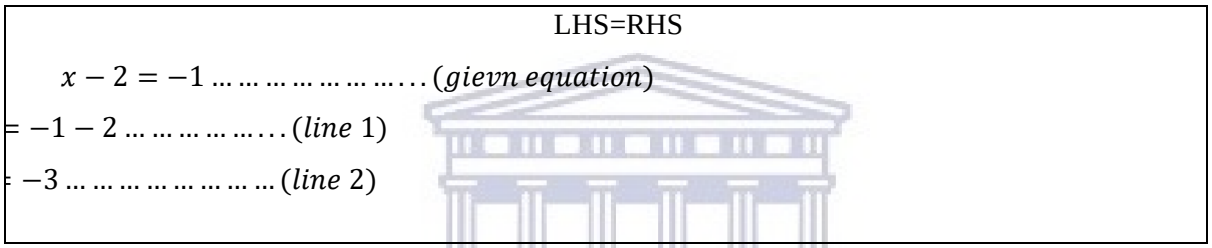


Figure 4.4: NEA Lesson 1 Example 4

Initially, concerning the fourth equation posed by NEA, as seen in Figure 4.4 line 1, she had made a calculation error. During the VSR interview the researcher noticed that NEA shook her head while watching the lesson observation. So, the researcher asked NEA what she had noticed. She replied:

> *"…As I previously mentioned to the researcher, I was thinking the night before am I supposed to be preparing a lesson plan. See as we learned at university. But then I thought to myself we said that it* (is) *just a normal lesson that I would have to give. So, I came without any preparation with regards to the activities. When every now and then if I struggle with the topic, then I sit with it and write it down, understand? But because I understand equations, I feel like I can explain it fluently. So, I thought I* (am) *not going to struggle with the activity. Where normally I complete the activity prior* (to the lesson) *on a page and then I monitor what the learners give me (their answers). But I did not do that, that is why I* (am making mistakes)" (NEA, Interview 1, 2022).

In addition, NEA wrote in her reflective journal:

> *"What I can improve is to have a book with me in front of the class where all the calculations of the examples are already calculated. In order not to make calculation errors on the board"* (NEA, Reflective Journal, Lesson 1, 2022).

In relation to the excerpts, NEA did not do any planning concerning the lesson she was going to teach, on equations. She thought she had a good understanding of the topic. This was not the case. Although NEA had rectified the errors she had made while teaching the lesson, she still made further calculation errors while teaching. This could have been avoided, if she had planned the lesson prior to teaching, as recommended by Stronge (2007) (see, Section 2.2.6). Although NEA was in the *unconscious incompetent* level, in terms of lesson planning, she had thought of ways to improve future lessons through the incorporation of a book containing pre-executed calculations. Clearly, she had moved to the *conscious incompetent* level, in terms of lesson planning.

The final question posed by the researcher, before the VSR interview ended, was: *If you look at the overall lesson now, what do you think you can change in future?* NEA responded:

> "*As I previously mentioned more examples. But one also has to look* (consider) *time. Because time differs at school* (the school's period lengths are not followed strictly). *More examples and then I would also like* (to play) *a mathematics game… I am thinking now about like terms, where I give them colour pages and then I ask them what is like terms and what is unlike terms… such type of games. I would also like to involve them so that they* (the learners) *can remember okay on that day I* (did that)*… cause the children* (the learners) *are very playful so what they do* (in class) *they will remember…*(So), *to make them more active and not just sit still in their desks and watch what I am doing"* (NEA, Interview 1, 2022).

Concerning the excerpt, NEA noticed that her lesson was too teacher-centred, as noted by Serin (2018), and could be enhanced by including games. She also sensed that she could include more examples to enhance learners' understanding of the concepts. This shows that NEA has moved towards the *conscious incompetence* level in terms of lesson planning, after watching the video. This concerned ways of making mathematics enticing by involving learners in mathematical games and providing more examples in future lessons.

It can be concluded that the following aspects were touched on in the first cycle of NEA's VSR: focus on a learner-centred approach to teaching, the broadening of the introduction to the lesson, the use of colour throughout the lesson, more eye contact with learners, lesson planning, overall teaching style, the way of writing on the whiteboard (handwriting), and the inclusion of more examples and mathematical games in future lessons.

4.3.2.1.2 Cycle 2 - Lesson observation, VSR interview and reflective journal of NEA

NEA's second lesson was on geometry. This lesson was conducted with the same Grade 8 class, as in lesson one. More learner participation was evident, in comparison with the first lesson. The lesson was arranged in such a way that the educator taught the concepts first, then allowed the learners to work in pairs and engage in a practical on how to use a protractor and two lollipop sticks to determine angles, as seen in Figure 4.6. Hereafter, the learners had to display the angles they determined using the two lollipop sticks and state what types of angles they were. The completion of this practical activity was followed by learners' use of the given photocopied protractor to determine various angles. The teaching of concepts lasted for approximately seventeen-minutes, and the remainder of the fifty-minute lesson was used for both the practical activity, involving learners' demonstration thereof, and the commencement of the next class activity. During this time, NEA walked around the classroom to support the learners with any questions they had pertaining to the practical activity. The researcher and the experienced educator were present throughout the first period of the double lesson. The experienced educator was taking field notes on the lesson, while the researcher was video recording the lesson. Given that the experienced educator had a class, she could not observe the second lesson of the double period. The figures display examples of lesson two, where NEA engaged with the mathematics lesson and encountered various states of awareness, when viewing the video lesson during the second VSR interview.

At the start of the second VSR interview, EEA asked whether the learners had completed their written work the previous day, from their textbooks. NEA stated that they did not use the textbook; she wrote down a short piece that she read to them from the notes. This was as the learners only received the notes the following day during lesson two. Here, NEA had not moved to the fourth level in terms of the Burch (1970) model. She stayed on the third level of *conscious competence*, in terms of lesson planning, with regards to not highlighting prior knowledge in the following lesson. Hence,

there was no link between the notes the learners had written down the previous day and the start of lesson two.

During the VSR interview, EEA noticed that NEA had handed out the class notes to the learners, prior to explaining the content. She recommended that:

> *"…So, if you start with the introduction of geometry, a suggestion is to make the handing out of the activity* (notes is) *the last thing you do after you have explained* (the content). *Because remember you just told them not to look on the page* (when asking a question). *Because if they look on the page, they will give you what is on the page…"* (EEA, Interview 2, 2022)

A few minutes later EEA stated that:

> "*They* (the learners) *come from different primary schools so the one says: "ma'am they are lying"* (when asked if they have done geometry before)… *That is because they come from different* (diverse) *backgrounds, so they name an acute angle an obtuse angle. But then you ask them to make an acute angle using their hands. This will grab their attention. Because now they are just naming angles which they possibly got from the page* (the given notes). *But we do not know whether they have done it with the Covid-19* (pandemic)… *when I started with the Grade 9 geometry I had different steps, which was their prior knowledge. I used about two periods to explain this… they* (the learners) *like the introduction… So, their prior knowledge is very important. And it takes time"* (EEA, Interview 2, 2022).

Regarding the excerpts, Ningsih and Retnowati (2020) explain that "learning is the process of building new knowledge by linking existing knowledge" (p. 61). Sidney and Alibali (2015) claimed that individuals "learn new information in the context of their own prior knowledge. For example, when learning new mathematical concepts, students draw on their existing knowledge of related mathematical concepts and procedures" (p. 160). Nonetheless, EEA stated that because the learners attended primary school on a rotational basis due to the height of the Covid-19 pandemic and came from different primary schools, they have varying levels of prior knowledge regarding geometry. One could argue that this is not only the case concerning geometry, but also with other topics. Hence, the recommendation that EEA made to NEA regarding the learners' prior knowledge was crucial to creating a link between prior knowledge and the exiting knowledge.

While watching lesson two, the researcher asked NEA what she had noticed about her teaching thus far. She replied:

> "*I am going to be honest it felt like most of the learners did not know that the three dots meant 'therefore'* (refers to the whiteboard). *And they would not have known that those strips mean parallel lines* (refers to the sketch on the whiteboard as seen in figure 4.5). *So, I felt like I did the right thing by explaining it to them and telling them that they should write it on the page. So, that when they study, they know what it means… I told the class they are not going to write out the word parallel lines. They are going to have to use the symbol"* (NEA, Interview 2, 2022).

Subsequently, the researcher asked NEA how she could change this in future. NEA then wondered:

> "*Maybe* (I could) *give them notes that have the words and symbols on it (key words)"* (NEA, Interview 2, 2022).

In relation to the excerpts, NEA reflected on her lesson thus far while watching the second lesson video. She had elaborated on the introduction of the lesson, in comparison to the first lesson observation. Consequently, she had moved from the *conscious competence* level towards the *unconscious competent* level, in terms of lesson planning, according to Burch (1970).

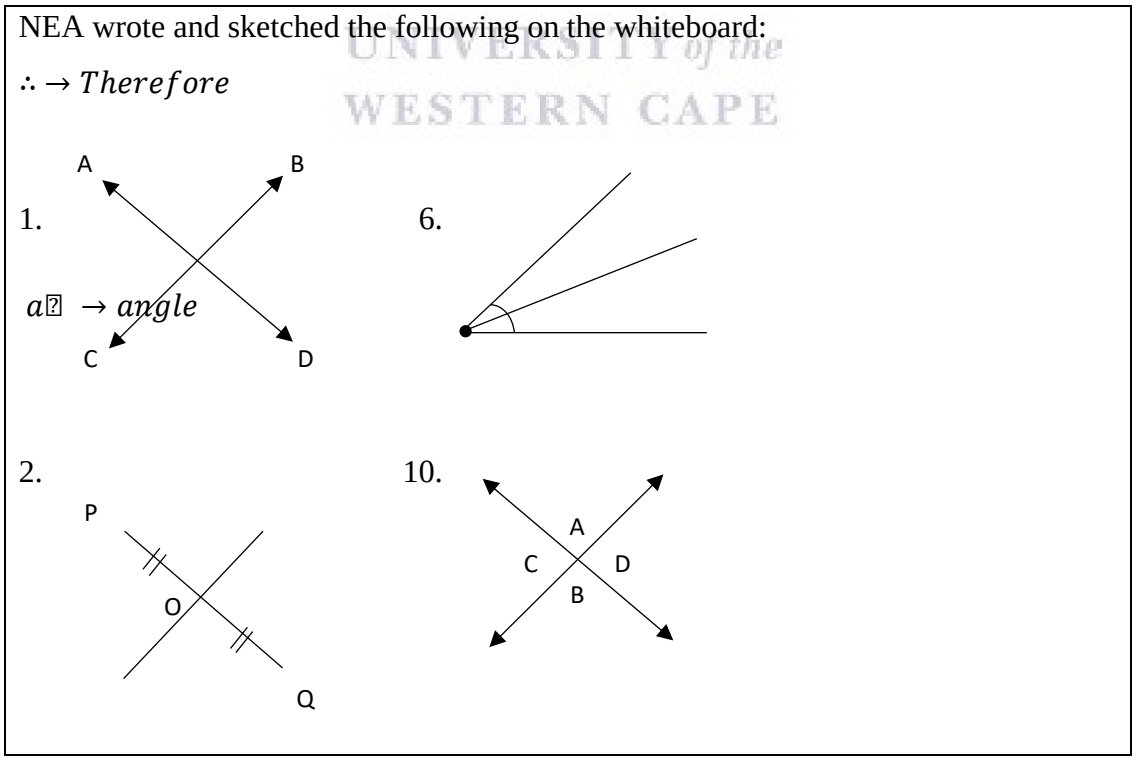


Figure 4.5: NEA Lesson 2 Example 1

Ten minutes later, during the VSR interview, the researcher asked NEA what she had noticed about her whiteboard writing in comparison to what was discussed in the first VSR interview of lesson one, as seen in Figure 4.5. She stated that:

> "*It* (is) *organised, I won't forget* (from the previous lesson)" (NEA, Interview 2, 2022).

As previously mentioned, when writing on the whiteboard, one "is to ensure that when one looks at the whiteboard, one can see the logical flow of the lesson with all the essential information on it" (Chan, 2020, p. 7). In comparison to the first lesson, this was now the case with NEA. She even remembered to number the equations according to the notes handed out to the learners. Her handwriting on the whiteboard became more organised. Therefore, NEA had recognised her previous handwriting style and rectified the way she writes on the whiteboard. She had thus adjusted and moved from the *conscious incompetent* level towards the *conscious competent* level, in terms of whiteboard writing, after viewing the video of lesson two, according to Burch (1970).

While watching the recording of the second lesson, EEA commented:

> *"Another thing the Department of Basic Education (DBE) said to us* (in their report) *was that… our learners need to learn to write dates. Because for the DBE it seemed as if the learners worked on certain days, then skipped a few days.* (But there are several factors that influence this)… *They* (the DBE) *also expect the books to be marked. But in …Grade 8 and Grade 9* (there are) *48 and 49 learners respectively* (if they) *want us to mark then when are we going to teach?"* (EEA, Interview 2, 2022)

In relation to the excerpt the researcher suggested:

> *"… I can maybe recommend… with regards to the marking when you give the learners the activity and you walk around to support them, walk around with your red pen and then mark…* (For example, if*)… one learner finished question one and you gave them question one to five,* (to do in class*) just mark and sign* (it). *And in that way your books will constantly be marked"* (Researcher, Interview 2, 2022).

Concerning the researcher's recommendation, the construct of marking books was never addressed during this study. Consequently, NEA remained in the *unconscious incompetent* level, in terms of not marking the learners' books.

Unfortunately, due to prior commitments, EEA had to leave the VSR interview, after posing the previous question from the DBE. Consequently, only the researcher and NEA remained for the rest of the VSR interview. The researcher then posed the following question to NEA: "W*hat have you noticed about your teaching thus far*? She responded:

> *"So far, all that I have noticed about my lesson is that it is a bit better than the last time as I went more in detail of what everything meant* (the introduction of the lesson)*…"* (NEA, Interview 2, 2022).

Regarding the excerpt, Mesiti and Clarke (2006) state that "the beginning of the lesson provides an opportunity to arouse the students' interest and facilitate their engagement, to situate and introduce the lesson's content, and to establish the subsequent work pattern for the lesson" (p. 47). In comparison to the first lesson, NEA had elaborated on the introduction of the lesson, which showed that she had moved from the *conscious competent* level towards the *unconscious competent* level, according to Burch (1970), in terms of her introduction of the lesson. Although NEA had moved towards the fourth stage of the awareness model, due to the duration of this study and it being done over three cycles, the researcher was unable to determine whether NEA was able to fully master this stage, in terms of whiteboard handwriting. This is because most educators need a few months to a few years to fully master the notion of *unconscious competence*, to the stage where they do not have to think about their teaching as much. Therefore, the researcher indicated that NEA was moving towards the fourth stage and the notion of 'effective teaching' but had not yet mastered this level.

Since ancient Greek, the most common tools used by individuals to draw geometric figures are a ruler, a protractor and a compass (Hendroanto & Fitriyani, 2019). Hendroanto and Fitriyani (2019) explain that "a protractor is a tool to measure the size of an angle. Mostly, a protractor is shaped like a half section of circle with standardized scale on its edge. Standardized angle measurement used mostly is a degree… to use a protractor one must put it on the drawing plane with the centre on the measured angle. Protractor also can be used to draw an angle with certain size" (p. 2). With regards to the second lesson, the learners used a protractor to determine the size of angles, using two 'lollipop' sticks, as shown in Figure 4.6. The latter demonstrates how the practical example occurred using a 90° angle and two lollipop sticks. NEA supported why she did the practical during the VSR interview by stating:

"The reason … I did that (the practical) *was because they* (the learners) *probably wonder where the degree comes from in geometry. I wanted to practically show them where the degrees came from…"* (NEA, Interview 2, 2022).

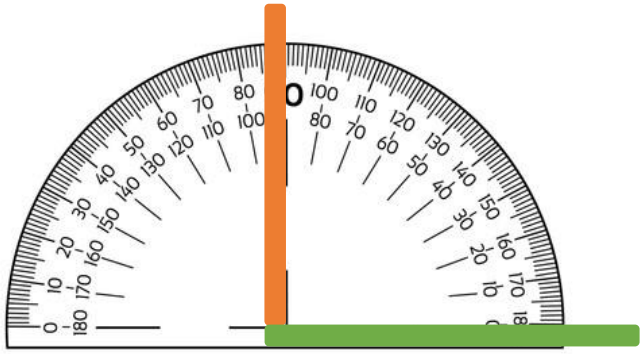


Figure 4.6: NEA Lesson 2 Example 2

The second last question posed by the researcher during the VSR interview was: *What did you notice when you were watching the video in terms of your teaching*? NEA responded:

"*Firstly, I could give the notes at the end of the lesson. My written work* (on the whiteboard) *was okay…, the learners at the back of the classroom seemed a bit sleepy to me so, I could ask them questions so, that they could wake up. And also, the learners who raise their hands I need to go to the learners in order of those who raised their hands first, 'first come first serve'… My lesson and my activity the learners* (seemed to have) *enjoyed it*" (NEA, Interview 2, 2022).

Here, NEA had moved to the *conscious incompetence* level, in terms of the order in which she was handing out the class notes, prior to explaining the concepts. She had remained on the *conscious competent* level, in terms of her board writing, according to Burch (1970). She had moved to the *conscious incompetent* level with regards the way she would use questioning techniques in future lessons, according to Burch (1970), in terms of her teaching style. In comparison with the first lesson, NEA stated that her learners seemed to have enjoyed the practical component of the lesson. She had consequently moved to the *conscious competent* level, in terms of lesson planning, according to Burch (1970).

The last question asked by the researcher was: *What changes did you notice compared to the first lesson (video)*? NEA replied:

> *"The board definitely; to make the activity more exciting instead of them just sitting and listening then doing the activity. I brought in more practical examples in the class I also did a practical example with them. In comparison to the first lesson, I elaborated on the introduction and also asked them questions on the relevance of geometry in the real world. And what could happen when using geometry in the real world especially with regards to buildings. But* (something that I have noticed is that) *time management is something that I need to work on"* (NEA, Interview 2, 2022).

In connection with the excerpt, NEA had moved towards the *conscious competent* stage of the awareness model, with regards to incorporating mathematics games and more examples, in terms of lesson planning. NEA had also identified an aspect of her teaching she still needs to work on, time management. Here, she had moved to the *conscious incompetent* stage, after watching the video.

It can be concluded that the following aspects were covered in the second cycle of NEA's VSR: linking of learners' prior knowledge, the broadening of the lesson introduction, the way of writing on the whiteboard (handwriting), questioning techniques, overall lesson planning, overall teaching style, and the inclusion of mathematics games and more examples.

4.3.2.1.3 Cycle 3 - Lesson observation, VSR interview, and reflective journal of NEA

NEA's third lesson was based on geometry. This lesson was conducted with the same Grade 8 class, as in lessons one and two. The learners partially participated throughout the lesson. The lesson was arranged in such a way that the educator marked the previous day's homework first, taught the concepts, and then allowed the learners to do the activity. The teaching of concepts lasted for approximately sixteen-minutes, the remainder of the fifty-minute lesson was used to start the class activity. During this time, NEA walked around the classroom to support the learners with any questions they had pertaining to the classroom activity. The researcher and the experienced educator were present throughout the lesson. The experienced educator was taking field notes on the lesson, whereas the researcher was video recording the lesson. Figure 4.7 displays an example of the lesson observation three, where NEA engaged with the mathematics lesson and encountered various states of awareness, when viewing the video lesson during the third VSR interview.

