University of the Western Cape

Education Faculty

for MEd Programme (Full thesis)

The impact of Video Stimulated Recall on the continuous professional development of in-service mathematics teachers

GEONEAL WADE WILLIAMS

Student Nr: 3640826

Supervisor: Dr. Benita P. Nel

Acknowledgements

I would like to thank my Lord and Saviour Jesus Christ, for providing me with the strength, knowledge, and capabilities to complete this thesis. I am thankful to my parents, George, and Gretchen Williams; my sister, Greshlan Williams; and my son, Riley Williams, for their moral support during the completion of this thesis. I would like to express gratitude to my supervisor, Dr. Benita P. Nel, for her endless guidance and support during this journey. Additionally, I would like to acknowledge the National Research Foundation, for its funding my research project. Without the support and contributions of all the above-mentioned entities/people/institutions, this project would not have been possible.

LIST OF ACRONYMS

DoE: Department of Education

FET: Further Education & Training

SACE: South African Council of Educators

PD: Professional Development

VSR: Video-Stimulated Recall

WCED: Western Cape Education Department

NRF: National Research Foundation

IQMS: Individual Quality Management System

DECLARATION

I, Geoneal Wade Williams, declare that this thesis is my own work; that it has not been submitted for any degree or examination in any other university; and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

November 2022

Signed

Table of Contents

List of Figures

List of Tables

Abstract

This study analysed mathematics teachers' reflection through Video Stimulated Recall (VSR), by investigating whether the four participating teachers change their teaching behaviour, after witnessing their live lesson presentations via video recordings. These teachers were from two different schools that taught mathematics in the intermediate and senior phases. The goal of the investigation was to contribute to the professional development (PD) of mathematics teachers, through VSR. The study aimed to investigate how mathematics teachers develop through the use of VSR. The findings of this study may assist teachers to enhance self-reflection through a real time view of their lessons. The findings may also provide teachers authenticity to improve their teaching practices. Thus, a series of lessons were video recorded, observed, and analysed by the participants and the researcher.

The research questions that guided this study were: How does Video Stimulated Recall enhance mathematics teachers' self-reflection? How does the use of Video Stimulated Recall as a tool for enhancing self-reflection contribute to the improvement of the teaching and learning of mathematics in the classroom?

The study followed a qualitative research paradigm where thick descriptive data were collected through observation and video recordings of two/three of the participants' lessons. Data collection also consisted of semi-structured VSR interviews whereby the responses were recorded, and body language and facial expressions were observed and noted. The theoretical framework used to analyse the research data was Burch's (2006) conscious-competence model. The study pursued a rigorous process of systematic data collection and analysis, to ensure the trustworthiness of the research findings. The data collection methods included video evidence,

notes from the observations, and the VSR interviews. The analysis technique was the comparison of video lesson recordings, transcription of interviews and relating the information to the theoretical framework used. The study found that VSR enhanced reflection, which contributed to improving the teaching and learning of mathematics; and that overall development occurred among the participants, as observations enhanced self-reflection. The teachers noticed and acted upon numerous aspects, in their subsequent lessons; however, they did not notice certain aspects through VSR. Teachers noticed their time management, their need for learner awareness, and their board-writing competencies. Teachers also noticed their lesson introductions and overall lesson presentations. The purpose of this study is to investigate if VSR can assist teachers in their professional development through reflection and the improvement of their classroom practices.

Keywords: video use; self-reflection; teacher learning; continuous professional development; mathematics teachers; video-stimulated recall.

Chapter 1

1.1 Introduction

This study investigated the impact of Video-Stimulated Recall (VSR) as a tool to foster experienced mathematics teachers' reflection on their practices. The aim was prompt these educators to improve specific areas of their teaching practice. VSR is an iterative process of recording a lesson presentation, for viewing and analysis at a later stage, to enable reflection on the lesson and the implementation of required changes or adjustments. It suffices to note that teachers use an array of personalised teaching approaches. As such, each teacher exudes a unique touch and character, whiles teaching. Teachers' daily teaching practices are thus based on their personality and character (Miller, 2012).