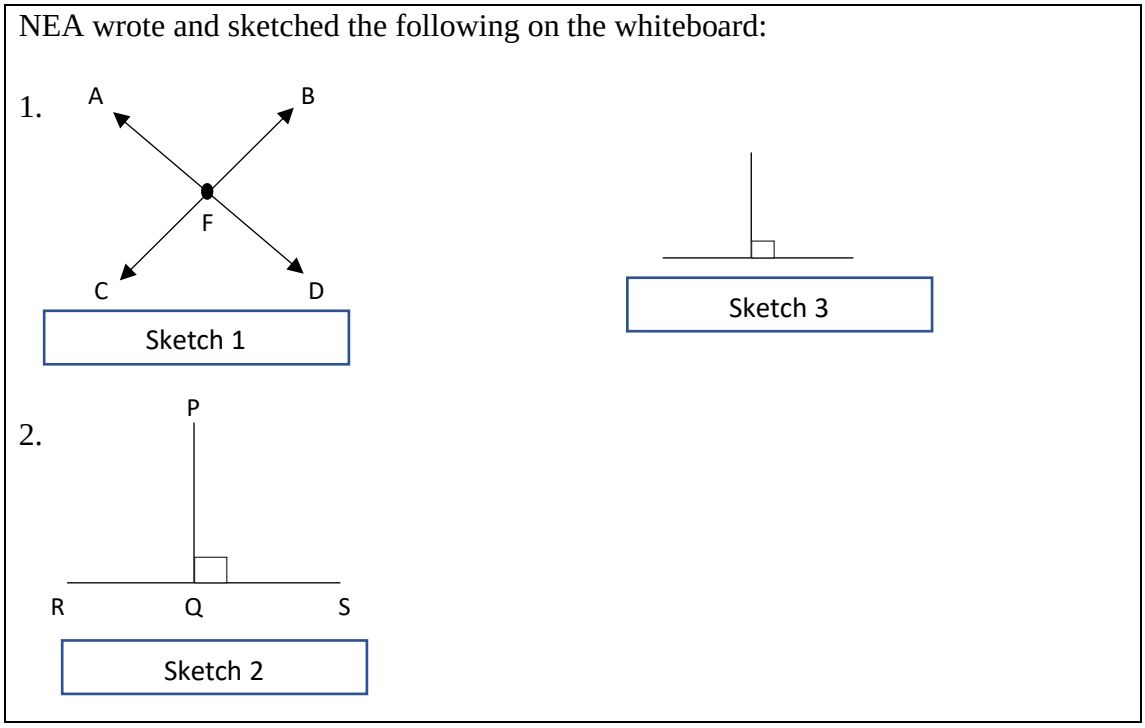


Figure 4.7: NEA Lesson 3 Example 1

In relation to Figure 4.7, after NEA had drawn sketch 2 on the whiteboard, she had stated that perpendicular angles are horizontal. Here, the researcher assisted NEA, advising her not to state that perpendicular angles are only horizontal, because they can also be diagonal (or upside down). NEA realised her error and moved from the *unconscious incompetent* level prior to watching the video, to the *conscious incompetent* level after watching the video, according to Burch (1970), in terms of content knowledge. Content knowledge was identified by Stronge (2007) as one of the elements of being an effective educator. Therefore, NEA had deepened her content knowledge, with the assistance of the researcher.

While the third-lesson video was playing, the researcher asked NEA what she had noticed about her learners while she was teaching and what she had noticed about her handwriting. She stated:

> *"I notice that they* (the learners) *are listening to me. They are doing their work. Here and there they are drifting from the work, but they are giving their cooperation. They do seem a bit uncertain of the answer, when I say the answer then they say it afterwards…It's organised* (in terms of handwriting)*…"* (NEA, Interview 3, 2022).

NEA remarked that the learners were initially very weary to participate and answer questions in the lesson, due to the presence of the researcher and the camera in the classroom. The educator also noticed that the learners tended to answer after the answer was given. With regards to her

handwriting, NEA had noticed that it had become even more organised, in comparison to the previous lessons. This showed that NEA had moved towards the *unconscious competent* stage, according to Burch (1970), in terms of whiteboard handwriting. Although NEA had moved towards the fourth stage of the awareness model, due to the duration of this study and it being done over three cycles, the researcher was unable to determine whether NEA was able to fully master this level of whiteboard handwriting. This is as most educators need a few months to a few years to fully master the notion of *unconscious competence*, to the point where they do not have to think about their teaching as much. Therefore, the researcher indicated that NEA was moving towards the fourth stage and the notion of 'effective teaching' but had not yet mastered this stage.

EEA had noticed that the learners were confused with the concepts of horizontal and vertical. She suggested to NEA:

> *"If they get confused with that* (the difference between vertical and horizontal)… *They are going to get confused because they do not often hear the words 'vertical' and 'horizontal'. So, if they do get confused with horizontal then ask them how they keep the sun out of their eyes they will show like this* (hand across their eyes). *So, the sun works on the concept of horizontal. I noticed that my children* (learners) *also get confused with that, and so I had to come up with a solution"* (EEA, Interview 3, 2022).

Here, EEA had supported NEA with regards to her teaching of concepts. EEA had assisted NEA in terms of her teaching style. This allowed NEA to move from the *unconscious incompetence* stage prior to watching the video, to the *conscious incompetent* level after watching the video, according to Burch (1970), in terms of teaching style.

Hereafter, the researcher asked NEA what she had noticed about her teaching thus far. She indicated:

> *"What I notice is the previous mistakes I rectified* (it) *through organising my handwriting* (on the whiteboard)… *I* (also) *go through literally every question besides number 6* (unlike the previous lessons)" (NEA, Interview 3, 2022).

NEA had noticed that she had rectified her writing on the whiteboard. Evidently, she had moved to the *unconscious competent* level, in terms of whiteboard handwriting. In addition, she had gone through each example that she was teaching, unlike in the previous lessons. Here, NEA had moved towards the *unconscious competent* level, according to Burch (1970), in terms of doing more

examples regarding lesson planning. Although NEA had moved towards the fourth stage of the awareness model, due to the duration of this study and it being done over three cycles, the researcher was unable to determine whether NEA was able to fully master this stage in terms of providing the learners with more examples, in comparison to the previous lessons. This is because most educators need a few months to a few years to fully master the notion of *unconscious competence*, to the level where they do not have to think about their teaching anymore. Therefore, the researcher stated that NEA was moving towards the fourth stage and the notion of 'effective teaching' but had not yet mastered this level.

The researcher then asked NEA if there was anything that she would change in this lesson so far. She responded:

> *"What I can do is, I feel … they* (the learners) *are getting everything handed to them on a spoon, why do I not get the answers from them rather? So, they are waiting on me for every answer where I could* (have) *instead asked: okay you tell me what you have written down…"* (NEA, Interview 3, 2022).

In relation to the excerpt, EEA remarked that:

> "*…at the moment the learners are speaking together* (and not answering individually) *and if they are speaking together, you would not know who understands and who does not. In my Grade 9 class I ask which learner will represent each row… the learners know that everyone can answer. I make them feel at ease though that method and then we unpack it. They already know who will represent them. Then I say no someone else must do it… The learners are afraid in general to answer…"* (EEA, Interview 3, 2022).

In relation to the excerpts, NEA had reflected on her teaching thus far, during the VSR interview. She had pondered how she could change this part of her teaching in future lessons. This episode focused on when NEA had realised that she was giving the learners most of the answers, instead of allowing them to answer. This reflected her being less learner-centred than recommended by Serin (2018). EEA assisted in this by providing an example as to how she deals with a similar situation, in her Grade 9 class. Here, EEA assisted and guided NEA on how she could adjust and alter her teaching in future lessons, to make the learners the focus of the lesson. Through reflection, NEA had moved from the *unconscious incompetent* level to the *conscious incompetent* level, as she was willing to learn from her previous ways of doing, in terms of her teaching style.

While watching the video of lesson three, NEA had noticed that she had asked a question to the learners but had proceeded to answering it herself. She noted that:

> *"I do that a lot. It is as if the answer just comes out, and I do not like it"* (NEA, Interview 3, 2022).

In relation to the excerpt, NEA had realised that she needed to work on her questioning techniques, as she often answers the questions posed to the learners. Clearly, NEA had moved from the *conscious incompetent* level to the *conscious competent* level, according to Burch (1970), in terms of her questioning technique linked to her teaching style.

At the end of lesson three, the researcher asked NEA what she noticed throughout this video regarding her teaching, when she compared it to her previous lessons. NEA elaborated:

> *"…the previous lessons the learners were a bit quiet I could see that they might have been scared to interact but then that same day* (on lesson observation three*) I realised that they got used to* (the researcher) *too quickly. Because then they were in their comfort zones, it's here that they gave their cooperation. In the beginning they were scared to answer, it almost felt like an evaluation lesson. The learners did not know whether they should answer or not. But afterwards they became comfortable. I also rectified my mistakes such as the board writing…"* (NEA, Interview 3, 2022).

Here, the educator elaborated on learners' conduct throughout lesson three. She claimed that the learners were more reserved in previous lesson observations, in comparison to the third lesson. In addition, she reflected on her style of writing on the whiteboard, which had improved in relation to the one observed in the previous lessons. Clearly, NEA had moved to the *unconscious competent* level of the awareness model, according to Burch (1970), concerning her whiteboard handwriting.

The researcher then asked NEA how her time management was compared to the one evident in the previous lessons. She had stated:

> "*I feel like it should have been like an evaluation lesson where I should have had everything done such as an introduction, objectives and a conclusion. And then the activity I should*

have marked a small section of the work so that they know where they are on the right track so that they could have done the rest for homework" (NEA, Interview 3, 2022).

Regarding the excerpt, EEA commented:

"I hope that you (NEA) *realise that you have grown a lot compared to the first lesson. A lot of things have changed, such as your interaction… your lesson planning too, your time management, you did not let the learners work on their own and then time passes… you did a part of the activity and then you went to unpack. There was a continuous involvement by the educator and the learners"* (EEA, Interview 3, 2022).

Based on the excepts, NEA had reflected on wanting her lesson to relate more to lessons that are being evaluated. Here, NEA had realised that her lessons had lacked the elements of evaluated lessons. NEA had thus moved from the *unconscious incompetent* level to the *conscious incompetent* level, according to Burch (1970), in terms of lesson planning.

The researcher then asked NEA how she thought the lesson had gone overall and how she thought it could be improved in terms of teaching style, classroom management, and time management. She responded:

"I am not going to say it was excellent, but I do feel that it went well. I did everything that I was supposed to do, and I went through everything that I was supposed to. (In terms of the learners) *learning style I cannot really show them* (on the projector), *but I can use the classroom as my examples… I can literally only use the examples in the class* (such as the shape of windows or the whiteboard). (I can)*… do more interactive activities like last time. The learners liked using the protractor and the sticks* (to measure angles)…" (NEA, Interview 3, 2022).

In relation to the excerpt, EEA emphasised that:

"You really, really grew a lot ma'am, we (are) *… proud of you…."* (NEA, Interview 3, 2022).

Concerning the excerpts, EEA had noticed that NEA had grown significantly from the implementation of this project. EEA had thoroughly supported NEA throughout the process, through peer support and guidance. However, due to the duration of this study and it only being over three cycles, the researcher was unable to witness the prolonged effect of VSR on NEA's

teaching practices. Hence, the researcher could not establish whether or not NEA was able to implement the above-mentioned changes regarding her lesson planning.

In conclusion, the following aspects were addressed in the third cycle of NEA's VSR: focus on a learner-centred approach to teaching, content knowledge, lesson planning, including more examples, whiteboard handwriting, the teaching of concepts, questioning techniques, overall teaching style, and overall lesson planning.

4.3.2.1.4 Summary of NEA's three cycles

Key findings emanated from the analyses and discussions of the data collected from NEA. This section summarises the findings related to the three subthemes that emerged from the data. Within the three cycles, it was evident that VSR served as a tool for in-house PD. Indeed, post-VSR interview three, NEA stated that she had managed to 'grow' in her teaching. Through this in-house PD programme, she was able to develop through self-reflection in her own teaching, by using VSR. This was evident as the subsequent lessons, after the first VSR interview, were altered and adjusted for them to move towards more effective teaching practices. Through peer support from EEA, NEA was able to effect change in various aspects. This was because EEA (peer) was able to provide support and guidance and identified unique weaknesses in NEA's teaching practices. This, in turn, assisted in the adjustment of her teaching style, lesson planning, and time management. Therefore, the formation of a school team (pair) had assisted NEA in moving towards effective teaching and classroom practices. The following subthemes emanated from the data collected form NEA: (1) lesson planning, (2) teaching styles, and (3) time management. The three graphs summarise the findings concerning these subthemes, where NEA engaged within the four levels of the conscious competence learning model, according to Burch (1970).

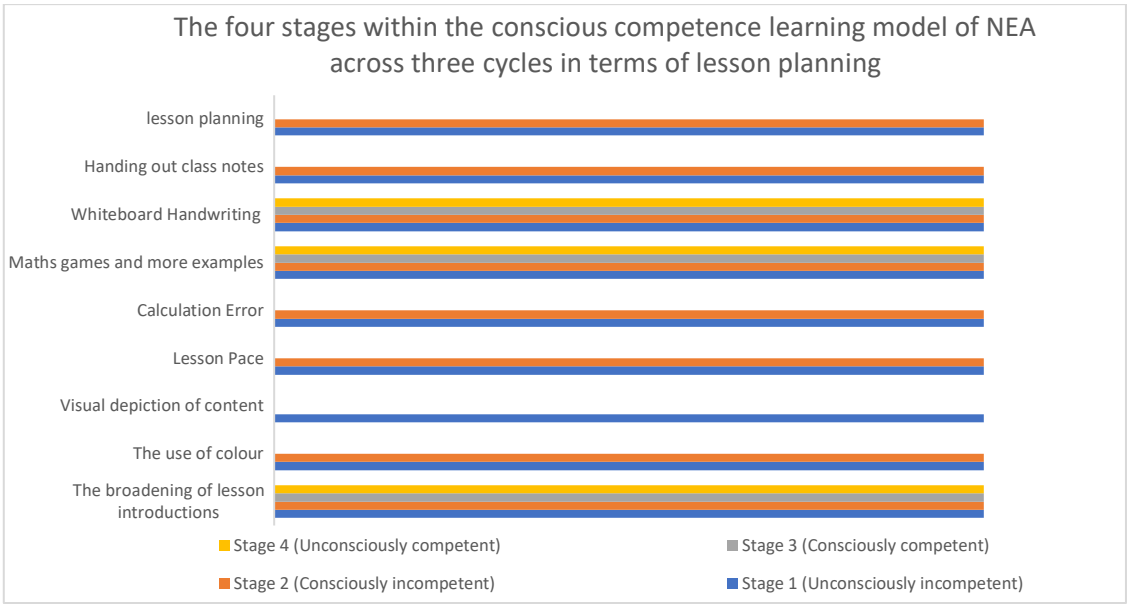


Figure 4.8: Graph highlighting the four stages of the conscious competence learning model, of NEA across three cycles in terms of lesson planning

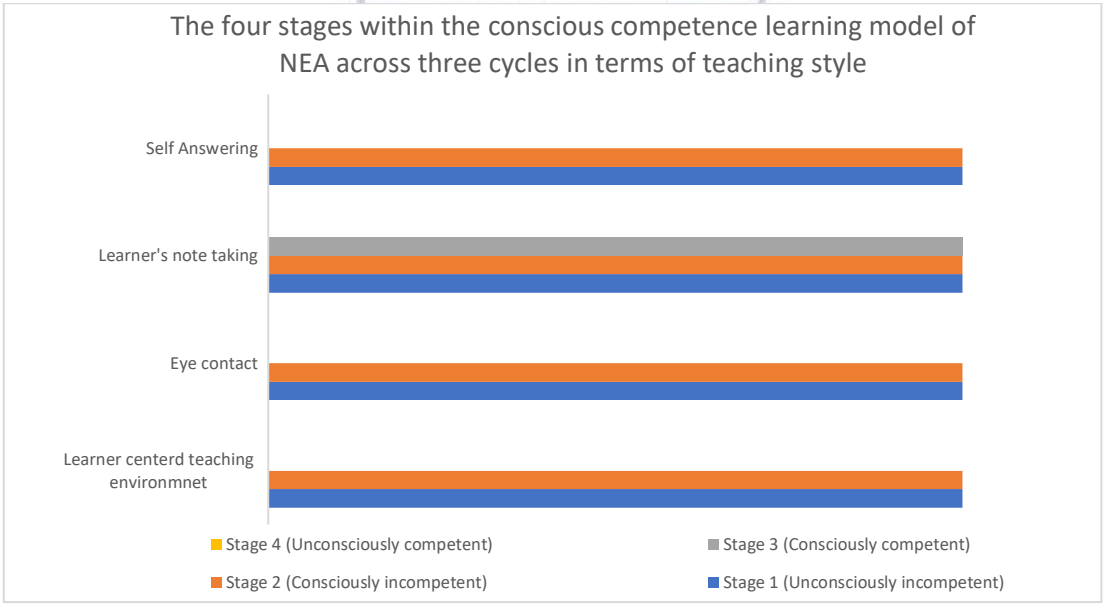


Figure 4.9: Graph highlighting the four stages of the conscious competence learning model, of NEA across three cycles in terms of teaching style

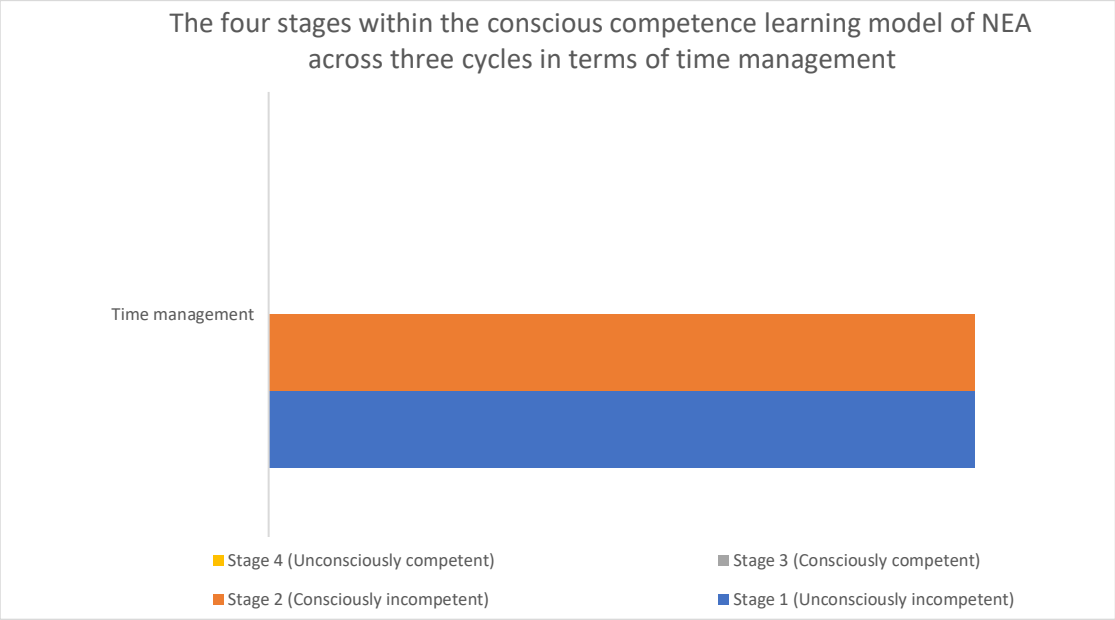


Figure 4.10: Graph highlighting the four stages of the conscious competence learning model, of NEA across three cycles in terms of time management.

4.3.2.2 Data Analysis of NEB1

4.3.2.2.1 Cycle 1 - Lesson observation, VSR interview, and reflective journal of NEB1

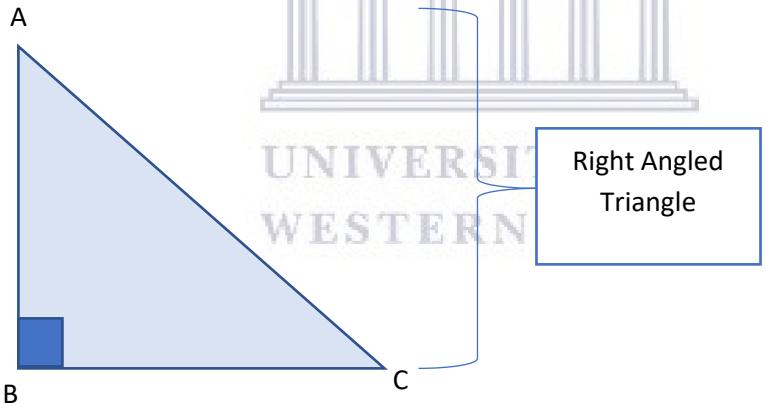
NEB1's first lesson was on the theorem of Pythagoras and determining the perimeter of 2D shapes. This lesson was conducted with a Grade 9 class. The learners partially participated throughout the lesson. The lesson concluded with the learners doing an activity where they had to determine the unknown sides of a right-angled triangle, using the theorem of Pythagoras and the formulas taught to solve questions on the perimeter of 2D shapes. The teaching of the lesson lasted for approximately twenty-five minutes, and the remainder of the sixty-minute lesson was used for the class activity. During this time, NEB1 walked around the classroom to support the learners with any questions they had pertaining to the classroom activity. The researcher and the experienced educator were present throughout this lesson. The experienced educator was taking field notes on the lesson, while the researcher was video recording the lesson. Figures 4.11, 4.12 and 4.13 showcase examples of the lesson observation one, where NEB1 engaged with the mathematics lesson and encountered various states of awareness, when viewing the video lesson observations, during the first VSR interview.

At the start of the VSR interview, when NEB1 watched lesson one, he immediately noticed how rowdy the learners were. This was attributed to the learners coming inside the classroom from recess. He justified:

> *"… I think the reason that there is too much noise, it was break time and I then… had to rush them* (in)*to class. I can see… there* (are) *boys playing soccer there outside… Yes, it was after break that's why there was too much noise"* (NEB1, Interview 1, 2022).

Although NEB1 noticed the learners rowdiness, he never addressed it at the start of lesson one. NEB1 immediately started to teach the lesson. This showed that he was at stage one, *unconsciously incompetent*, of the conscious competent awareness model (Burch, 1970), in terms of classroom management. Here, the educator went on to teach comfortably, completely unaware (Broadwell, 1969) of the prevailing predicament regarding classroom management.

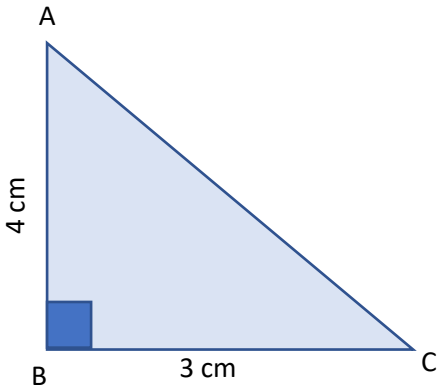
NEB1 drew the following sketch on the board:



Sketch 1

NEB1 wrote the following on the board: *"In a right-angled triangle, the sum of the two sides squared equals the hypotenuse squared"*. Then, without referring to the sketch, he wrote the following on the board:

$$A\,C^2 = A\,B^2 + B\,C^2$$



Sketch 2

- NEB1 then stated: "*Now let's say we have side AC which is 4cm and side BC is 3 cm, then how are we going to calculate side AC?*"
- NEB1 subsequently code-switched and re-explained the question to the learners in isiXhosa, to better their understanding of the question posed.
- A learner responded: "$4c\,m^2$ + $3c\,m^2$", but NEB1 only wrote: "$4^2 + 3^2$" on the board.
- This showed that the learner understood both that he had to substitute the numeral values and the concept of units. Yet, NEB1 only wrote down the numeral values of the equation on the board.

Hereafter, NEB1 told the learners: "*You apply your maths and add everything up*". He then asked the learners to respond but answered line three and line four himself.

$$AC^2 = AB^2 + BC^2 \ldots\ldots (given\ equation)$$

$$AC^2 = 4^2 + 3^2 \ldots\ldots (line\ 2)$$

$$= 16 + 9 \ldots\ldots (line\ 3)$$

$$AC^2 = 25 \ldots\ldots (line\ 4)$$

NEB1 then said: "*Learners what you do on the right-hand side (RHS) you must also do on the left-hand side (LHS)*". Thereafter, he asked the learners what the next step is and, the learners responded that you square root both sides.

$$\sqrt{AC^2} = \sqrt{25} \ldots\ldots (line\ 5)$$

NEB1 added the units of the equation and then expressed the importance of adding the units.

$$AC = 5cm \ldots\ldots (line\ 6)$$

Figure 4.11: NEB1 Lesson 1 Example 1

The omission of 'cm' from line two to line six, in Figure 4.11, signalled that NEB1 was at level one of the conscious competence learning model, as he was *unconsciously incompetent* in terms of lesson planning. The educator was comfortable in that level; he was completely unaware of the error he had made. Broadwell (1969) contends that nothing can be done to improve this educator's teaching, until he reaches the next level, which is the *conscious incompetent* level. During the VSR interview, when watching the lesson video, NEB1 realised that he had omitted '*cm*' on the board. He acknowledged this error, and thus moved towards the *conscious incompetent* level of the awareness model. He stated:

> *"… I should put everything that is there in the equation…that is what I need to do… So, that … they* (the learners) *understand where that cm is coming from"* (NEB1, Interview 1, 2022).

It was evident that NEB1 had moved to the *conscious incompetence* level of the awareness model (Burch 1970), through the use of video. He had identified his error through the concept of 'noticing'. This is because the video assists educators to learn to 'notice', and to "develop new ways of "seeing" what is happening in their classrooms" (Sherin & van Es, 2002, p. 476). Through the intervention of VSR, NEB1 was able to notice the error in his teaching and moved towards the *conscious incompetence* level (Burch, 1970) regarding the use of appropriate units concerning lesson planning.

NEB1 drew the previous sketch (Figure 4.9: sketch 1) on the board, to illustrate a second point of when one side is missing from a right-angled triangle.

NEB1 stated: "*Let's say you have side A C□2□ and side B C□2□ what do you do to get side A B□2□*?

$$A\,C\square 2\square = A\,B\square 2\square + B\,C\square 2\square \ldots\ldots\ldots (given\ equation)$$

A learner responded: "*You are going to subtract*"

NEB1 then asked: "*You are going to subtract what*?"

The learner responded: "*You are going to subtract AC and BC*."

$$A\,C^2 = A\,B^2 + B\,C^2 \ldots\ldots (given\ equation)$$

$$B\,C^2 = A\,B^2 \ldots\ldots line\ 2$$

NEB1 then asked: "*When you take over BC what happens*?"

A learner responded: "*The sign changes*."

NEB1 confirmed: "*Yes the sign changes*".

The equation was left unfinished, as NEB1 moved to the next topic relating to perimeter.

Figure 4.12: NEB1 Lesson 1 Example 2

In example 2, NEB1 did not sketch the drawing on the board but referred to the previous diagram (Figure 4.11, sketch 2). During the first VSR interview, he commented:

> *"These learners… they are visual learners; they are visual learners. So… what I did here, I just told them that okay let's assume that we do not have side AB, we only have side AC and BC. So that is the hypotenuse and that is the adjacent side* (refers to the sketch 2 in figure 4.8). *I did not put that in writing. So… next time I should put that in writing so that they can see because… if they do* (not) *see it then that means chances of them understanding it, they are slim. They are very slim… so that is what I* (am) *seeing"* (NEB1, Interview 1, 2022).

In addition to the excerpt, NEB1 wrote the following in his reflective journal regarding lesson one:

> *"These learners tend to learn visually… If only I had connected a projector so that they see clearly what I was talking about, the lesson would have been better"* (NEB1, Reflective Journal, Lesson 1, 2022).

Concerning the excerpts, mathematics educators are often "confronted with the formidable task of creating a constructivist learning environment, while also considering the learning style preferences of the learners in the class" (Schulze & Bosman, 2018, p. 2). In the extract, NEB1 implemented the visual aspect of the VARK learning style model which refers to 'visual', 'auditory', 'reading and writing', and 'kinaesthetic' learning modalities. According to Schulze and

Bosman (2018), learners may be monomodal, bimodal, trimodal or multimodal, with regard to VARK model. Although learners may vary concerning the VARK model, NEB1 focused on the 'visual' aspect of the learning model, as he had identified that these learners (the Grade 9 class) are mostly 'visual' learners. According to Nyaumwe and Mtetwa (2011), the concept of effective teaching entails presenting concepts in multiple forms, to integrate explanations and demonstrations through the notion of pictorial representations "to make mathematical concepts familiar to the learners' contexts" (p. 145). Therefore, through the recognition of the learners as 'visual' individuals, NEB1 moved from the second level prior to watching the video to the third stage of *conscious competent*, in terms of the Burch (1970) model. He moved towards the notion of effective teaching, with regards to the teaching style.

$$A\,C\square 2\square = A\,B\square 2\square + B\,C\square 2\square \ldots\ldots\ldots (given\ equation)$$

$$\underline{A\,C\square 2\square - B\,C\square 2\square = A\,B\square 2\square \ldots\ldots\ldots\ line\ 2\square}$$

Figure 4.13: NEB1 Lesson 1 Example 3

As seen in Figure 4.13, the blue underlined step of line 2, NEB1 did not complete the equation. He stated that:

> *"…the other thing that I'm noticing is that I did not finish, I did not* finish (refers to the equation)*. I left them hanging, I left them hanging…"* (NEB1, Interview 1, 2022).

Here NEB1, was in the first stage of the awareness model: *unconsciously incompetent* (Burch, 1970). However, after viewing this episode of the video, during the VSR interview, NEB1 moved towards the second level of the awareness model, according to Burch (1970), *consciously incompetent* in terms of completing all the steps.

In this episode of cycle one, it was clear that NEB1 was in the stage of being incompetent. But he was willing to try something new and he was willing to admit that he was not getting through to his learners. Broadwell (1969) claims that this is because this educator wants to improve in their teaching. Hence, he was moving toward the second level of the awareness model: *consciously incompetent,* after viewing the lesson, during the first VSR interview.

The entire mathematics lesson lasted approximately sixty-minutes in which NEB1 stated that he was told by the Head of Department (HOD) that he "*must work at least 20%* (of the lesson) *and let the learners work 80% in a lesson"* (NEB1, Interview 1, 2022). Hence, the classroom activity was longer than the classroom lesson. NEB1 further stated that:

> *"…maybe if a period is an hour-long, I teach like maybe for not more than 20 minutes so that they have more time to do the activity and then more time for me to do corrections as well..."* (NEB1, Interview 1, 2022

The excerpt displayed that NEB1 had encountered the second level of the conscious model as he is *consciously incompetent* in terms of time management, according to the Burch (1970) model. This is as he already considered what his HOD had recommended. Broadwell (1969) claimed that because he has reached the second level, "the chances are pretty good that he will find a way to improve his methods" (p. 3) of teaching. NEB1 wanted to improve his teaching methods, as seen when he stated that he thought the lesson went '*okay', "even though I think … I need improvement"* (NEB1, Interview 1, 2022). This sentiment had allowed NEB1 to move from the first level of *unconsciously incompetent,* where he was comfortable with his teaching method, to the second level of *consciously incompetent*, where he became insecure about certain aspects of his teaching. This was evident in his body language during the VSR interview.

At the end of the VSR interview, the researcher asked NEB1 how he thought this lesson had gone, after watching the video recording? His response was:

> *"… it went well. There are things that … should be changed but other than that… I think, it went okay, even though I think… I need improvement. …, because… the fact that the learners finished quick* (with the classroom activity)*, they all finished that simply states that…, they understood the lesson.* (NEB1, Interview 1, 2022).

In connection with the extract, NEB1 claims that the learners understood the content that they were taught during the lesson, as they managed to finish their classroom activity well before the lesson ended. However, when he gave them a test, on the theorem of Pythagoras and the perimeter of 2D shapes, a few days later, the entire class performed dismally. He then conveyed this message, about learners deficient performance to the learners' parents and then gave them a second test a few days later. In the second test, the learners performed better. The learners only performed better after NEB1 had included the guidance of their parents.

In addition, NEB1 wrote the following in his reflective journal regarding lesson management in lesson one:

> *"I think, the lesson went well as the learners were responding positively throughout the lesson… in future I would come well prepared in such a way that I organise a projector in time, or I write everything on the board... I write it in time… before they come to class to limit time wasting…"* (NEB1, Reflective Journal, Lesson 1, 2022).

NEB1 reflected, after class, how he could have saved time, if he used a projector to display some of the writing. Also, during the VSR interview, when the researcher asked NEB1 how he thought the overall lesson had gone, after watching the video of lesson one, his response was:

> "*Overall, …, is that if … I had all the notes written down on the board instead of me having to write and write and write, … because that is time-consuming, ... If only … I had done that, … the learners would have understood better… I would have just explained what is there and then I'm done explaining, give them an activity. In that way I could have saved time for me to also do corrections on the board, that* (is) *what I could have improved on"* (NEB1, Interview 1, 2022).

However, it was not about the content that he is teaching but rather about how he is conveying the content. He was thus in the *unconsciously incompetent* stage of the Burch (1970) model in terms of his teaching style. NEB1 stated that one way to rectify this was if he was able to use the projector. This was later rectified in lesson two when NEB1 used the projector in conjunction with the whiteboard, to convey the mathematical content. Here, rather than using the traditional method of 'talk and chalk' or whiteboard teaching, the projector served as an extension of his teaching style. He was thus moved towards the second level of being *consciously incompetent* (Burch, 1970) in terms of his teaching style.

Moreover, the researcher noticed that the learners did not take any notes throughout the lesson and conveyed this to NEB1. This may have assisted in their misunderstanding of key concepts during the lesson, as many learners needed assistance from NEB1 during the class activity. NEB1 responded:

> *"…how I can change that is, that I feel the most effective way is if I have the projector on, then first I teach-teach-teach and after I am done teaching, they can take notes, … that is*

> *how I can maybe improve, or print out notes for them then give them, …* that (is) *another way which I can make this* (lesson) *more effective"* (NEB1, Interview 1, 2022).

In relation to the except, in a traditional mathematics setting, the instructor (educator) normally writes the definitions, theorems, and proofs covered on the chalkboard or whiteboard, and then gives an informal oral explanation that assists learners to make sense of what was written (Feudel & Panse, 2022). Therefore, in this traditional setting, the learners take notes of the content taught so that they can use it when they revise. According to Boch and Piolat (2005), "note-takers take notes to fulfil two major functions: to record information and/or to aid reflection" (p. 101). Note-taking is thus an essential tool in information-transmission situations (Boch & Piolat, 2005). The note-taking methods commonly used in schools, which have proven to be effective, consist of a "copy-regurgitate" strategy. Boch and Piolat (2005) claim that the "use of note taking to store transmitted information often overshadows another important role—reflection" (p. 101). The notes taken are thus used by the learners to reflect on what was taught, for them to gain insight and deepen their mathematical understanding. Therefore, there is a general sentiment that learners take notes to record essential information that they will need to learn at a later time and date. Although literature argues that note-taking is used scholastically, often, learners are unable to take notes due to the teaching and learning style of their mathematics educators. This was evident in NEB1's classroom. Hence, NEB1 was in the *unconscious incompetent* level prior to watching the video in terms of note-taking, with regards to lesson planning, but moved towards the *conscious incompetent* level after watching the video.

EEB, who was an active participant throughout the VSR interview, assisted in the above predicament by recommending:

> *"… One thing that can help because I saw your seating arrangement – there is no room for discussion, … because I believe that when they* (the learners) *do mathematics okay, they must work in groups... I think your seating arrangements it must leave room for discussions. So, more group work could have helped even without notes, more group work could have even helped"* (EEB, Interview 1, 2022).

The last question posed by the researcher, before the VSR interview ended was: "*Do you think more aspects in the lesson that can be improved like your teaching style …, your class management, is there anything else that you think could have been improved?"* NEB1 responded:

> *"… I could have just made them work in groups, … so that maybe if a learner in that group does* (not) *understand, there could be a learner in the group that understand* (so he or she) *would be able to explain the work to the others…."* (NEB1, Interview 1, 2022)

In relation to the excerpts, when trying to make the lesson more 'effective', EEB had assisted NEB1 with the inclusion of group work, by recommending a probable change in the seating arrangement of the classroom. Through peer support from EEB, NEB1 was able to implement change, as noted in lesson observation two. This allowed NEB1 to move from the first level of *unconsciously incompetent* to the second level of the awareness model, *consciously incompetent* (Burch, 1970). Hence, through the in-house PD programme proposed in this study, EEB (peer) was able to provide support, guidance and identify unique weaknesses in NEB1's teaching practices. This, in turn, assisted in the adjustment of his teaching style, as noted in the second lesson observation.

It can be concluded that the following aspects were covered in the first cycle of NEB1's VSR: classroom management, appropriate use of units, the VARK model, incomplete equations, time management, teaching style, learners' note-taking, and seating arrangement.

4.3.2.2.2 Cycle 2 - Lesson observation, VSR interview, and reflective journal of NEB1

When I (the researcher) entered NEB1's classroom, I immediately noticed that he had changed his learners' seating arrangement, from the traditional seating arrangement to a modular seating arrangement, as recommended by McCorskey and McVetta (1978) (see, Section 2.2.6). Hence, the educator moved to the third level of the awareness model, *consciously competent,* with regards to seating arrangement. He considered what was viewed and discussed in the first VSR interview and implemented change. After I noticed this change, I asked NEB1 about the new arrangement and he explained that the seating arrangement was to allow the learners to work in groups, should they have any misconceptions around the mathematics content they were going to be taught. He was confident in the possibilities of this new seating arrangement.

NEB1's second lesson was on exponents. This lesson was conducted with the same Grade 9 class, as in lesson one. The learners participated more, in comparison to the first lesson. The lesson lasted for approximately twenty-seven minutes and the remainder of the sixty-minute lesson was used for the class activity. The learners had to solve equations using the exponential laws of multiplying exponents, zero exponents, dividing exponents, raising a power to a power, and raising the product or quotient to a power. During the classroom observation, the researcher had noticed that the learners were engaging with the mathematics throughout the lesson and during the classroom activity, the learners engaged with one another, as a result of the new seating arrangement. Furthermore, the figures display examples of the lesson where NEB1 had engaged with the mathematics lesson and encountered various states of awareness, when viewing the video recording of the lesson. It is important to note that throughout the VSR interview, EEB was unable to attend the first 40-minutes of the 60-minute interview, due to teaching commitments. Although EEB arrived in the last 20-minutes, only the researcher and NEB1 were present for most of the interview.

According to Ahmad and Eka (2020), the educator "will have an easier time to reach the aim of the learning process if she/he can implement class management well or conduct an effective learning process both for individual and group" (p. 429). Effective classroom management influences learners' academic achievements. Therefore, the educator is to "have good class management skills to successfully improve student's achievement in learning" (Ahmad & Eka, 2020, p. 429). Hence, the educator must be able to conduct a lesson through an effective teaching and learning process. Ahmad and Eka (2020) further claim that classroom management is in itself an important aspect that receives attention by both experienced and/or new educators. This attention from educators is the manifestation of their 'will' to "create a learning process that can deliver the material in a good way, and thus, make the material easy to understand" (p. 429). During the second VSR interview, NEB1 immediately noticed that the learners were rowdy as soon as they entered the classroom after recess. He narrated:

> *"This was after break… so learners…, should know that… the minute… the bell rings… they come to class… So, there were learners in class and there were learners outside… still coming to class. So, that means that…the learners that came to class earlier are* (on) *time. I have managed to discipline them to the point where they keep time* (that they were on time) *and that*

> *means that… I need to work on, getting those learners that arrive late cause they* (are) *waste*(ing) *time… I was beginning to talk* (start teaching) *and then the learners came in*(to class) (NEB1, Interview 2, 2022).

Immediately after NEB1 addressed this issue during the second VSR interview, when continuing to watch the video, he instructed:

> "*Okay… next time… when the bell rings you come straight to class… please you come straight to class. Please take out your books, pencils and everything that you will need*" (NEB1, Lesson 2, 2022).

Although, NEB1 had reflected during the second VSR interview about what he would change in future regarding learner conduct, through classroom management, he already addressed this issue during lesson two. This means that he had moved from the *unconscious incompetence* level to the second level of *conscious incompetence* of the Burch's (1970) model, concerning classroom management. For Stronge (2007), effective classroom management constitutes effective teaching.

Chan (2020) indicates that for one "to foster mathematics learning, the whiteboard can be exploited as an instructional scaffold for sequencing mathematics visually so that students will have greater clarity of where the lesson starts, the connections within the lesson, and where the lesson is going" (p. 7). This notion of teaching and learning fosters an environment in which the organisation of the writing on the board allows for a coherent progression of the lesson. This ensures that learners are able to follow and organise their thinking, which inevitability allows them to "see the connections between different parts of the lesson" (p. 7). Although this notion of writing is encouraged, it is not always implemented, as seen in Figure 4.14:

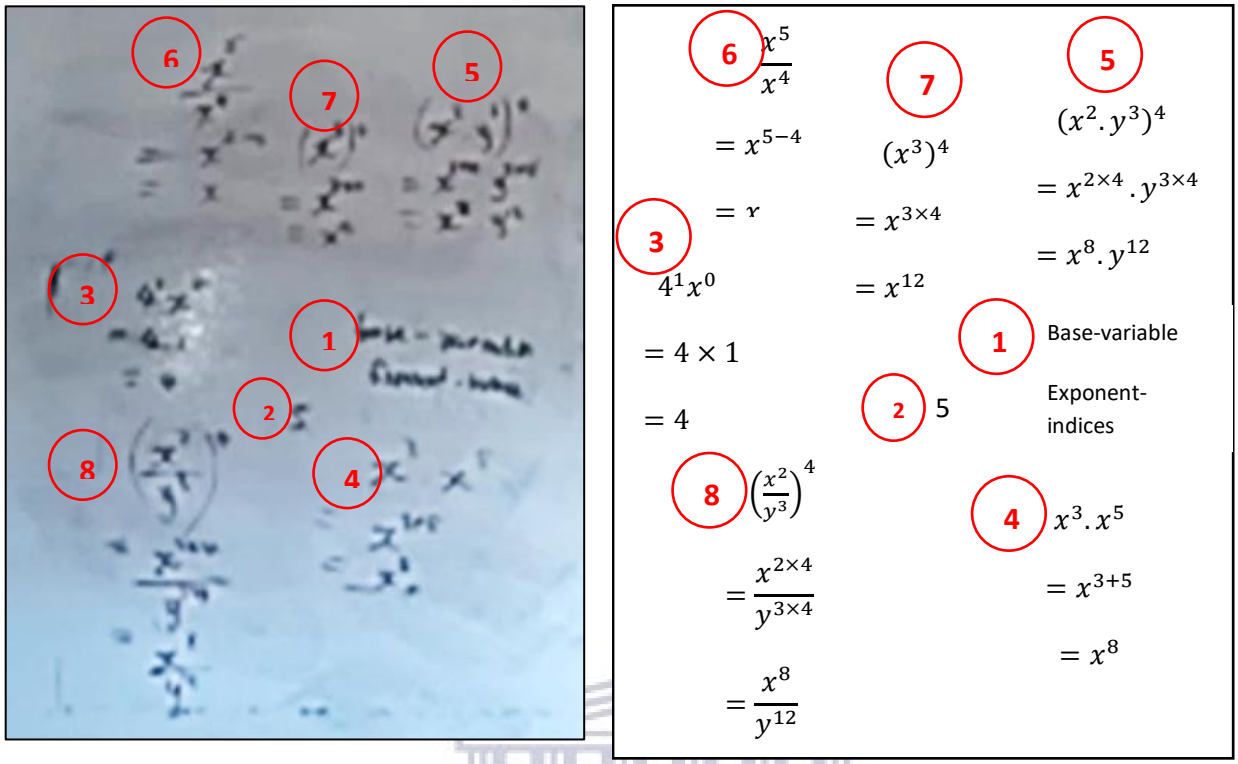


Figure 4.14: NEB1 Lesson 2 Example 1

In relation to Figure 4.14, NEB1 stated , during the VSR interview:

> "*There is a lot written, … so if … I would… just section it well…,* (because) *here I focus on this and here I focus on this* (points to the observed video image) *cause now there is just too much on the board…, and these learners… are more visual learners… So, there is too much on the board and that kind of confuses them…"* (NEB1, Interview 2, 2022).