One problematic aspect in the education system is the lack of self-evaluation and self-reflection (McAlpine & Weston, 2002; Schratz, 2006). Yet, Mathew, Mathew, and Peechattu (2017) stress the importance of reflection in the teaching profession. The complexity of the teaching profession requires the questioning of practices, and the self-evaluation of professional practices (Mentz et al., 2020). According to the South African Council of Educators (SACE), professional practice and reflection practice are included in the standards of teacher professionalism (Mentz et al., 2020). Teacher professional practice is also a notable factor influencing learner performance. In fact, learner performance is indirectly dependent on teacher professionalism (Arends, 2017; De Clercq, 2013). The investigation of experienced teachers' reception of VSR could play an important role in supporting professional mathematics teachers' development.

A process of continuous learning is enhanced when reflection on action is realised and used (Mathew et al., 2017). The most important questions to consider are whether VSR will stimulate experienced mathematics teachers' self-reflection; and whether VSR will enhance the teaching and learning of mathematics in the classroom. This study could be useful to policymakers, curriculum planners, and professional development officials. It would enable them to establish the most efficient ways of developing teachers professionally. This research is important because it can directly influence the possible improvement of the professional development (PD) of experienced mathematics teachers as well as the teaching and learning of mathematics in the classroom. Thus, this study could provide new insights into the relationship between self-reflection and the continuous PD of mathematics teachers.

1.2 Background

In schools, the ideal is that teachers should teach, and learners should learn (Lakshmi, 2010). Many educators teach in the conventional ways they are accustomed to, consisting of standing in front of the class and explaining concepts on the board (Osta, Laborde, Hoyles, Jones, Graf, & Hodgson, 1998; Monaghan, 2004). This uninterrupted manner of teaching, without feedback or reflection, perpetuates the habitual good or bad learner results of this pedagogy.

Teachers spend significant amounts of time preparing their lessons (Schleicher, 2012). They plan their lessons, each with their own idea of how they will present and teach it. Novice teachers tend to discover their preferred pedagogical conduct and teaching styles during their pre-service training (Lim & Chan, 2007). Unlike experienced teachers with many years in the profession, novice teachers tend to constantly adapt their teaching methods, in line with their learners' particular pedagogical needs at a given time (Deed et al., 2019). Adaptive teaching involves

changing teaching methods, to ensure that they are more suitable to the context and that, ultimately, they are more beneficial to learners (Schipper, Goei, de Vries, & van Veen, 2017). Conversely, experienced teachers use their preferred ways of teaching, without necessarily having the natural urge to change or adapt their teaching practice (Lim & Chan, 2007). VSR is regarded as a reflective tool that allows teachers to receive feedback on their teaching, through self-reflection (Muir, 2010).

Gazdag, Nagy, and Szivák (2019) explain that, "The concept of reflection appeared in the educational sciences as a form of pedagogical thinking. Reflection is understood as a dialogue between a problem and its experiencer. Reflection is a source of many purposes. These purposes are guidance, a useful source of information and many more" (p. 61). The reflection prompted using video is referred to as Video-Stimulated Recall (VSR). VSR consists of observing the current practice of teachers, while striving to develop new suitable pedagogical practices (Muir, 2010). VSR provides immediate and specific feedback, which might lead to the effective development of a teacher, with the support of another educator, a researcher, or a critical friend.

Shandomo (2010) suggests that some teachers stop developing as professionals, after their first year of service. He discussed this with his students (teachers in training), and the discussions mostly ended with his student-teachers realising how easy it can be for teachers to fall into comfortable patterns, especially after gaining a few years of experience.

In this research, I aim to contribute to the literature on continuous teacher PD through the exploration of tools to that can enhance PD. This study endeavours to contribute to the body of knowledge on self-reflection and VSR in the South African context. The focus will be on under-resourced schools. The population of interest includes teachers of intermediate phase, senior

phase, Further Education and Training (FET), and teacher educators. An investigation into the use of VSR as a tool for enhancing self-reflection, to achieve PD, might be useful to most mathematics teachers and learners in South Africa.