In relation to the excerpt, according to Chan (2020), the crucial aspect of planning concerning the whiteboard "is to ensure that when one looks at the whiteboard, one can see the logical flow of the lesson with all the essential information on it" (p. 7). This was not the case with NEB1's lesson two, as seen in the red numerals displaying the order in which he wrote on the board. Thus, NEB1 was in the *unconscious incompetent* level, before watching the lesson video. NEB1 recognised his lack of logical sequencing, with regards to his whiteboard writing, after watching the video recording of the lesson and consequently moved to the *conscious incompetent* level. This level was substantiated by the organisation of his whiteboard writing, compared to the level of preparation of the educator, prior to teaching the lesson. As seen in Figure 4.14, NEB1 never wrote the equations in order and never numbered the examples provided. Therefore, his focus during

lesson preparation was reflected in the way he used the whiteboard. This did not assist in fostering the learners' mathematical understanding (Chan, 2020) and may, instead, have caused confusion.

At the end of the VSR interview, the researcher asked NEB1 how he thought lesson two had unfolded, after watching the video, compared to the first lesson? His response was:

> *"... now I have managed to finish teaching at the right time, and I managed to give them work so that they finish at the right time... I feel like this lesson went better than the last one. The last one I do* (not) *think I had slides* (PowerPoint slides)*... I was struggling with the projector. There is a big improvement okay there is major improvement compared to the first one"* (NEB1, Interview 2, 2022).

In relation to the excerpt, NEB1 had moved to the *conscious incompetent* level, in terms of lesson planning, as he recognised the improvement in comparison to his first lesson.

The researcher asked NEB1 about the changes he implemented post-VSR interview one. His response was:

> *"EEB... did mention that ... he makes groups,* (arranges the classroom according to the modular seating arrangement to allow for learner group work). *So*…(that) *if a learner does not understand in that certain group, there should be a learner in that group who understands so, they can help each other. So, that* (is) *what I have changed,* (because) *I remember the last time I had* (arranged the desks in) *rows"* (NEB1, Interview 2, 2022).

Regarding the excerpts, in trying to make the lesson more 'effective', EEB had assisted NEB1 with the classroom arrangement by recommending change in the classroom seating arrangement. Through peer support from EEB, NEB1 was able to effect change. This allowed him to embark on the third level of the awareness model, *consciously competent* (Burch, 1970). Hence, through the in-house PD programme implemented in this study, EEB (peer) was able to provide support, guidance and identify unique weaknesses in NEB1's teaching practices. This, in turn, assisted in the adjustment of NEB1's teaching style, as noted in the second lesson. NEB1 is thus moving towards the third stage of being *consciously competent* (Burch, 1970), in terms of classroom management.

The researcher's final question to NEB1 and EEB was: "*How can the lesson be improved in future and whether or not more aspects can be changed to improve the lesson*?" NEB1 responded:

> "*When I teach, they* (the learners) *make notes and I remove the unnecessary points on the slides or the point that I* (would not) *talk about in the lesson. I can improve in that way and make it* (the content on the PowerPoint slide) *much simpler* (by not) *put*(ting) *more examples on the board that I* (would not*) explain on the side* (the whiteboard)" (Interview 2, NEB1, 2022).

Although NEB1 had allowed the learners to take notes during the first few minutes of lesson two, he became impatient and asked them to stop writing and listen to the teaching of the lesson. Therefore, NEB1 was still in the second stage of the awareness model, in relation to the first VSR interview, in terms of learners' note-taking. However, he stated that in future lessons, he would allow learners to take notes while he was teaching. Consequently, this had allowed him to move to the third level of *conscious competence*, as he was working on how best to make changes in future lessons.

In relation to the question posed by the researcher, EEB stated:

> "*I think he* (NEB1) *is doing very well because we see the way the learners perform with the marks ….there is a big difference"* (EEB, Interview 2, 2022).

Then, the researcher enthusiastically asked: "*What was the marks like before we started* (with) *this* (professional development*) intervention*?

EEB responded thus: "*The first term they were not that good, the second term there is a big difference*" (EEB, Interview 2, 2022).

In relation to the excerpts, School B provided the following information regarding NEB1's mathematics Grade 9 class: (1) NEB1's class average for term 1 and (2) NEB1's class average for term 2. NEB1's term 1 mathematics class average was 23.4%, before this VSR PD programme. However, his term 2 mathematics class average was 45.2%, after this VSR PD programme. Although term 1 and 2 results were given, the term 3 results were still unavailable after NEB1's post video stimulated interview two. Figure 4.15 summarises the results obtained from these two terms, in the form of a bar graph:

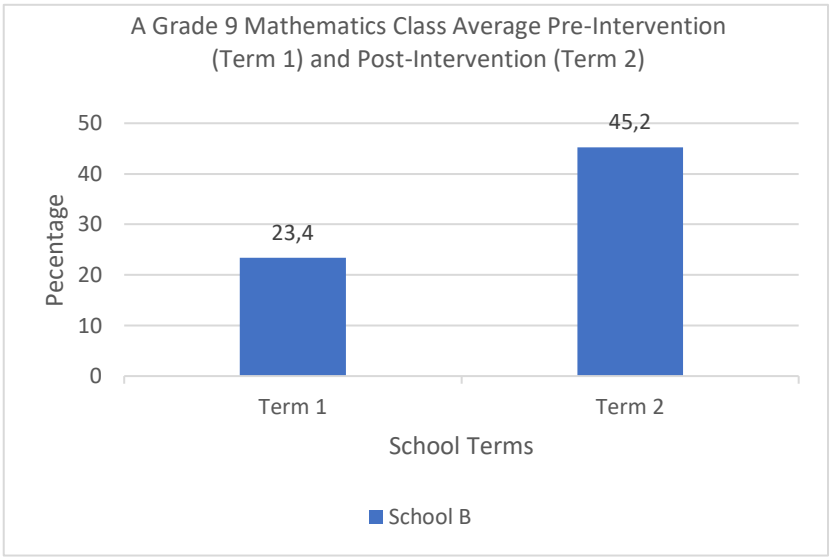


Figure 4.15: Graph highlighting NEB1's Grade 9 Mathematics Class Average Pre-Intervention (Term 1) and Post-Intervention (Term 2)

It can be concluded that the following aspects were addressed in the second cycle of NEB1's VSR: addressing learners coming late to class, seating arrangement, whiteboard writing, time management, classroom management and organisation, and learners' note-taking.

4.3.2.2.3 Cycle 3 - Lesson observation, VSR interview, and reflective journal of NEB1

NEB1's third lesson was on functions and relationships, where the concepts of input and output values were taught. This lesson was conducted with the same Grade 9 class previously involved in lesson observations one and two. The learners participated more in this lesson, compared to their engagement in the first two lesson observations. The lesson concluded with the learners doing an activity where they had to use tabulated values and substitute them into a given equation. Then, they had to plot the coordinates onto a cartesian plane. The teaching part of the lesson lasted for approximately twenty-seven minutes; and the remainder of the sixty-minute lesson was used for the class activity. During this time, NEB1 walked around the classroom to support the learners with any questions they had pertaining to the classroom activity. NEB1 walked around the modular seating arrangement and marked the work of learners who had already completed the activity. The curriculum advisor and the experienced educator were present throughout this lesson. Post-lesson, the curriculum advisor provided feedback to NEB1 about his teaching of the lesson. I, as the researcher, was allowed to be present for this discussion. Although I will not disclose what was discussed, due to confidentiality, I may state that the focus of the feedback from the advisor was the

teaching of the content (mathematics), whereas my focus throughout this study was on how the content was presented (the teaching of mathematics). The figures display examples of lesson observation three, where NEB1 engaged with the mathematics lesson and encountered various states of awareness, when viewing the lesson during the third VSR interview.

At the commencement of lesson three, NEB1 encountered technical difficulties regarding the overhead projector, his laptop and the PowerPoint slides that he had on a removable flash drive (memory stick). In relation to watching the first few minutes of the video during the VSR interview, NEB1 commented:

> *"Okay … this* (points towards video, two minutes into the lesson) *is when I started realising that… we have a problem. And… that is when I started panicking because… I was trying to fix the problem, but things were not on my side and as I am doing this…. I am trying to think, how else am I going to conduct this lesson if this is not working… my laptop froze"* (NEB1, Interview 3, 2022).

The researcher probed NEB1 further by asking how he would prevent this predicament in future lessons. He indicated that:

> "*… its best if I have plan B you know, if… I see okay plan A is not working, I start automatically with plan B* (o)*n time. Instead of having to try and force things on… the plan that is not working… because now look, the learners were just waiting for me, you know and time was ticking and* (at this point*) I am still thinking what* (I am) *going to do* (without the projector and PowerPoint slides)" (NEB1, Interview 3, 2022).

NEB1 had noticed, ten minutes in the VSR interview, that he was still trying to connect his laptop to the projector. He stated:

> "*I noticed that I am trying to connect* (to the projector) *again because I have not yet thought of what I was going to do…the second plan* (plan B)" (NEB1, Interview 3, 2022).

It is crucial to have a backup plan that is non-technology-based, in case of technological failures or equipment problems, so that the educator has his/her backup materials available at a moment's notice, as advised by Angers and Machtmes (2005). Therefore, NEB1 reverted to the *unconscious incompetence* stage, prior to watching the lesson observation video; but moved towards the *conscious incompetence* stage regarding the use of technology, after watching the video concerning lesson planning.

While NEB1's laptop was restarting, he posed the following riddle to the learners:

Let's say you are running a race and you pass the second one what place are you in?

The learners responded: "*You are in second place"*

One learner responded: *"If you pass the first one you will be in second place."*

NEB1 repeated this learner's response.

The class responded as a collective and disagreed with the last learner's answer.

One learner then said: *"You did not pass the first one, you passed the second one, so you are in second place*".

NEB1 then introduced the lesson.

Figure 4.16: NEB1 Lesson 3 Example 1

In relation to the extract, Figure 4.16, lesson 3, example 1, NEB1 stated that:

> "*The reason that I … did that riddle … was for me to actually … teach them how to think first before they answer...you know... so what I was trying to do was to get them to think before answering a question*" (NEB1, Interview 3, 2022).

With regards to the excerpt, NEB1 had engaged with the mathematics for the learners to activate their cognition. Von Kotzebue, Müller, Haslbeck, Neuhaus and Lankes (2020) have defined cognitive activation "as setting challenging tasks, practicing content-related discourse, and activating prior knowledge" (p. 284). Hence, by using this example included in Figure 4.16, NEB1 had engaged the learners in the mathematics immediately at the start of the lesson, by means of a riddle. This served as a creative introduction that stimulated cognition (Milkova, 2012). Therefore, NEB1 was in the *conscious competence* level, according to Burch (1970), regarding lesson planning, after watching the video.

NEB1 Wrote the following on the whiteboard and posed the question to the learners: 1, 2, 3, 4, 5, 6, 7, 8, and 9 Take any number and you multiply it by 5 and subtract your answer from 50. What is your answer?

Figure 4.17: NEB1 Lesson 3 Example 2

Concerning the example in Figure 4.17 NEB1 explained:

> *"…what I was doing you know I was trying to get them to see that… this* (mathematical language - sentence) *is the same as the equation… The formula. I had written it in words … I was trying to make them understand that… when they see… the variables… the bases, they must not get confused. And that they can calculate that using their minds without having to write* (it) *down or use a calculator. Because they have this tendency of wanting to punch everything in the calculator whereas they actually know 4×5 what it is, 5×5 what it is you know, but they just want to… use a calculator. I think, that is time consuming for them because not all of them have calculators. So, they borrow each other calculators*" (NEB1, Interview 3, 2022).

Riccomini, Smith, Hughes and Fries (2015) state that "vocabulary understanding is a major contributor to overall comprehension in many content areas, including mathematics" (p. 235). The Curriculum and Assessment Policy Statement (CAPS) defines mathematics as a "language that makes use of symbols and notations to describe numerical, geometric and graphical relationships" (p. 11). Riccomini, Smith, Hughes and Fries (2015) further claim that learners' "mathematical vocabulary learning is a very important part of their language development and ultimately mathematical proficiency" (p. 235). Therefore, the teaching and learning of the language of mathematics is a crucial component of learners' ability to develop mathematical proficiency.

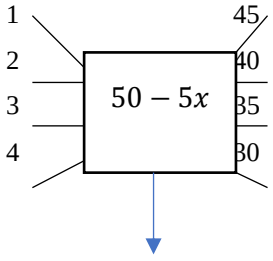
In addition, it has been reported that the practice of mental mathematics could enable learners "to develop new and economical ways of solving arithmetic problems that traditional paper-and-pencil contexts rarely afford, because the latter are often focused on techniques that are too time-consuming for a mental mathematics context" (Proulx, 2020, p. 110). Mental mathematical sessions usually follow the same structure, according to Proulx (2020): "(1) A task is offered orally or on the board; (2) Students listen and solve the task mentally; (3) When time is up, students are asked to explain their answer (adequate or not) in detail to the classroom, taken in note on the board (and in some

cases students themselves come to the board to explain it); (4) Other students who solved differently (or thought of solving differently) are invited to offer their answers; once all is said and done, another task is given" (p. 110). Therefore, these stages of mental mathematics allow learners to activate their cognition, while simultaneously contributing to broader discipline of constructivism. Although NEB1 had struggled with the technological aspect of his lesson, and it took him about ten-minutes to produce plan B; once he had implemented plan B, it was on par with his lesson objectives. Therefore, NEB1 was in the *conscious incompetence* level, prior to watching the video; but he moved towards the *conscious competence* level, according to Burch (1970), concerning lesson planning.

As previously mentioned in Chapter 2, Chan (2020) indicates that for one "to foster mathematics learning, the whiteboard can be exploited as an instructional scaffold for sequencing mathematics visually so that students will have greater clarity of where the lesson starts, the connections within the lesson, and where the lesson is going" (p. 7). In Figure 4.18, lesson three, NEB1 had engaged the learners and fostered an environment in which the organisation of the writing on the whiteboard had allowed for a coherent progression of the lesson. He had divided the whiteboard into three sections and worked from top to bottom, in each column, and moved to the next methodically. Unlike in the previous lesson (lesson two), the learners were able to follow and organise their thinking. This inevitability allowed them to "see the connections between different parts of the lesson" (Chan, 2020, p. 7). Therefore, NEB1 had used what he had learnt through the VSR of the previous lesson and developed cognitively in his lesson planning skills. Hence, he moved from the *conscious incompetence* level to the *conscious competence* level (Burch, 1970), with regards to board writing.

Flow diagram

Input Output



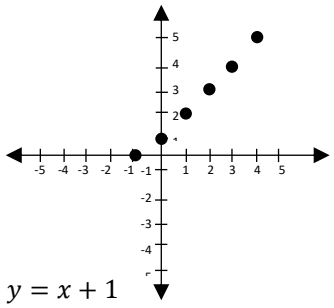
Mathematical operation

$y = 50 - 5x$

Cartesian Plane

Vertical line - y axis

Horizontal line – x axis



$y = x + 1$

Class Activity 2/08/2022

Complete the following and represent it in a flow diagram, table and cartesian plane.

Given: $y = 1\square 2\square x + 2$

x	-2	-1	0	1	2	3
y						

Table

x	1	2	3	4
y	45	40	35	30

Figure 4.18: NEB1 Lesson 3 Example 3

In relation to Figure 4.18, the researcher asked NEB1 what he noticed while watching the lesson, during the VSR interview. He responded:

> *"…how I sectioned my lesson on the board. Because* (the) *last time I used to write everything in one place, so I sectioned them* (the writing on the whiteboard) *well. Also… the language which I used* (while teaching)… *We do not ask them questions* (in the tests and exams) *in isiXhosa or Sotho or… Afrikaans or… other languages we ask them in English. So, we must actually familiarise them with the language of instruction… The learners were also answering* (the questions posed) *in English that is what I noticed"* (NEB1, Interview 3, 2022).

The excerpt highlights a crucial aspect of planning in relation to the whiteboard. Chan (2020) states that one "is to ensure that when one looks at the whiteboard, one can see the logical flow of the lesson with all the essential information on it" (p. 7). In comparison to the second lesson observation, this was now the case with NEB1's lesson three, where the three columns displayed the order in which he wrote on the board. NEB1 recognised this change regarding his whiteboard writing and had thus moved to the *conscious competent* level, according to Burch (1970). This stage is substantiated by the organisation of whiteboard writing, which is evocative of the educator's level of preparation (Chan, 2020).

When the researcher asked NEB1 what the most prominent change engendered throughout this lesson video was, compared to the other two lessons, he responded:

> *"...the notes taking. Because… as I was writing notes and… talking (teaching) they were also writing notes and listening at the same time. So… having me… to finish teaching first; then them to write notes after I am done teaching, that is time consuming. So, I think, I implemented what we talked about from the last video* (simulated interview)" (NEB1, Interview 3, 2022).

As previously mentioned, in Capter 2, note-taking is an essential tool in information-transmission situations (Boch & Piolat, 2005). The 'copy-regurgitate' note-taking strategy is commonly used in

schools and has proven effective. Therefore, as observed in this lesson, NEB1 had adapted his teaching style to include the note-taking process. This is because of the general sentiment that learners take notes to record essential information that they will need to study at a later time. Hence, with regards to note-taking in the form of teaching style, NEB1 had moved from the *conscious competent* level towards the *unconscious competent* level (Burch, 1970). Although NEB1 was moving towards the fourth stage of the awareness model, due to the duration of this study and it being undertaken over three cycles, the researcher was unable to determine whether NEB1 was able to fully master this level in terms of note-taking, in relation to the teaching style. This is because most educators need a few months or a few years to fully master the notion of *unconscious competence*, to the point where they do not have to think about their teaching. Therefore, the researcher claimed that NEB1 was moving towards the fourth stage and the notion of 'effective teaching' but had not yet mastered this stage.

The researcher's final question to NEB1 was: "*How do you think this lesson can be improved in future and whether or not more aspects can be changed to improve the lesson*?" His response was:

> "*To engage learners more… when I ask questions, I must wait for them to answer and not ask them* (a question) *and wait for… one second then I answer for them. I think, that is something I can work on… I should work on. Also… my posters there is like a lot of life science posters there (*on the classroom wall*) of which yes, it's the subject that I teach as well but what about the others* (the other subjects). *So, I should start having more posters on maths formulas you know…"* (NEB1, Interview 3, 2022).

According to McCarthy, Sithole, McCarthy, Cho and Gyan (2016), mathematics educators' "questioning in mathematics is an important diagnostic tool for teaching as well as measuring the academic progression and comprehension of the learner" (p. 80). Hence, educators' questioning in mathematics fosters the enhancement of learners' learning and self-assessment. NEB1 had moved to the *conscious incompetent* level with regards to the way he would use questioning techniques in future lessons, according to Burch (1970), in terms of his teaching style. Nonetheless, due to the duration of this study and it being over three cycles, in relation to the excerpt, the researcher was not able to witness the prolonged effect of VSR in terms of NEB1's teaching practices. Hence, she was unable to indicate whether or not NEB1 was able to implement the above-mentioned changes concerning learner engagement in terms of questioning techniques related to the teaching style. With regards to NEB1's ability to create a teaching and learning environment conducive to mathematics teaching and learning specifically, I was invited back, a

few weeks later, to view the changes implemented in the classroom, as illustrated in Figure 4.19. More mathematical examples and posters were on the classroom walls, which was alluded to by Stronge (2007), (see Section 2.2.6) as moving towards effective teaching practices. Here, NEB1 had implemented changes to his classroom, to create an environment that is more suitable to mathematics teaching and learning. As seen in Figure 4.19, prior to this intervention, no mathematics teaching materials existed on the classroom walls. However, a few weeks later, post-intervention, NEB1 had involved the learners, allowing them to create their own teaching and learning environment by means of self-designed mathematics posters.

Pre-Intervention | Post-Intervention

Figure 4.19: Pre- and post-Intervention teaching and learning environment

It can be concluded that the following aspects were covered in the third cycle of NEB1's VSR: having a plan B should there be technological failures, learner cognition activation, learners engaging with the language of mathematics, whiteboard handwriting, overall lesson planning, teaching style, classroom management and organisation and learners' note-taking. Questioning techniques were exuded.

4.3.2.2.4 Summary of NEB1's three cycles

From the data collected from NEB1, clear key aspects emanated from the data analyses and discussions. This section summarises the findings regarding the three subthemes that emerged from the data. Within the three cycles, it was evident that VSR served as a tool for in-house PD, as NEB1 stated post-VSR interview three that he managed to learn from his own teaching. Through this in-house PD programme, he was able to develop through self-reflection, in his own teaching, by using VSR. This was evident as the subsequent lessons, post-VSR interview one, were altered and adjusted, moving them towards effective teaching practices. Through peer support from EEB, NEB1 was able to implement changes in various aspects. This was because EEB (peer) was able to provide support and guidance and identify unique weaknesses in NEB1's teaching practices. This, in turn, assisted in the adjustment of his teaching style, lesson planning, and classroom management. Therefore, the formation of a school team (pair) had assisted NEB1 in moving towards effective classroom practices. The following subthemes emanated from the data collected from NEB1: (1) classroom management and organisation; (2) lesson planning; (3) teaching styles; and (4) time management. The graphs summarise the findings regarding these three subthemes, where NEB1 enacted the four stages of the conscious competence learning model, according to Burch (1970).

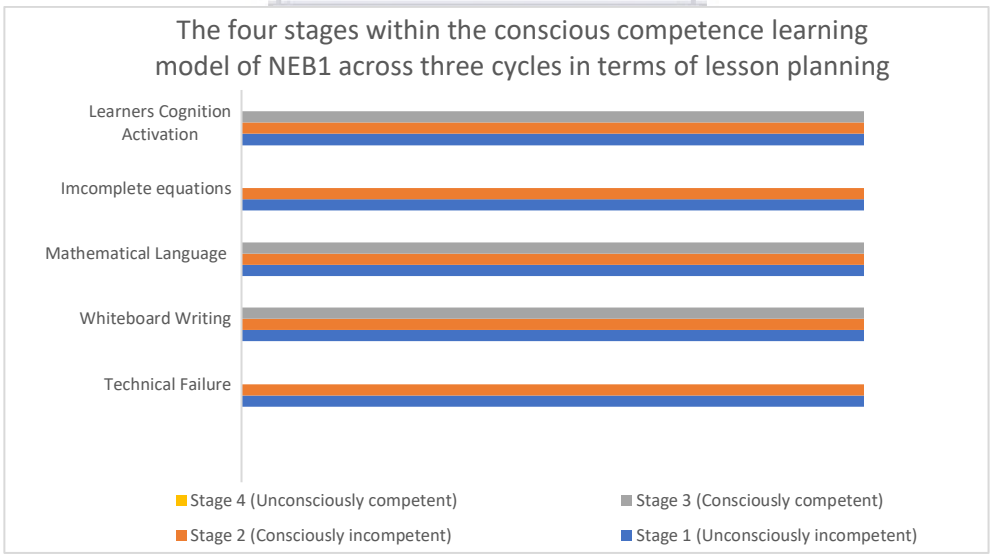


Figure 4.20: Graph highlighting the four stages of the conscious competence learning model of NEB1 across the three cycles, in terms of lesson planning

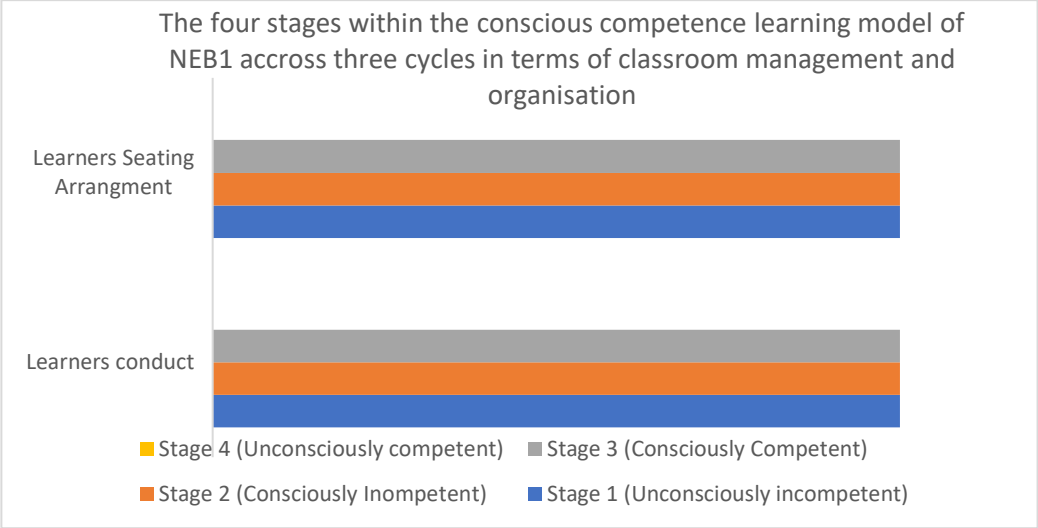


Figure 4.21: Graph highlighting the four stages of the conscious competence learning model of NEB1 across three cycles, in terms of classroom management

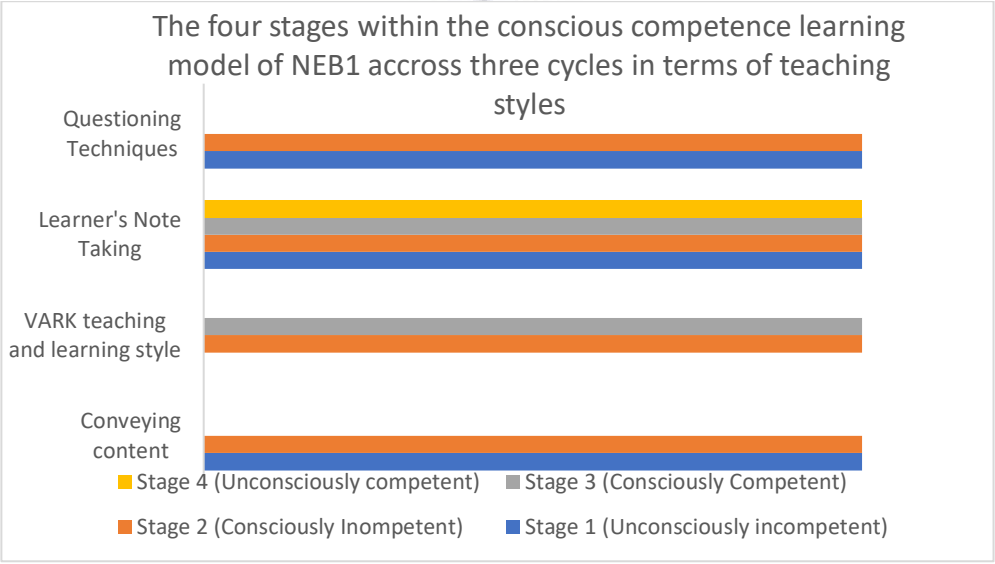


Figure 4.22: Graph highlighting the four stages of the conscious competence learning model of NEB1 across three cycles, in terms of teaching styles

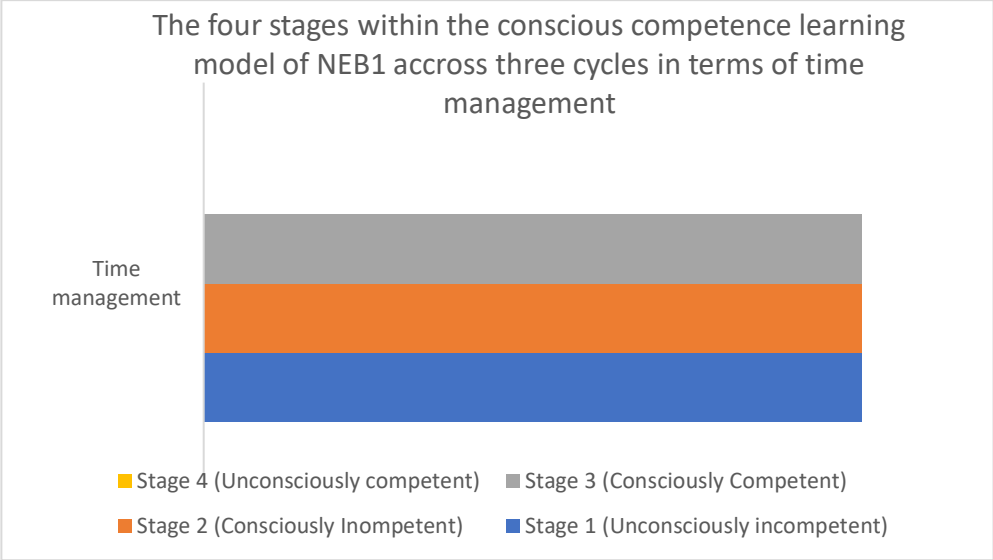


Figure 4.23: Graph highlighting the four stages of the conscious competence learning model as enacted by NEB1 across three cycles, in terms of time management

4.3.2.3 Analysis of NEB2's data

4.3.2.3.1 Cycle 1 - Lesson observation, VSR interview, and reflective journal of NEB2

NEB2's first lesson was on cubic expressions. This lesson was conducted with a Grade 8 class. The learners fully participated throughout the lesson. The latter was arranged in such a way that the educator taught the concepts then allowed the learners to participate in the lesson by creating a learner-centred classroom, as recommended by Serin (2018) (see, Section 2.2.6). This integration was achieved by allowing one learner per group, per modular seating arrangement, to come to the front of the classroom and unpack the question posed by the educator. This learner was allowed to receive assistance from their group. The completion of the given expression was followed by another learner completing the next question posed by the educator, where they were also assisted by their group. This cycle continued until all five questions posed were answered. The educator then asked the learners to copy down these notes into their workbooks. Hereafter, he gave them the first part of the class activity (the first three questions). The engagement with the activity entailed the educator walking around to support learners and mark the books of those who had completed the first three questions. These learners were then instructed to do the second part of the activity (question 4 and 5). After 10 minutes, NEB2 did corrections on the board, which allowed the rest of the learners to mark their own work. Thereafter, the lesson was concluded. The teaching of concepts lasted for approximately fifteen-minutes and the remainder of the fifty-minute lesson was used for both the class activities and the marking of the first and second activity. During this time, NEB2 walked

around the classroom to support the learners with any questions they had pertaining to the classroom activity. The researcher was present throughout this lesson. Unfortunately, due to prior commitments, the experienced educator was not present for the lesson observation, or the VSR interview. The figures display NEB2's engagement with the mathematics lesson and his encounter with the various states of awareness, when viewing the video recorded lesson, during the first VSR interview.

While watching lesson one, as seen in Figure 4.24, example 1, NEB2 shared that:

> *"I have also noticed something, my learners from this side* (the left-hand side of the classroom) *I suspect they cannot even see because of those windows…"* (NEB2, Interview 1, 2022).

In the reflective journal, the educator had noted that:

> *"I have picked up from the lesson that six of my learners are obstructed or cannot see during a lesson as the board reflects light coming in from the windows"* (NEB2, Reflective Journal, Lesson 1, 2022).

In order to compensate for this visual impairment, as seen in Figure 4.24, NEB2 was uncertain how to overcome this barrier. So, the researcher suggested that he used black paper on his windows. NEB2 agreed with this suggestion but later overcame the barrier using a plain white PowerPoint slide to improve learners' vision of the whiteboard. The educator thus moved from the *unconscious incompetent* level to the *conscious incompetent* level (Burch, 1970), concerning planning. This change was evident in lessons two and three.

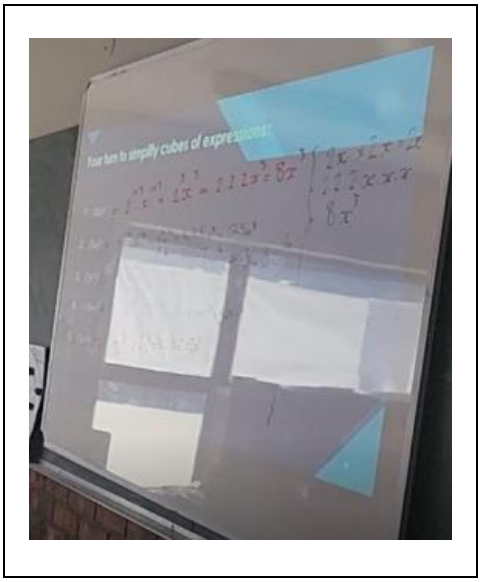


Figure 4.24: NEB2 Lesson 1 Example 1

The researcher then asked NEB2 if there is an anything that he would change, at this point, with regards to his teaching style or his method of teaching. NEB2 responded:

> *"I* (would) *like to try and be more on their side* (of the classroom) *... get a* (pointer) *where I can switch* (the slides). *So, I am actually going to try and get that, so that I am always next to them* (instead of being based at the desk throughout the teaching aspect of the lesson). *Because* (then) *I can even use it to point instead of being stationed* (at the desk) *most of the time"* (NEB2, Interview 1, 2022).

In addition, NEB2 reflected about this aspect in his reflective journal. This is evident when he states:

> *"Another factor that may lead to my classes being* (more) *effective is having a laser pointer, as I use the projector most of the time in my class. I have picked up that my lessons most of the time I am stationed next to the laptop to in order to switch to the next slide"* (NEB2, Reflective Journal, Lesson 1, 2022).

In relation to the excerpts, the educator would like to create a teaching and learning environment in his mathematics classroom where he is not stagnant in front of the learners. In his opinion, he is not able to connect with the learners through this method of teaching. In future lessons (lesson three), NEB2 used the computer mouse on the opposite side of the desk to switch the PowerPoint slides. He moved from the *unconscious incompetent* level to the *conscious incompetent* level, according to Burch (1970), in terms of his teaching style.

After watching the recording of lesson one, the researcher asked NEB2 how he thought the lesson had unfolded, overall. He responded:

> *"…It went the way I wanted it to in terms of participation. When I marked them* (the work) *some of them could get* (understand) *what was going on. I could say that this session was very easy because it was just adding like terms and so on. So, I would say it went okay but I would not say they 100% benefited"* (NEB2, Interview 1, 2022).

Through reflection, NEB2 had moved from the *unconscious incompetent* level to the *conscious incompetent* level, according to Burch (1970), concerning lesson planning.

The final question posed by the researcher was about how NEB2 could improve the lesson in future. He answered:

> *"…giving more examples* (and) *being around more to the kids* (the learners). *We did not do more DBE's* (textbooks given by the DBE). *Then when they are done with schoolwork, they could continue with DBE's… then probably they are getting some more practice to understand a bit more. The main thing that I am trying to get them to do is to ask* (questions). *If I can get them to ask, then I am more than happy with them. But if they do not ask then I know that something is wrong* (in) *terms of their understanding"* (NEB2, Interview 1, 2022).

In relation to the excerpts, the educator claimed that the lesson went according to plan, as he had achieved the set objectives. Nonetheless, he stated that learners may not have fully benefited, due to shortcomings regarding his lesson planning. To overcome this issue in future, he suggested the use of the textbooks provided by the DBE to ensure that learners have more examples of the content taught. Therefore, NEB2 had moved from the *unconscious incompetent* level, prior to watching the video of lesson one, to the *conscious incompetent* level (Burch, 1970), in terms of lesson planning.

It can be concluded that the following aspects were discussed in the first cycle of NEB2's VSR: focus on a learner-centred approach to teaching, the visual obstruction of the windows, lesson planning, teaching style, and trying to be more on the learners' side when teaching.

4.3.2.3.2 Cycle 2 - Lesson observation, VSR interview, and reflective journal of NEB2

NEB2's second lesson was on setting up equations as well as simplifying algebraic equations. This lesson was conducted with the same Grade 8 class involved in lesson one. The learners participated extensively throughout the lesson. The lesson was arranged in such a way that the educator taught the concepts then allowed the learners to participate in the lesson by creating a learner-centred classroom, as suggested by Serin (2018) in Chapter 2. This integration was realised by allowing one learner per group, per modular seating arrangement (McCorskey & McVetta ,1978) to come to the front of the classroom and unpack the question posed by the educator. This learner received assistance from both their group and the educator. The completion of the given equation and determining whether it was true or false led to another learner completing the next question posed by the educator. The next learner was also assisted by their group and the educator. This cycle continued until all six questions posed were answered. Hereafter, the educator gave them a class activity. The activity required the educator to walk around to support and mark the books of learners who had already completed the questions. After twelve-minutes, NEB2 allowed the learners to once again come to the front of the class to do corrections on the board. This allowed the rest of the learners to mark their own work. Thereafter, the educator gave the second classroom activity based on simplifying algebraic equations, and then the lesson concluded. The teaching of concepts lasted for approximately sixteen minutes and the remainder of the fifty-minute lesson was used for both the class activities and the marking of the first and start of the second activity. During this time, NEB2 walked around the classroom, to support the learners with any questions they had pertaining to the classroom activity. The researcher and the experienced educator were present throughout this lesson. The examples display where NEB2 engaged with the mathematics lesson and encountered various states of awareness, when viewing the recorded video lesson, during the second VSR interview.

While watching the second video-recorded lesson, the researcher asked NEB2 what he noticed about his teaching. He commented that:

> *"…I am still stationed at the laptop but hopefully I am going to change that soon* (by buying a pointer)*"* (NEB2, Interview 2, 2022).

In relation to the excerpt, NEB2 had realised that he is still mostly stationed at his desk, when he needed to switch the slides in the PowerPoint. He had thus remained on the *conscious incompetent* level, from the last lesson, in terms of his teaching style (Burch, 1970).

During the first VSR interview, the researcher was concerned that the learners may develop a misconception about the equal sign. This was because NEB2 was placing more than one equal sign in the same row, as seen in Figure 4.25. Although in the given examples the expressions were equal, the researcher voiced the concern that the learners might experience challenges later, if the meaning of the equal sign was not properly grasped. This was because the equations were written horizontally, and not below one another, as seen in Figure 4.25.

Simplify cubes of expressions:

$2x^3 = 2^1 \times 3. \; x^1 \times 3 = 2^3. \; x^3 = 2 \times 2 \times 2. x \times x \times x =$

$8\,x^3$ ……. $(line\ 1)$

Figure 4.25: NEB2 Lesson 2 Example 1

In relation to Figure 4.25, during the second VSR interview, NEB2 stated:

> *"…I also saw that about what you* (the researcher) *said about them writing horizontally* (refers to having more than one qual sign in a row). *Some of them actually were writing like that so I had to change the whole class… And now what I have noticed is that some of them even make a mistake if they go horizontally…*" (NEB2, Interview 2, 2022).

In addition, NEB2 had written in his reflective journal:

> *"An improvement from the previous lesson is that the learners have changed the way that they write.* (Which caused) *their books* (to be)… *neater as they have corrected a misconception that was caused in class"* (NEB2, Reflective journal, Lesson 2, 2022).

In relation to the excerpts, the misconception of the equal sign was evident, as seen in Figure 4.25. This manifested practically when a learner came to the board to answer the first question in the class activity, during the second lesson observation. The learner answered the first question, then answered line 2 and line 3. His answer is depicted in Figure 4.26. Consequently, the educator was in the *unconscious incompetent* stage, prior to watching the video, and moved towards the *conscious incompetent* stage, in terms of correct mathematical writing, after watching the video back, regarding to lesson planning.

NEB2 wrote the following on the whiteboard:

Solve the following equations

a. $x + 3 = 5$…….*(line 1)*

$x = +3 - 3 = 5 - 3$…*(line2)*

$x = 2$……*(line 3)*

NEB2 then asked*: "Is that correct?"*

Some learners responded *"Yes"*, while others responded *"No that's incorrect"*

NEB2 then stated: *"Are we supposed to be having two equal signs?"*

The learners responded: "*No"*

Another learner was then called to correct the misconception.