1.3 Purpose of the study

The purpose of this study is to investigate if and how self-reflection by mathematics teachers, through VSR, might contribute to the PD of experienced mathematics teachers. Reflection is conceived as the active and continuous consideration of a belief, practice, and result (Tlali, 2019). Technological tools can enable the participants in this study to actively view and reflect on their teaching practices. Tlali (2019) views reflection as a foundation for the development of higher levels of professional competence in education. The study also aims to create awareness among professional bodies servicing the Western Cape Education Department (WCED) and the Department of Basic Education (DBE), to develop teaching practices within the classroom. It is hoped that this awareness will lead to these bodies developing better methods to assist teachers in their continuous PD.

1.4 Research questions

The study seeks to answer the following research questions:

- How does Video-Stimulated Recall enhance mathematics teachers' self-reflection?

- How does the use of Video-Stimulated Recall as a tool for enhancing self-reflection contribute to the improvement of the teaching of mathematics in the classroom?

1.4.1 Context of the study

Mathematics teachers do not reflect sufficiently and significantly. Yet, VSR could assist teachers to enhance their reflection, as they review their classroom-teaching conduct in real time. In this way, teachers notice aspects of their practice such as time management, learner awareness, content delivery, and their board writing. Observation enhances self-reflection and overall development. Four teachers from two different primary schools participated in this study. The schools are situated in the same areas, in proximity and share the same socio-economic environment. The selection of participant teachers was based on their roles within the school, all teachers are mathematics teachers who teach in different phases.

1.5 Literature review

This section reviews the literature pertaining to this study. The discussion starts with the conceptions of self-reflection, continues with continuous PD, and concludes with the role of VSR in both.

1.5.1 Self-reflection

Self-reflection is perceived to be a key feature of PD and growth, worthy of exploring in this study. Self-reflection is defined as a key to self-awareness (Raelin, 2002; Habash, 2019). Self-reflection allows persons to neutrally examine their own emotions, feelings, and actions – with interest and curiosity. Farrel (2004) defines self-reflection as a systematic viewing process that

enables all teachers to make links between one experience and another. It is the teacher's responsibility to ensure that the process maximises learners' progress and teachers' classroom practice.

Reflective practice is an important tool for developing teaching. Practising reflection consists of much more than personal experience (Bengtsson, 1995). Reflection is taking a conscious look at all factors constituting a professional experience (Mathew et al., 2017). These factors include emotions, experiences, and actions, as well as the responses witnessed. Through reflection, existing knowledge is established, and new information is added, to achieve a higher level of understanding. For teachers, the audience is their learners.

The organisation of thoughts is one of numerous possible outcomes of reflection. Reflection and self-reflection allow the identification and labelling of thoughts, while linking them to theory (Mathew et al., 2017). This process works well when linked to specific contexts such as classrooms, in teachers' case. The identification of thoughts during reflection allows teachers to pinpoint weaknesses in their teaching practice (Mathew et al., 2017).

1.5.2 Reflection and continuous professional development

Reflection is a process that facilitates teaching, learning, and the understanding of educational processes (Finlay, 2008). The practice of reflection plays a central role in teachers' PD (Mathew et al., 2017). Reflection is also described as inquiry within oneself. When teachers inquire in this way, they begin to better understand themselves, their teaching practices as well as their learners (Mathew et al., 2017). Constantly, exploring their own experiences and actions can trigger professional growth in teachers.

According to Liu (2015), critical reflection is a means of facilitating introspective learning from

the values, beliefs, and experiences of oneself in relation to others in the surrounding environment. Liu (2015) further argues that this practice is essential in the development of future teachers and the formal training of novice teachers, as recommended by the school-university alliance and Cambridge University (Farrel, 2004). The aim of reflection is to professionally develop teachers to the point where they can critically reflect and present productive and participative lessons, with impeccable time management (Liu, 2015).

Brandt (2008) examined the importance of reflective practices in the method modules of all teaching training programmes and PD. Method classrooms help to illustrate the importance of professional introspection and growth, thus justifying the existence of these methods classrooms. Brandt (2008) suggests that teachers maintain the habits of inquiry and reflection they had when they became teachers. This habit of inquiry and reflection will move them forward, continuously and successfully. Shandomo (2010) exhorts teachers to become life- long learners of teaching, an attitude and skill enabling them to become the most professionally- developed versions of themselves. Therefore, my study focuses on self-reflection as a means for practising mathematics teachers to enhance lifelong learning.