Figure 4.26: NEB2 Lesson 2 Example 2

The misconception identified in the above response by a learner is associated to the notion of viewing the 'equal' sign as an operational symbol and not as a 'relational' symbol. According to a study by Byers and Herscovics (1977), which is further explored by Kieran (1981), learners may "possess an underlying understanding of equivalence regarding the notion of the equal sign and that they are just using shortcuts in their procedural work". Nevertheless, "it can also be contended that the learners' written work reflects a basic lack of awareness of the equivalence role regarding the equal sign" (Kieran, 1981). Hence, the 'shortcut errors' may suggest that the learners are "still interpreting the equal sign as an operational symbol" where it serves as a 'do something symbol', to find the 'answer'. Moreover, Kieran (1981) states that the notion of 'shortcuts' or viewing the equal sign as an 'operator' may enhance misconceptions within other topics, such as algebra. This corresponds to the situation where the "absence of the equal sign may create conceptual difficulties as most learners identify algebra with equations". This was evident in Figure 4.26, as the learner knew that he had to solve x in the given equation but lacked the understanding of equivalence between the expressions. Therefore, this example shows that learners may experience various challenges if the meaning of the equal sign is not clearly grasped. This implies that the educator is in an *unconscious incompetent* level, in terms of lesson planning.

While watching the second lesson, during the second VSR interview, the researcher noticed that every time a learner volunteered and came to the whiteboard, to answer a question, they would just copy what was previously written down. This showed that they might not have fully understood what was expected of them. In relation to this, NEB2 stated, "*I actually rectified that to the next class*" (NEB2, Interview 2, 2022). NEB2 elaborated on how he rectified his teaching method thus:

> *"… what I did in the next class is instead of asking them* (having to determine) *if it's true or false I first instructed them to simplify* (the equation) *and then I said: Now if it says here if x is equal to negative three what did you get? Then they would say I got positive three. Then (I would ask) is it true or false, now they could see where I got that* (from)" (NEB2, Interview 2, 2022).

In the excerpt, NEB2 had moved towards the third level of *conscious competence*, when he rectified his teaching style in the following lesson, with another Grade 8 class. This is linked to the notion of reflection-on-action (post-lesson reflection), as it involved a recollection of thought on what the educator had done during the instructional episode, to assess how their knowing-in-action produced (un)intended learner outcomes (Schon, 1983). Although in this study post-lesson reflections occurred once the educator had finished teaching the lesson, which was video-recorded, the selected episode was viewed one to two weeks later. The educator was able to reflect, post-lesson two, on what worked and what did not work. Here, the educator was able to recall and analyse the decisions made and actions taken through the second lesson observation and made changes in the next Grade 8 class.

During the VSR interview, NEB2 commented that:

> *"The main challenge of our kids* (learners) *is that they don't read the instructions* (in activities, tests and exams)*"* (NEB2, Interview 2, 2022).

Regarding the excerpt, the researcher asked NEB2 how he could overcome learners not reading the instructions. He stated: *"I have no idea"* (NEB2, Interview 2, 2022). It was here that the researcher recommended that NEB2 spoke more English in the classroom, as it is the school's medium of instruction. This could motivate the learners to ask questions and better understand the instructions on activities, tests and examinations. NEB2 agreed with this recommendation and said

he would try to implement it in the following lessons. NEB2 was at the *unconscious incompetent* level of the awareness model, according to Burch (1970), in terms of the LoLT.

At the end of the VSR interview, the researcher asked NEB2 what he had noticed throughout the video. NEB2 stated that: *"…the board is still an obstruction,… ".* (NEB2, Interview 2, 2022). In relation to the above excerpt, NEB2 had remained at the *conscious incompetence* level, according to Burch (1970), with regards to noticing that the whiteboard was still obstructed by the reflection of the windows.

The researcher then asked NEB2 what changes he had noticed, compared to the first lesson. NEB2 stated that:

> *"The way of writing I changed the way of writing. It allows them to make sense of everything and I even saw that they write more neatly, and I saw that they are creating spaces in between…sums. I am trying to get them all to write that way"* (NEB2, Interview 2, 2022).

In addition, NEB2 had noted in his reflective journal that:

> *"An improvement from the previous lesson is that the learners have changed their way of writing. Their books are … neat and they have corrected the misconception that was created in class"* (NEB2, Reflective journal, Lesson 2, 2022).

Here the handwriting and the way of writing on the whiteboard constituted a crucial aspect that NEB2 had noticed in terms of the changes he had implemented, compared to the first lesson. Here NEB2 had remained at the *conscious incompetent* level, in terms of his way of writing on the whiteboard, according to Burch (1970).

When the researcher asked how NEB2 thought the lesson had gone, overall. He explained:

> *"I was trying to do a lot but … at the end of the day it was much easier when we were repeating the whole thing on the last period* (after school) *in the afternoon. It was only a success later on because there was a lot of things, I was trying to get them to do"* (NEB2, Interview 2, 2022).

In the excerpt, NEB2 acknowledged that he might have done too much work in a short timeframe. He had thus recognised his error, after watching the video, and had moved from the *unconscious incompetent* level towards the *conscious incompetent* level, in terms of lesson planning.

The researcher then asked: *How do you think this lesson can be improved overall*? NEB2 stated that:

> "(The) *use of DBE* (textbooks) *for his lesson specifically. I gave them p. 126-129 to do. And then there is a textbook that I got these six questions from* (algebraic equations) …*so, the used of various materials and not limiting them… If we can do 4-6 examples in class, then let them do even four at home. I think that the best way… I started to write incomplete work across their books, and they hate it, so they actually do work*" (NEB2, Interview 2, 2022).

According to Dewi, Hakim, Setiawan, Adhisuwignjo and Rohadi (2018), "there is significant influence of the use of Teaching Aids on the students' achievement, and it is said the Teaching Aids can improve students' activity when they are learning Math concept" (p. 1). Therefore, the use of additional teaching aids, such as the DBE textbooks and the additional textbook the educator used to simplify the algebraic equations, may have assisted the learners to deepen their understanding of equations. In the above excerpt, NEB2 acknowledged that the extra teaching aids might have assisted learners in their overall understanding. Thus, he used the DBE textbooks, unlike in the previous lesson. After watching the video, he moved from the *unconscious incompetent* level towards the *conscious incompetent* level, concerning lesson planning (Burch, 1970).

The final question posed by the researcher was: *Do you feel that what we are doing with this video stimulated recall is helping you*? NEB2 affirmed:

> "*It does because I would not have seen the writing. I would not have been aware of that* (and) *I do not want to lie… If a person could, I would really recommend that you record yourself and then go watch it…then you start seeing what you are doing* (in terms of your teaching)" (NEB2,Interview 2, 2022).

In relation to the excerpt, the researcher posed a question to determine whether the notion of VSR was assisting NEB2 in his teaching of mathematics. NEB2 affirmed that it was assisting him, as he would not have noticed his way of writing on the whiteboard, without it. He further recommended that this project be used by other educators to record their teaching, watch it back and adjust and/or adapt it.

In summary, the following aspects were addressed in the second cycle of NEB2's VSR: lesson planning, teaching style, the use of teaching aids, and teaching too much content in a short span of time.

4.3.2.3.3 Cycle 3 - Lesson observation, VSR interview, and reflective journal of NEB2

NEB2's third lesson was based on geometry. This lesson was conducted with the same Grade 8 class of lessons one and two. The learners participated throughout the lesson. The lesson was arranged in such a manner that the educator taught the concepts then allowed the learners to participate in the lesson by creating a learner-centred classroom, as noted by Serin (2018), in Chapter 2. This was depicted through allowing one learner per group, per modular seating arrangement to come to the front of the classroom and unpack the question posed by the educator. This learner received assistance from their group and the educator. Hereafter, the educator gave the learners an extra example which was to be completed for homework, if they did not complete it in class. Throughout the activity, the educator walked around to support the learners and mark the books of those learners who had completed the first and second question. After twenty-minutes, NEB2 allowed a learner to come to the front of the class to do corrections of question one on the whiteboard. This enabled the rest of the learners to mark their own work. Thereafter, the lesson concluded. The teaching of concepts lasted for approximately eighteen-minutes and the remainder of the fifty-minute lesson was used for the marking the first and start of the second question. During this time, NEB2 walked around the classroom to support the learners with any questions they had concerning the class activity. The researcher was present throughout this lesson. However, due to prior commitments and being unwell, the experienced educator was not present for this lesson observation as well as the VSR interview. The examples illustrate where NEB2 engaged with the mathematics lesson and encountered various states of awareness, when viewing the video lesson observations, during the third VSR interview.

At the start of the video stimulated interview, the novice educator immediately noticed the way of mathematically writing an 'angle' as ∠, as seen in number one in Figure 4.27. He stated:

> *"…This angle I prefer to write it like that* (∠) *but now I saw that I wrote it in a very bad way the learners hey started writing* (the letter) *'L'…when I checked the books it was a bit of a nightmare. I actually wrote on that book* (reflective journal). *I actually reflected that one mistake that you make as an educator that you are actually creating a misconception so that's one of the good things about a lesson being prepared you get to avoid those misconceptions so that is what I have noticed"* (NEB2, Interview 3, 2022).

In relation to the excerpt, NEB2 claims that the way of writing, as seen in Figure 4.27, was unclear. The curly shape of the angle symbol created confusion among the learners, as they interpreted the shape as an 'L' and not as an angle (∠). When the researcher asked NEB2 if he was prepared to teach the lesson, he stated that:

> *"Uhm not that much because I wanted them to be on the same level as the Grade 9's, because they do the same thing when it comes to geometry. So, I noticed that if I deprived them… of the full knowledge then they struggle again. I just did not want to touch on three things* (alternate, adjacent and vertically opposite angles*). And I also noticed that the approach that I did here, it's very slow if you separate the angles* (instead of combining it). *Rather… use one drawing and then they take out the angles… using one drawing all of them at the same time… that what I have noticed.* (This resulted in the) *lessons* (being)… *a bit longer*" (NEB2, Interview 3, 2022).

Ten minutes later, NEB2 added:

> "*Another thing that shows that I was not prepared because I wanted to use GeoGebra throughout this lesson so that they* (the learners) *can see it* (the different angles). *Now I did not have time to prepare that* (prior to the lesson) *so I just drew it on the board… I was ready to teach it, but I was not prepared in terms of the* (teaching) *materials. Because I wanted to mix it with Grade 9's. I saw they were doing something and then I said let me take the same examples* (from the activity page) *and just leave whatever is meant for Grade 9"* (NEB2, Interview 3, 2022).

Regarding the excerpts, the educator stated that he was not as prepared to teach the lesson as he should have been. He told the researcher, post-lesson three, that he had used a Grade 9 activity sheet throughout the teaching of this lesson. This is because he had only received it a period prior to

teaching it. Consequently, he had no time to thoroughly prepare to teach the lesson using the material he had just received. Therefore, the educator was in a state of *unconscious incompetence*, prior to watching the video of lesson observation three, and then he moved to the *consciously incompetent* level, according to Burch (1970), after watching the video, in terms of lesson planning.

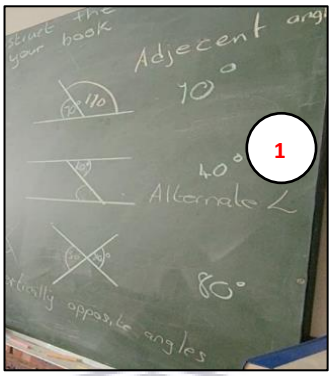


Figure 4.27: NEB2 Lesson 3 Example 1

Throughout lesson observation three, the researcher noticed that the NEB2 only focused on one of the three angles, as seen in figure 4.27. Although the basic concepts of adjacent angles, alternate angles, and vertically opposite angles were taught, the educator only focused on adjacent angles throughout the fifty-minute lesson. When the researcher asked NEB2 why he only focused on one of the three angles, he said that:

> *"The main idea was to get them* (the learners) *to understand this first* (adjacent angles) *then the next day we… do two of this (*alternate angles) *then the see the difference between those two again. It goes down to the same thing … make one drawing where you can find all three at the same time, then I say look for the F shape, the Z shape and the C shape … So… I was afraid of them not seeing an F and only seeing an x or … seeing that F but then not being able to find the Z…that's what I was afraid of. The idea was to separate them and then try and bring them together"* (Interview 3, NEB2, 2022).

Throughout this episode, the educator was *consciously incompetent* (Burch, 1970), concerning lesson planning, although he was not as prepared to teach as he should have been.

While the video of the third lesson was playing, NEB2 had noticed that his teaching and learning materials were not as organised as they should have been. He stated:

> *"Over here I have noticed that my slides were everywhere, in fact all of the documents that I needed were everywhere on my USB* (flash drive). *So now I combined everything on one folder so that I can easily access it"* (NEB2, Interview 3, 2022).

Here, NEB2 had moved from the *unconscious incompetent* level to the *conscious incompetent* level (Burch, 1970), in terms of lesson planning post-lesson observation three. He stated that after the lesson commenced, he had reorganised his teaching materials, to be more organised. This is so that they were at hand while he was teaching.

While watching the video of the lesson observation, NEB2 mentioned that he had changed his style of teaching regarding the learners' sketching of the various angles of the geometric figures. He stated, in the follow-up lessons with the other Grade 8 classes:

> *"… like today I have opted to print out the notes instead of them drawing each sketch. Then I would say okay today we are focusing on this sketch then tomorrow we focus on those sketches and so on. With the construction they are a bit slow …"* (NEB2, Interview 3, 2022).

In relation to the excerpt, NEB2 had moved from the *unconscious incompetent* level, post-lesson three, to the *conscious incompetent* level (Burch, 1970) in terms of teaching style, as he had adapted his teaching method.

Throughout the lesson observation three video, NEB2 had noticed that he had changed the background of the PowerPoint slide, on the whiteboard, to a plain white page. He explained:

> *"The reason … I have also changed to that one* (the white page) *is that I do not want to confuse them. So, if I change to a white* (slide) *then they can see clearly* (on the whiteboard)" (NEB2, Interview 3, 2022).

Concerning the excerpt, NEB2 had learnt from the previous lessons (lessons one and two) where the learners were unable to clearly see what was on the whiteboard, due to the reflection of the sun through the windows. He had thus moved to the *consciously competent* stage, from the *consciously incompetent* stage, in terms of structuring the PowerPoint.

NEB2 had started teaching the lesson using the following example:

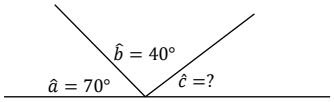
Given Figure	Statement	Reason
	$a° + b° + c° = 180°$ $70° + 40° + c° = 180°$ $110° + c° = 180°$ $c° + 110° = 180°$ $c° + 110° - 110° = 180° - 110°$ $c° + 0 = 70°$ $c° = 70°$	Adjacent angle on straigh line equals 180°

Figure 4.28: NEB2 Lesson 3 Example 2

Hereafter, NEB2 gave the learners the following example to complete in class, as part of the class activity.

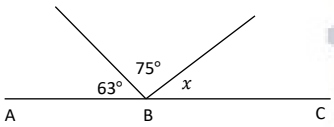
The following question was posed to the learners by NEB2, during lesson observation three. A learner was asked to complete the statement and reason of the given geometric figure.		
Given Figure	Statement	Reason
If Line ABC is a straight line  Determine the angle x	$a° + b° + c° = 180°$ $63° + 75° + c° = 180°$ $135° + c° = 180°$ $c° + 135° = 180°$ $c° + 135° - 135° = 180° - 135°$ $c° + 0 = 42°$ $c° = 42°$	Adjacent angle on straight line equals 180°

Figure 4.29: NEB2 Lesson 3 Example 3

In relation to Figure 4.28 and Figure 4.29, NEB2 stated the following:

> *"I have noticed something as well. The labelling* (of the diagram in the given figure 4.27) *that I have done wrong. But luckily, I have noticed it in this class* (the observed class). *Because in the other classes* (other Grade 8 classes) *I have done the same thing* (labelled the angles and the diagram) *but what I did…was I labelled the first example, I labelled the second example and the third I did not label. So, I said: you would notice that the first two are labelled but the third is not labelled so you do not have to say* $a° + b° + c°$. *But* (the last example) *I gave as homework and then they did the same thing the wrote* $a° + b° + c°$. *But we corrected that on the corrections"* (NEB2, Interview 3, 2022).

In addition, NEB2 had reflected in his journal thus:

> *"Early in the lesson I had noticed that I had made a mistake by not labelling the diagram where I had used labels in previous examples. Learners started to follow what I have written on the board"* (NEB2, Reflective journal, Lesson 3, 2022).

In relation to the excerpts, during the VSR interview, NEB2 noted that:

> "*At least today it is much better. What I saw in their homework is that some of them when adding up in the final example they wrote:* $2y + 48° + 52° = 180°$, *then at some point it became* $2° + y$. *I could not believe it. So, it's actually good when they come to the board and to see how they think…We corrected it on the board… I did not even expect it…"* (NEB2, Interview 3, 2022).

In relation to the excerpts, NEB2 had rectified his teaching error in the following lessons with the previously observed Grade 8 class and in the teaching of the same lesson with the other Grade 8 classes. He had thus moved from the *unconscious incompetent* level to the *conscious incompetent* level, according to Burch (1970), in terms of his teaching style.

The researcher then asked NEB2 how the learners' writing had been since the implementation of the project. He stated that:

> *"It is good no one is writing that way (*horizontally*)… But from time to time, you see there is a mistake where you see two equal signs* (in the same row). *But nonetheless I rectify it in their books by circling it. They hate having red pen in their books if it's not* (used to mark correctly) *a tick on the books, but it's getting there…"* (NEB2, Interview 3, 2022).

In relation to the excerpt, the educator had rectified the misconception that Kieran (1981) had identified, where the equal sign was being misconstrued as an 'operator'. The educator had thus moved from the *conscious incompetent* level to the *conscious competence* level (Burch, 1970), in terms of correcting the misconception about the equal sign.

After watching the third videoed lesson, the researcher asked NEB2 what he noticed throughout watching this video now? Compared to the previous videos, what changes did he notice? NEB2 responded:

> *"Okay, I can tell the changes on myside I was more aware of my mistakes that I am doing in the class…especially if it's a new topic. Learners because they trust you, they will follow whatever mistake that you do because it's something new. Especially if it's something new*

you (need)*... to be fully prepared if not prepared you have to be over prepared. I noticed that I was well aware of my surroundings.. .learners they were fine. And I also notice that I take note of everything now when it comes to their books, the way they write, and I make sure it's correct"* (NEB2, Interview 3, 2022).

In connection with the excerpt, the educator stated that in future lessons, he would need to be more prepared for the teaching of the lessons. Consequently, he remained on the *conscious incompetent* level (Burch, 1970), in terms of lesson planning. In addition, he mentioned that he had become aware of the way the learners are writing, which is a shift towards the *conscious competent* level, according to Burch (1970), concerning the awareness of the way of writing.

The final question posed by the researcher was how does NEB2 think he can change parts of this lesson in future. He indicated that:

"... I actually already did change (with the other Grade 8 classes) *because by the time the lesson ended, I already knew what was wrong in the lesson. It's not just about completing the lesson it's about making sure that whatever mistake is there is rectified"* (NEB2, Interview 3, 2022).

Here, the educator had moved towards the *consciously competent* level of the awareness model (Burch, 1970), regarding lesson planning, post-lesson observation three. He had reflected post-lesson three and had rectified his teaching errors immediately after the lesson was video recorded. This shows that the project had positively influenced NEB2, as he was able to change his way of teaching the content, prior to teaching the following Grade 8 classes. Nevertheless, due to the duration of this study and it only being undertaken over three cycles, the researcher was unable to see the prolonged effect of VSR in terms of NEB2's teaching practices.

In short, the following aspects were covered in the third cycle of NEB2's VSR: lesson planning, the use of teaching aids, the LoLT, correcting the misconception about the equal sign, and board writing.

4.3.2.3.4 Summary of NEB2's three cycles

Based on the data collected from NEB2, key findings emanated from the data analyses and discussions. The following is a summary of the findings in terms of the subthemes that emerged

from the data. Within the three cycles, it was evident that the VSR served as a tool for in-house PD, as NEB2 stated post-VSR interview three that he recommends this project be implemented in other school subjects, such as Natural Science. Through this in-house PD programme, he was able to develop through self-reflection, in his own teaching, by using VSR. This was evident as the subsequent lessons, post-VSR interviews one and two, were altered and adjusted, moving NEB2 towards effective teaching practices. Through peer support from EEB, NEB2 was able to effect change in various aspects. This was because EEB (peer) was able to provide support and guidance and identify unique weaknesses in NEB2's teaching practices. This, in turn, assisted in the adjustment of his teaching style, lesson planning, and classroom management. Therefore, the formation of a school team (pair) had assisted in moving NEB2 towards effective classroom practices. The following subthemes emerged from the data collected from NEB1. These subthemes were: (1) lesson planning and (2) classroom management and organisation. The graphs summarise the findings regarding these subthemes. Here, NEB1 enacted within the four stages of the conscious competence learning model (Burch, 1970).

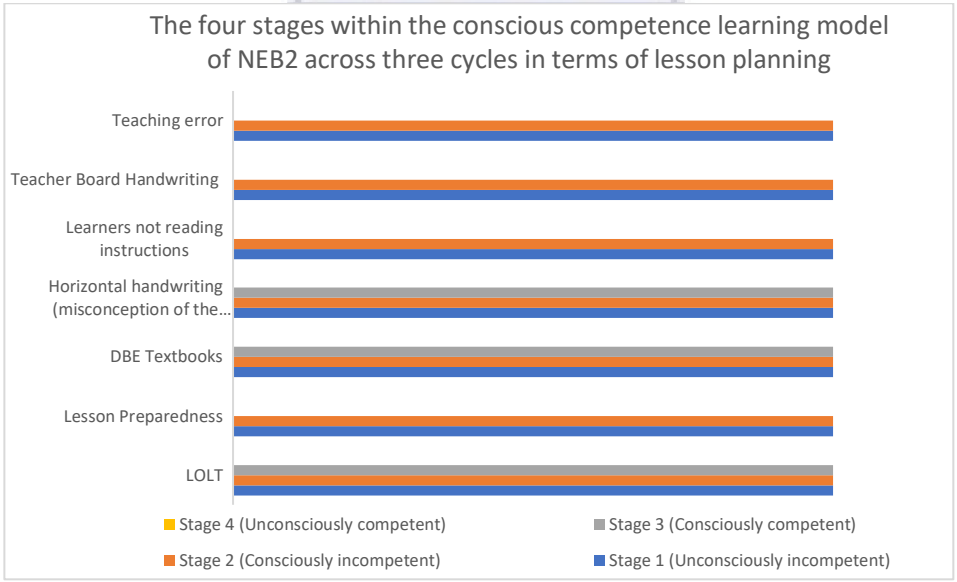


Figure 4.30: Graph highlighting the four stages of the conscious competence learning model, of NEB2 across the three cycles in terms of lesson planning

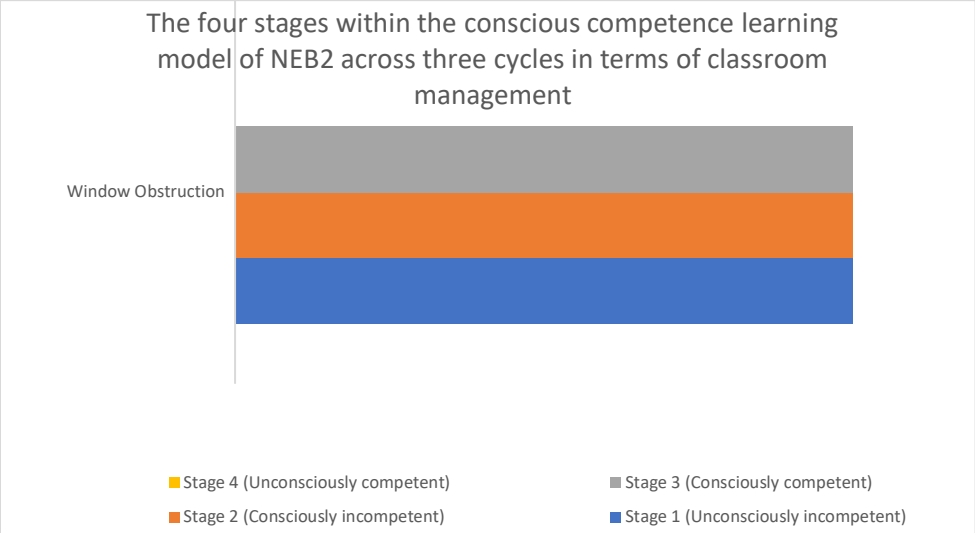


Figure 4.31: Graph highlighting the four stages of the conscious competence learning model of NEB2 across three cycles in terms of classroom management

4.3.3 Post-questionnaire

After the final cycle (cycle 3) of this study was concluded, a post questionnaire was completed by all the participating novice educators. Table 4.2 summarises all the information obtained from the post-final-interview questionnaires.

Table 4.2: Summary of the information obtained from the post-final-interview questionnaire

	NEA	NEB1	NEB2
Going through this process of Video Stimulated Recall (VSR), do you think this tool can serve as part of an in-house Professional Development (PD) programme? If yes/no, please elaborate.	Yes, because with every reflection session one can recognise one's errors. During the lesson one does not necessarily recognise your errors. When you are able to recognise your teaching errors you are able to rectify it. So, through this programme it assists you to develop your PD over a period of time.	Yes, it can serve as part of PD because after having to watch the video of yourself teaching, you get to reflect on how the lesson went and things that you can do to make the lesson go better.	Yes, it would definitely serve as a PD tool as it allows you as a teacher to reflect on your lessons and work on whatever misconception you have created in class.
Have you as a novice educator noticed any positive or negative developments within your teaching, in this short timeframe, with regards to the process of self-reflection after	Yes, I have learnt a lot throughout the self-reflective process. There was with every video	Yes, I have noticed positive developments. The influence that it had on me as a novice educator is that it has helped me take note of	Yes, I have noticed positive developments.

the influence of VSR? If yes/no, please elaborate.	recording an improvement than the previous video.	where I need to improve on and what I was doing.	
How has the implantation of Video Stimulated Recall (VSR) influenced your subsequent (following) lessons, after the first video stimulated interview?	It has assisted in keeping me 'on track', in rectifying my errors. With every lesson the reflective sessions words (feedback) played through my mind over and over. This assisted in helping to make the class more effective.	It influenced the other lessons in a way that the things I was doing such as explaining some things in a language that is not the medium of instruction had to end and start explaining everything in English since all questions will be asked in English (in tests and exams). I also started giving extra activities to learners who finish the class activity earlier so that they get familiar with the work and with more practice they get better. All that I have noticed from reflecting on the lesson and analysed what I needed to change in order to make the lesson go better.	All misconceptions that were created on that particular lesson were rectified in the next lesson. All misconceptions they (the learners) had were rectified on the follow up lesson. All misconceptions that I created were corrected on the next lesson.
Has the formation of a school team (pair) assisted in the notion of moving towards more effective classroom practices? If yes/no, please elaborate.	Yes, with this programme.	Yes, in terms of saving time and spending it wisely and pointing out the main objectives of the lesson. Another point made was to make my class mathematically more equipped by putting mathematics posters on the wall etc. With that being said the support I have received from the experienced teacher really helped because I have seen it make a difference on the learners.	Yes, it has.

4.4 Summary of the chapter

This chapter analysed and discussed the findings from the data collected from the research participants. Four main themes emerged from the data: (1) whether or not VSR could serve as tool for in-house PD; (2) whether novice educators were able to develop, in a short timeframe, through the process of self-reflection, after the influence of VSR; (3) how the implementation of VSR influenced novice educators' subsequent lessons; and (4) whether the formation of a school team (pair) assisted in moving the novice educators towards more effective classroom practices. In addition, five subthemes emanated from the aforementioned themes: (1) lesson planning, (2) teaching style, (3) classroom management, (4) classroom layout, and (5) time management. The next chapter covers the conclusions, recommendations, limitations, and overall conclusion of the study.

CHAPTER 5

CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

5.1 Introduction

Chapter 4 presented the data analyses and discussions of the findings of this study. The present chapter provides a brief overview of the study and a summary of the findings resulting from an analysis and interpretation of the research data in relation to the research questions and the relevant literature. This chapter also discusses the implications of the research findings and makes recommendations for future studies. The recommendations proffered to various stakeholders within the education sector seek to contribute to moving towards effective teaching through the use of Video-Stimulated Recall (VSR) as a reflective tool. The chapter further highlights the limitations of this study and makes suggestions for future studies. Finally, the chapter provides a general conclusion to the study.

5.2 An overview of the thesis

This study endeavoured to investigate the influence of using VSR as a reflective tool for Professional Development (PD) among novice mathematics educators, in two schools, across three cycles. The purpose of these three VSR cycles involving purposefully selected educators was to prompt and assist the novice educators in reflecting on their practice, to enhance their classroom practices. The context of this study was constituted by two semi-rural schools in the Cape Winelands region, in the Breede Valley District of the Western Cape Province, South Africa.

In this study, the mathematics classroom was emphasised by the DBE as a learning-centred space where the notion of 'doing' mathematics occurs through the interaction between learners and their educators. In teaching mathematics, educators need to engage in various strategies, to create the most suitable teaching and learning environment, and to attain their relevant pedagogical outcomes. To efficiently achieve the necessary outcomes, it is argued that educators should partake

in PD programmes where the notion of 'effective teaching' is constituted. This endeavour may lead to learners improving their overall mathematics performance.

Literature has shown that 'effective teaching' involves reflection. The latter is regarded as a consistent and deliberate examination of one's teaching, in an effort to improve it, while simultaneously fostering an environment where learners become more engaged in their mathematics lessons. Within this study, the process of reflection was endorsed through self-reflection, where the participants (novice educators) were able to view themselves through the tool of video. The latter prompted them to develop new ways of teaching within their classrooms, after watching the video, during the VSR interview. By reflect on what they were watching, the participating educators (novice educators) were able to visually notice and identify their teaching errors and/or misconceptions; ineffective teaching practices; teaching practices that could be improved even further; as well as where improved mathematics teaching techniques could be attempted or incorporated. Through the discipline of noticing, educators were able to act and teach differently, in follow-up lessons, in the subsequent cycle. Clearly, the VSR interviews led novice educators to the adjustment and alteration of their teaching.

5.3 The key findings in relation to the main research question

The main research question investigated in this study was:

> What is the influence of Video-Stimulated Recall on the teaching and classroom practice of novice mathematics educators, through the use of reflective practice?

From the data collected, it was evident that the novice educators had adjusted and altered their teaching practices in the subsequent lessons, after VSR was implemented in the first cycle. Through the implementation of this in-house PD programme, the peers (the experienced educators) were able to provide support and guidance to enable the novice educators to identify unique weaknesses in their teaching practices. This, in turn, assisted in the adjustment and alteration of certain skills of their teaching styles in subsequent lessons (lessons two and three). This was evident at the commencement of the second and third cycles. All the participating novice educators had moved towards more 'effective teaching' practices, after viewing their own video-recorded lessons. This was possible by allowing the novice educators to view themselves through a different

lens, using video. This prompted them to develop new and improved ways of seeing what happens in their classrooms. Subsequently, the notion of educators being able to reflect on their own teaching practices, through the use of video stimulation, allowed for the visual and cognitive identification of teaching errors and/or misconceptions; ineffective teaching practices; teaching practices that could be improved even further; as well as where improved techniques for teaching mathematics could be attempted or incorporated. Thus, insight was gained through the means of 'noticing'. This enabled them to act and teach differently in follow-up lessons. This is because the video tool offered the novice educators with a video record of their classroom interactions; hence, they did not simply have to rely on their memory of what transpired. Instead, they could view the video numerous times, if they wished, to examine what transpired. This subsequently led to the alteration and adjustment of their teaching styles. Therefore, it may be concluded that VSR, through reflective practice, had a positive influence on the teaching and classroom practices of all the participating novice mathematics educators.

5.4 Summary of the key findings in relation to the sub-research questions

The sub-research questions were:

1. Have the novice mathematics educators been able to develop through the use of VSR as a proposed tool for PD? If so, to what extent?
2. How does the implementation of reflective practice in relation to VSR affect the novice educators' teaching of mathematics in subsequent lessons?
3. Has the pairing of the experienced and novice educators assisted the latter in moving towards more effective classroom practices? If so, to what extent?

5.4.1 Have the novice mathematics educators been able to develop through the use of VSR as a proposed tool for PD? If so, to what extent?

From the analysis of the collected data, the participating novice mathematics educators have been able to positively develop through the use of VSR, as a proposed tool for PD. PD was identified as a construct used to ensure the continuous expansion and strengthening of educators' skills and knowledge throughout their teaching practices, to implement effective teaching (Mizell, 2010). Through reflection during the VSR interview, by means of the construct of retrospection,

it was evident that that the novice mathematics educators had developed professionally through the use of VSR. The construct of self-reflection occurred during the VSR interview and within the reflective journals. Within these reflective processes, it was clear that all the participating novice mathematics educators (NEA, NEB1, and NEB2) were able to develop to a varying extent, through the use of VSR as a proposed tool for PD.

Indeed, the researcher asked NEA, NEB1, and NEB2, in the post-questionnaire, whether as novice educators they had noticed any positive or negative developments within their teaching, in this short timeframe, regarding the process of self-reflection, after the influence of VSR. In response to the question, NEA, NEB1, and NEB2 affirmed:

> "*Yes, I have learnt a lot throughout the self-reflective process. There was with every video recording an improvement than the previous video*" (NEA, Post questionnaire, 2022).

> "*Yes, I have noticed positive developments. The influence that it had on me as a novice educator is that it has helped me take note of where I need to improve on and what I was doing*" (NEB1, Post questionnaire, 2022).

> "*Yes, I have noticed positive developments*" (NEB2, Post questionnaire, 2022).

Table 5.1 further illustrates the extent to which the novice educators have developed. The skills and competencies highlight that the novice mathematics educators have been able to develop, through the use of VSR as a proposed tool for PD, to varying degrees.

Table 10: Summary of the extent to which the novice educators developed

Name of novice educator	Skills and competencies in which they developed	The extent to which they developed (level 1 to level 4)
NEA	Lesson Planning	Level 1 to level 2
	Whiteboard writing	Level 1 to level 4
	Mathematics games and more class examples	Level 1to level 4
	Lesson pace	Level 1 to level 2
	The use of colour on the whiteboard	Level 1 to level 2

	The broadening of lesson introduction	Level 1 to level 4
	Time management	Level 1 to level 2
	The concept of eye contact	Level 1 to level 2
	Self-answering questions posed	Level 1 to level 2
	Learners' note-taking in class	Level 1 to level 3
	Learner-centred teaching environment	Level 1 to level 2
NEB1	Learner cognition activation	Level 1 to level 3
	Incomplete equations posed	Level 1 to level 2
	The use of mathematical language	Level 1 to level 3
	Whiteboard writing	Level 1 to level 3
	Technical failures	Level 1 to level 2
	Learners seating arrangement	Level 1 to level 3
	Learners' note-taking	Level 1 to level 4
	Questioning techniques	Level 1 to level 2
	VARK teaching and learning style	Level 2 to level 3
	Time management	Level 1 to level 3
NEB2	Teaching error	Level 1 to level 2
	Teacher handwriting	Level 1 to level 2
	The use of DBE textbooks	Level 1 to level 3
	Lesson preparedness	Level 1 to level 2
	Language of Teaching and Learning (LoLT)	Level 1 to level 3
	Window obstruction	Level 1 to level 3

5.4.2 How does the implementation of reflective practice in relation to VSR affect the novice educators' teaching of mathematics in subsequent lessons?

From the collected data, it was evident that the implementation of reflective practice in relation to VSR positively affected the novice educators' teaching of mathematics in subsequent lessons. Within this study, the act of self-reflection in relation to the teaching of mathematics enhanced the novice mathematics educators' teaching practices. This was because it allowed the participating educators to view themselves in the video through a different lens. This prompted these educators to develop new and improved ways of seeing what happens in their classrooms. Consequently, VSR enabled the visual and cognitive identification of teaching errors and/or misconceptions (NEB2's misconception concerning the equal sign); ineffective teaching practices (NEA's teaching of perpendicular angles being only horizontal); teaching practices that could be improved

even further (NEA, NEB1, and NEB2's whiteboard handwriting); as well as where improved techniques for teaching mathematics could be attempted or incorporated (NEA's broadening of the introduction of the lesson). Thus, insight was gained through the means of the 'Discipline of Noticing'. This is because the educators were able to re-validate, when they found themselves noticing aspects of their teaching that they had not previously noticed (Mason, 2021), which enabled them to act and teach differently in follow-up lessons. This subsequently led to the alteration and adjustment of their teaching. Although they had made teaching errors and/or engaged in misconceptions, they were willing to learn from them, to improve their overall teaching and learning of mathematics in subsequent lessons.

In this study, reflection stimulated by video allowed the novice educators to reframe and revise their own beliefs about the process of teaching and learning, in subsequent lessons. This was evident when the researcher asked the novice educators, in a post-questionnaire, how the implementation of VSR influenced their subsequent lessons, after the first video stimulated interview. NEA and NEB1 stated that:

> "*It has assisted in keeping me 'on track' in rectifying my errors. With every lesson the reflective sessions words* (feedback) *played through my mind over and over. This assisted in helping to make the class more effective*" (NEA, post research questionnaire, 2022).

> "*It influenced the other lessons in a way that the things I was doing such as explaining some things in a language that is not the medium of instruction had to end and start explaining everything in English since all questions will be asked in English* (in tests and exams). *I also started giving extra activities to learners who finish the class activity earlier so that they get familiar with the work and with more practice they get better. All that I have noticed from reflecting on the lesson and analysed what I needed to change in order to make the lesson go better*" (NEB1, Post research Questionnaire, 2022).

Hence, using VSR in this study ensured that the subsequent lessons were more aligned to effective teaching practices, where the educators' pedagogical skills and knowledge were necessary in the teaching of mathematics. This was because the VSR interviews and reflective journals enabled the novice educators to plan future lessons better, in comparison to what they were viewing in relation

to their past lessons. Therefore, the implementation of reflective practice in relation to VSR positively affected the novice educators teaching of mathematics in subsequent lessons.

5.4.3 Has the pairing of the experienced and novice educators assisted the latter in moving towards more effective classroom practices? If so, to what extent?

The analysis of the collected data reveals that the pairing of the experienced and novice educators assisted the latter in moving towards more effective classroom practices. Through active peer support from EEA and EEB, NEA, NEB1 and NEB2 were able to implement change. This was as EEA and EEB (peers) were active participants who were able to provide support, mentorship and guidance and identify unique weaknesses in NEA's, NEB1's and NEB2's teaching practices. This, in turn, assisted in the adjustment of their (1) lesson planning, (2) teaching style, (3) classroom management, (4) classroom layout, and (5) time management.

In fact, the researcher asked NEA, NEB1 and NEB2, in a post-research questionnaire, whether the formation of a school team (pair) assisted them in moving towards more effective classroom practices. NEA, NEB1, and NEB2 affirmed:

> "*Yes, with this programme*" (NEA, Post research questionnaire, 2022).

> "*Yes, in terms of saving time and spending it wisely and pointing out the main objectives of the lesson. Another point made was to make my class mathematically more equipped by putting mathematics posters on the wall etc. With that being said the support I have received from the experienced teacher really helped because I have seen it* (the changes) *make a difference on the learners*" (NEB1, Post research questionnaire, 2022).

> "*Yes, it has"* (NEB2, Post research questionnaire, 2022).

Therefore, the formation of a school team (pair) had assisted NEA, NEB1 and NEB2 in moving towards effective classroom practices. To make the teaching and learning process more 'effective' EEA and EEB had assisted NEA, NEB1 and NEB2 by recommending changes in their teaching. For example, EEA assisted NEA with lesson planning. She had suggested that NEA first explained the notes that the learners had taken down in the previous lesson, to check their understanding. This

form of teaching and learning might create a link between the previous lesson taught and the new lessons to be taught in future. Suggestions similar to this, made by the experienced educators, allowed the novice educators to embark on the second (*conscious incompetent*), third (*conscious competent)*, and sometimes fourth level (*unconscious competent*) of the awareness model (Burch, 1970), after watching lesson one, two and three. This, in turn, assisted in the adjustment and adaptation of their overall teaching style, lesson planning, classroom management, classroom layout, and time management, as noted in the second and third lessons. Therefore, the pairing of the experienced and novice educators assisted the novice educators in moving towards more effective classroom practices.

5.5 Implication of the study

The findings of this study focused on three cases, at two high schools, in two semi-rural schools within the Cape Winelands region, in the Breede Valley District, in the Western Cape Province of South Africa. The results of this study illustrated several ways that PD through using the VSR tool provided the participating novice educators with opportunities to gain experience and teach differently in subsequent lessons. The importance of an educator's ability to interpret and notice classroom interactions as well as the ways in which the novice educators in these three cases developed were illustrated. The use of VSR interviews allowed the novice educators to plan future lessons better, in comparison to what they were viewing regarding their past lessons. Therefore, this study had allowed the novice educators to notice aspects of their teaching that they had not noticed before. This, in turn, prompted them to make changes in terms of their effective teaching practices. Moreover, when describing and interpreting these cognitive changes that occurred concerning how the novice educators attended to the video episodes, emphasis was placed on the alteration and adjustment of their teachings in the subsequent lessons. Therefore, within this study, the influence of VSR on the teaching and classroom practice of novice mathematics educators, through the use of reflective practice was exuded.

5.6 Recommendations for further studies

Based on this study, the researcher recommends that future studies increase their sample size, to include more than three case studies, or increase the number of schools involved in the study. Furthermore, the researcher suggests involving more than two schools from different districts. This

could enable future studies to draw comparisons about the different teaching and learning environments and the different districts. Moreover, the researcher recommends that future studies incorporate more than three cycles, where more than three lessons are observed and video-recorded, to investigate the influence of VSR on the teaching and classroom practice of novice educators over a longer period of time. For example, the timeframe of future studies could be from six months to a year. This type of investigation could enable educators to reflect on their teaching practises over a longer period of time. This could afford the novice educators more opportunities to implement changes based on what they have noticed during the video-stimulated interview. This could allow the participating educators to enter and fully master the fourth level of the conscious competence learning model (Burch, 1970), to the point where the participants are able to reflect-in-action. The art of reflective practice may be used by educators as a way to evaluate their level of PD and as a means to improve their practice-based professional learning, where they can notice learners' level of understanding. Therefore, this form of teaching and learning affords the participating educators the opportunity to redesign the task at hand while doing it. Thus, combining both reflection and action, which could be the ultimate aim of future VSR studies. In addition, the researcher recommends that more educators (novice and experienced) use the VSR, as it allows one to reflect on one's own teaching practices, without having to complete off-site (off school premises) PD programmes. This is because the VSR is customised to one's own teaching practices and is not based on general teaching practices. This could allow for both cognitive development and the educators' move towards more effective teaching practices, as these educators find new ways of working in their classrooms.

5.7 Limitations of the study

According to Theofanidis and Fountouki (2018) "limitations of any particular study concern potential weaknesses that are usually out of the researcher's control, and are closely associated with the chosen research design, statistical model constraints, funding constraints, or other factors". In other words, a limitation is a restriction that is imposed and is out of the researcher's control. Akanle, Ademuson and Shittu (2020) note that limitations are "usually found and determined during fieldwork and/or even after fieldwork" (p. 106). Throughout this study, four limitations were noted during fieldwork and were evident despite the logical and chronological structure of the study.

5.7.1 Language

The research was conducted in English, despite the fact that some of the participants' first language was not English, which was their second or third language. This may have led to the participants having difficulties in understanding what was expected during the information session as well as the questions that were asked during the video-stimulated interview. Although the researcher and her supervisor are bi-lingual (conversant in English and Afrikaans), the study was conducted in English. Yet, School A's educators were all Afrikaans speaking. Hence, the consent, assent and information forms were translated into Afrikaans, for School A, to further accommodate the participating educators and learners. Although some language barriers may have been overcome, most of the educators in School B did not have English as their first language; hence, they had to communicate in their second or third language.

5.7.2 The Covid-19 pandemic

The pandemic caused by Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) (Covid-19) was also a limitation throughout this study. On 18 March 2020, due to the level 5 restrictions imposed, the South African president called on all schools and universities to shut down and find alternative ways to offer teaching and learning online, as a precautionary measure (DHET, 2020). This appeal raised questions as to the feasibility of e-learning (online teaching and learning), particularly at previously disadvantaged universities and lower quintile schools. Once the schools re-opened in late 2020, many schools had to form rotational timetables due to limited space and classroom sizes, which included the schools in this study. Through this approach, learners had limited face-to-face contact with educators, which also resulted in limited teaching, learning and assessment of school subjects such as mathematics. During this phase and the previous phase (national lock down) of the pandemic, many schools such as School A were unable to continue teaching for several reasons. Hence, no teaching and learning occurred during this time. This hindered many learners' overall academic performance, due to the loss of valuable teaching and learning time, especially in crucial subjects such as mathematics, as seen in figure 1.1 where the Grade 12 mathematics results were exuded.

5.7.3 Three case studies

This study was limited to three case studies. Case study one was based on School A which had one participating novice educator and one experienced educator. Case study two and three was based on School B which had two participating novice educators and one experienced educator. The sample size of this study could be regarded as small and unable to influence this field of research. Although one cannot generalise in this study, due to the small sample size, the aim is to extend the knowledge within this field and to continue to contribute to the wider discipline.

5.7.4 Two schools and three cycles

Within this study, three cycles were implemented. However, due to the duration of this study the researcher could not witness the prolonged effect of VSR after the three cycles. However, the results still contribute to the wider discipline of the project as well as the broader discipline of PD in Mathematics Education.

5.8 Conclusion

Throughout this study, all three participating novice educators had shown an awareness of their teaching, to varying degrees. This was as they were provided with the opportunity to view their lessons through a different lens, through the notion of retrospection within a safe environment which allowed for pedagogical development and reflection.

Therefore, through watching the videotaped episodes, the novice educators were able to use what they saw on video as a recollection of their own past experiences. Using this practice, the novice educators were able to relate to their own teaching practices through the notion of reflection. This enabled them to evoke change through the alteration and/or adjustment of a specific skill and/or discipline, in subsequent lessons (lessons two and three). The process of reflective practices allowed the novice educators to be more aligned to effective teaching practices, which may have enhanced their MKfT. The four states of cognitive awareness of the Burch's (1970) model, namely, (1) *unconscious incompetence*, (2) *conscious incompetence*, (3) *conscious competence*, and (4)

unconscious competence, were recognised when the educators were able to reflectively articulate their teaching practices (Geiger, Muir & Lamb, 2016). Through the awareness model developed by Burch (1970), it was evident that the novice educators became conscious and aware of their own incompetence within a certain skill and/or discipline, with regards to teaching through self-reflection, by noticing aspects they had not noticed prior to this investigation.

Each cycle of the video recording of a lesson was followed by a VSR interview, to determine the educators' take-up of self-reflection through VSR. By engaging with the novice educators in post-lesson observations, through discussion, the researcher was able to critically analyse the novice educators' teaching methods. This was achieved by analysing the manner in which they had taught in terms of the Burch (1970) model. While the novice educators had shown a deeper awareness of their teaching, it was at various degrees, as the educators reflected on various aspects of their teaching. Through the assistance of the experienced educators, the novice educators were able to move towards more effective teaching practices. This was because they were able to develop within their overall teaching style, lesson planning, classroom management, classroom layout, and time management, as noted in the second and third lesson observations. Although the educators had engaged in reflective practices, to enhance their notion of effective teaching practices, some aspects of their teaching were not altered and/or adjusted. Nevertheless, through reflection, they became cognisant of their teaching to the point where they were able to visually identify where professional, yet context-specific development could occur. Therefore, VSR can be used as a reflective tool for PD among novice mathematics educators.

5.9 Summary of the chapter

This chapter gave an overview of the study. It also explored the path that the researcher had followed throughout the study by explaining the major trends and findings that emerged from the data. Moreover, the key findings in relation to the main research question and sub-research questions were exuded. This chapter further explored, in detail, the recommendations, implications and limitations of the study. The recommendations were encompassed to cast light on the influence of VSR on the teaching and classroom practice of novice mathematics educators, through the use of reflective practice.

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APPENDICES

Appendix A

INFORMATION LETTER TO THE SCHOOL

Dear Sir/Madam

My name is Zanda Young. I am a Master's Student in the faculty of Education at the University of the Western Cape.

I am doing research on what the influence of Video-Stimulated-Recall (VSR) has on the teaching and classroom practices of novice Mathematics educators, through the use of reflective practice. I would like to ask your school to participate in the study. The title of my study is: **The influence of using Video-Stimulated Recall as a reflective tool for Professional Development amongst novice Mathematics educators**.

My research involves doing an information session with the participating educators on the use of Video-stimulated recall as a reflective tool for professional development. I would then humbly request for two mathematics educators to volunteer to participate in the observation and video recording of two or three of their mathematics lessons. The researcher will make field notes during these video recording with the camera placed in such a way to not interfere in the lesson. Thereafter a one-on-one video-stimulated interview will be conducted with the educator via an in-person or virtual session depending on the circumstances of the current pandemic. I would like to audio-record the interview. This process of video recording a lesson followed by a video stimulated interview, will be repeated (second cycle). The third and final cycle will involve the educator to pair up with the other educator to possibly observe each other's lessons while it is being recorded. Thereafter they can watch the video together and reflect on it as with the previous lessons. This interview will also be audio-recorded. This can be seen as an in-house professional development program in your school. These cycles will commence whenever you are able to, without disturbing your teaching schedule, where the educators and learners will not be disadvantaged in any manner. Your school's participation is voluntary, and you can withdraw from the study at any time without any negative consequences. The data will be discarded within 5 years after the study have been completed.

Please let me know if you require any further information. You can also contact my supervisor Dr Benita Nel at 021 959 3796 or email bnel@uwc.ac.za or the Humanities and Social Sciences Research Ethics Committee at 021 959 4111 or email research-ethics@uwc.ac.za if you have any concerns or complaints that have not been adequately addressed by me.

I do hope that you will take this request into consideration, and I look forward to your response as soon as convenient.

Yours Sincerely

Z. S. Young

Appendix B

UNIVERSITY of the WESTERN CAPE

INFORMATION LETTER TO THE EDUCATORS

Dear Sir/Madam

My name is Zanda Young. I am a Master's Student in the faculty of Education at the University of the Western Cape.

I am doing research on what the influence of Video-Stimulated-Recall (VSR) has on the teaching and classroom practices of novice Mathematics educators, through the use of reflective practice. I would like to ask you and your school to participate in the study. The title of my study is: **The influence of using Video-Stimulated Recall as a reflective tool for Professional Development amongst novice Mathematics educators**.

My research involves doing an information session with the participating educators on the use of Video - stimulated recall as a reflective tool for professional development. I would then humbly request two mathematics educators to volunteer to participate in the observation and video recording of two or three of their mathematics lessons. The researcher will make field notes during these video recording with the camera placed in such a way to not interfere in the lesson. Thereafter a one-on-one video-stimulated interview will be conducted with the educator via an in-person or virtual session depending on the circumstances of the current pandemic. I would like to audio-record the interview. This process of video recording a lesson followed by a video stimulated interview, will be repeated (second cycle). The third and final cycle will involve you to pair up with the other educator to possibly observe each other's lessons while it is being video recorded. Thereafter you can watch the video together and reflect on it as with the previous lessons. This interview will also be audio-recorded. This can be seen as an in-house professional development initiative in your school. These cycles will commence whenever you are able to, without disturbing your teaching schedule, where the educators and learners will not be disadvantaged in any manner. Your participation is voluntary, and you can withdraw from the study at any time without any negative consequences. The data will be discarded within 5 years after the study have been completed.

Please let me know if you require any further information. You can also contact my supervisor Dr Benita Nel at 021 959 3796 or email bnel@uwc.ac.za or the Humanities and Social Sciences Research Ethics Committee at 021 959 4111 or email research-ethics@uwc.ac.za if you have any concerns or complaints that have not been adequately addressed by me.

I do hope that you will take this request into consideration, and I look forward to your response as soon as convenient.

Yours Sincerely
Z. S. Young

Appendix C

UNIVERSITY of the WESTERN CAPE

INFORMATION LETTER TO THE PARENTS OR GUARDIANS

Dear: Sir/Madam

My name is Zanda Young. I am a Master's Student in the Faculty of Education at the University of the Western Cape.

I am doing research on what the influence of Video-Stimulated-Recall (VSR) is on the teaching and classroom practices of novice Mathematics educators, through the use of reflective practice. I would like to ask your child's school to participate in the study. The title of my study is: **The influence of using Video-Stimulated Recall as a reflective tool for Professional Development amongst novice Mathematics educators**.

My research involves video recording of two or three of the mathematics lessons your child will be a part of. The lesson will only be video-recorded and in no way be interfered in besides that there will be someone at the back of the classroom recording the lesson. Your child's face will not appear in the video recording of the lesson. However, if it does happen that their face appears in the video, it will be blurred out in order not to reveal his and/or her identity.

The teaching schedule will not be disturbed, nor will the learners be disadvantaged in any manner. There are no foreseeable risks in participating in this study. If you or your child opt not to be involved in the research, your child will be placed under supervision during the time that we record the lessons, I will ensure that you child catches up with possible work missed during these periods. The identity of the school, the educators and the learners involved will be kept anonymous at all times and in all academic writing of the study. The data will be kept confidential at all times and in a locked and secure place and on a password-protected computer to ensure confidentiality of the data. Only myself and my supervisor will have access to the data. The data will be destroyed in 5 years after the completion of the study.

Please let me know if you require any further information. You can also contact my supervisor Dr Benita Nel at 021 959 3796 or email bnel@uwc.ac.za or the Humanities and Social Sciences Research Ethics Committee at 021 959 4111 or email research-ethics@uwc.ac.za if you have any concerns or complaints that have not been adequately addressed by me.

I do hope that you will take this request into consideration, and I look forward to your response as soon as convenient.

Yours Sincerely
Z. S. Young

Appendix D

UNIVERSITY of the WESTERN CAPE

INFORMATION LETTER TO THE LEARNERS

Dear: Learners

My name is Zanda Young. I am a Master's Student in the Faculty of Education at the University of the Western Cape.

I am doing research on the influence of reflection by your Mathematics teacher. The title of my study is: **The influence of using Video-Stimulated Recall as a reflective tool for Professional Development amongst novice Mathematics educators**.

My research involves video recording two or three of the mathematics lessons of your class. The lessons will only be video-recorded, and I do not want to interfere in the lesson besides that there will be someone at the back of the classroom recording the lesson. Your face will not appear in the video recording. However, if it does happen by accident that it appears in the video, it will be blurred out in order not to show your face.

There are no risks or disadvantages in any way in allowing me to do the recording. I therefore would like to ask your permission to do the video recording of the lessons. If you decide not to be in the class at the time, you will be placed under supervision (with another teacher) during the time that we record the lessons. I will ensure that you catch up with possible work missed during these periods. The identity of the school, the educators and the learners involved will be kept anonymous at all times and in all academic writing of the study. The recordings will be kept confidential at all times and in a locked and secure place and on a password-protected computer to ensure confidentiality of the data. Only myself and my supervisor will have access to the data. The data will be destroyed in 5 years after the completion of the study.

Please let me know if you require any further information. You can also contact my supervisor Dr Benita Nel at 021 959 3796 or email bnel@uwc.ac.za or the Humanities and Social Sciences Research Ethics Committee at 021 959 4111 or email research-ethics@uwc.ac.za if you have any concerns or complaints that have not been adequately addressed by me.

I do hope that you will consideration this request. I look forward to your response as soon as possible.

Yours Sincerely
Z. S. Young

Appendix E

EDUCATOR CONSENT FORM

Title of Research Project: The influence of using Video-Stimulated Recall as a reflective tool for Professional Development amongst novice Mathematics educators.

This study has been described to me in a language that I understand. My questions about the study have been answered. I understand what my participation will involve, and I agree to participate of my own choice and free will. I understand that my identity will not be disclosed to anyone, and that the researcher and her supervisor will be the only people to access the data. I understand that I may withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits.

Please circle the relevant answer:

I agree to partake in the study	YES / NO
I agree that my lessons can be observed, and video recorded and/or audio recorded	YES / NO
I agree that the interview can be video and/or audio recorded	YES / NO

Participant's Name: ……....

Participants Signature: ……

Date: ……

Appendix F

UNIVERSITY of the WESTERN CAPE

LEARNER ASSENT FORM

Title of Research Project: The influence of using Video-Stimulated Recall as a reflective tool for Professional Development amongst novice Mathematics educators.

This study has been described to me in a language that I understand. My questions about the study have been answered. I understand what my participation will involve, and I understand that being in the class will the lesson is recorded, is out of my own free will. I understand that my name or face will not be revealed to anyone, and that the researcher and her supervisor will be the only people to access the video. I understand that at any time I may change my mind to be in the class during the recording without giving a reason and without fear of negative consequences thereof.

Please circle the relevant answer:

I agree that my mathematics lessons can be observed, and video recorded and/or voice recorded. YES / NO

Participant's Name: …….....

Participants Signature: ……..…

Appendix G

SCHOOL CONSENT FORM

UNIVERSITY of the WESTERN CAPE

Title of Research Project: The influence of using Video-Stimulated Recall as a reflective tool for Professional Development amongst novice Mathematics educators.

This study has been described to me in a language that I understand. My questions about the study have been answered. I understand what my school's participation will involve. I understand that my school's identity, the identity of the participating educators and learners will not be disclosed to anyone, and that the researcher and her supervisor will be the only people to access the data. I understand that the educators and learners can withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits. I was given the undertaking that the data will be discarded after five years.

Please circle the relevant answer:

I agree that educators' lessons can be video-recorded, and field notes be taken.	YES / NO
I agree that the educators can be interviewed, and the interviews be audio-recorded.	YES / NO
I agree that educators can form a team to implement VSR as part of a professional development programme	YES / NO

Principal's Name: …….....

Principal's Signature: ……..…

School Name: ……..…

Date: ……

Appendix H

PARENT / GUARDIANS CONSENT FORM

UNIVERSITY of the WESTERN CAPE

Title of Research Project: The influence of using Video-Stimulated Recall as a reflective tool for Professional Development amongst novice Mathematics educators.

This study has been described to me in a language that I understand. My questions about the study have been answered. I understand what my child's/guardian's participation will involve, and my child's/guardian's participation is our own choice and free will. I understand that my child's/guardian's identity will not be disclosed to anyone, and that the researcher and her supervisor will be the only people to access the data. I understand that he/she may withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits.

Please circle the relevant answer:

I agree that my child may partake in the study. YES / NO

I agree that my child's mathematics lessons can be observed, and video recorded and/or audio recorded. YES / NO

Parent's/ Guardians Name: ……....

Parents/ Guardians Signature: ……

Date: ……..

Appendix I

LANGUAGE EDITING AND PROOFREADING CERTIFICATE

07/11/2022

To whom it may concern,

Re: Language editing & proofreading certificate

I hereby confirm that I completed language editing and proofreading work on Ms Zanda Sharna Young's Master's dissertation titled "The influence of using video-stimulated recall as a reflective tool for professional development amongst novice mathematics educators" on 07 November 2022.

I find the edited copy to be of a much-improved language standard than that of the original sent to me electronically. I provided the author with a clean copy (reflecting comments to be addressed) and a track-changes copy of the dissertation (reflecting my full editing and proofreading interventions). The author was to read the document and ultimately accept/reject the changes, where applicable. This certificate excludes any changes made after my intervention.

Should you have any queries, please do not hesitate to contact me on the details below.

Yours sincerely,

Mr. Hervé Mitoumba-Tindy

Credentials & contacts:

Master's of Arts in English (University of Johannesburg)

PhD in Education & Curriculum Studies – in progress (University of Johannesburg)

Basic Editing & Proofreading Certificate 2017 (McGullivray Linnegar Associates)

Cell: 0824898108

Email: mitoumba2000@hotmail.com

City: Johannesburg

Country: South Africa

Appendix J

WCED ETHICAL CLEARANCE CERTIFICATE

Western Cape Government
Education

Directorate: Research

meshack.kanzi@westerncape.gov.za
Tel: +27 021 467 2350
Fax: 086 590 2282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20220117-9054
ENQUIRIES: Mr M Kanzi

Ms Zanda Young
8 Belinda Street
Johnsons Park
Worcester
6850

Ms Zanda Young,

RESEARCH PROPOSAL: THE INFLUENCE OF USING VIDEO-STIMULATE-RECALL AS A REFLECTIVE TOOL FOR PROFESSIONAL DEVELOPMENT AMONGST NOVICE MATHEMATICS EDUCATORS.

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

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **17 January 2022 till 30 September 2022.**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Mr M Kanzi at the contact numbers above quoting the reference number.
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Research Services
Western Cape Education Department
Private Bag X9114
CAPE TOWN
8000

We wish you success in your research.

Kind regards,
Meshack Kanzi
Directorate: Research
DATE: 17 January 2022

Appendix K

TURNITIN REPORT AND CERTIFICATE

3606629:Z._Young_Master's_Thesis_Draft_8.pdf

ORIGINALITY REPORT

10%	9%	2%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	etd.uwc.ac.za Internet Source	2%
2	Tonya Tripp. "Using video to analyze one's own teaching : Video self-analysis", British Journal of Educational Technology, 11/2011 Publication	1%
3	files.eric.ed.gov Internet Source	1%
4	uir.unisa.ac.za Internet Source	1%
5	www.questia.com Internet Source	1%
6	Submitted to University of South Africa Student Paper	<1%
7	hal.archives-ouvertes.fr Internet Source	<1%
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Submitted to University of the Western Cape

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