1.5.3 Video-Stimulated Recall and the teaching of mathematic

Video-Stimulated Recall (VSR) is the viewing of a live recorded footage of a lesson presentation, which fosters self-reflection. The goal is to ground PD through reflection on teachers' specific classroom practices. The greatest chance for success is when teachers' learning occurs in their environment, specifically the classroom setting (Muir, 2010). Teachers learn through feedback received; and, the reflection on their experiences helps to evolve their teaching practices. The continued engagement with professional learning offers an opportunity

for a new and different approach to the teaching and learning of mathematics. For professional learning and reflection to occur, teachers need a tool to assist with these practices in real time.

VSR is known to encourage and/or force self-reflection upon those who participate (Schmid, 2011). For research purposes, the VSR process is conceived as the collaboration between the teacher and the researcher/colleague(s). This collaboration is a professional inquiry foregrounding an interaction between the researcher and the participating teachers (Powell, 2005; Muir, 2010). These reflective dialogues, which are stimulated by video recordings, allow teachers to control and recognise their thinking and feelings (Muir, 2010). This is achieved through a focus on inquiring about their professional practices.

The use of video footage to stimulate reflection has been studied by only a few researchers. Muir (2010) highlights that the existing limited research involved practising experienced mathematics teachers. Other researchers did not only cover mathematics but also all the other subject areas, to stimulate recall via video. Building on the work of Powell (2005), Davies and Walker (2005) emphasise the importance of reflective dialogue. The use of video footage alone might not lead to reflection but, with the guidance of the researcher, the teacher may learn to notice mathematical moments and practise reflection. With VSR, a video-recorded lesson is played to teachers, after its conclusion. After the teachers view the video, they reflect on their lesson. During this process, teachers might explore different ways in which they might improve their lessons. The video recording process is repeated over two lessons.

The above-discussed literature regarding the study of VSR will be explored in more depth in Chapter 2. To conclude this section, the preliminary literature discussion has highlighted the essence and role of self-reflection in continuous PD. In addition, the status of VSR as a tool to

improve self-reflection, PD and, ultimately, mathematics teaching and learning was explored.

1.6 Theoretical framework

Teachers must consider many factors, when managing a classroom. These factors include discipline as well as effective teaching and learning. Teachers are required to continuously adapt to changes induced by various educational factors (Roberts, Benedict, & Thomas, 2014). Stressful developments include curriculum and policy changes. Teachers must adapt to these specific organisational changes at all times, requiring shifts in their practice (Bierwolf & Frijns, 2019). The change process is a comprehensive matter of consciousness and competence (Schratz, 2006). The inverse of this is unconsciousness and incompetence. The management and leadership of a classroom can be an organisational challenge for many teachers (Schratz, 2006).

The individual role of a teacher is to purposefully view themselves in their professional capacity in the classroom, which directly translates into learners. Roberts et al. (2014) regard the ability to adapt as a professional trait of teachers. Therefore, the theoretical framework of this study is about transformation and change (Thompson & Pascal, 2012). Changes pertain to the history of education and a shift in the culture and paradigm of education in terms of classroom leadership competence (Schratz, 2006). Bierwolf and Frijns (2019) conceive change as a regular process to which humans have grown accustomed. This implies consciously knowing if there is a need for change. In this context, the ironic aspect of change in education is that teachers are often oblivious to the on-going changes surrounding them. The changes referred to here are on a macro level. However, for this study, the focus is on the micro level of education, which is the pedagogical environment. This is the classroom that involves the interaction among teachers, learners and curricula.

At the heart of educational change is PD, because it is a major educational leadership issue (Crawford et al., 2020; Schratz, 2001). Change consists of many stages. It is important to note that everything and everyone has the potential to develop. As staff development became a priority for leadership, many theories in education development surfaced. Abend (2019) defines theories as formulations that explain, predict, and help to understand phenomena that often challenge existing knowledge. The theory, as visually illustrated in Figure 2, identifies the possible problems, their consequences, as well as their solutions and successes. Schratz (2006) and Sonia (2017) note that teachers tend to be comfortable with familiar habits. These latter include attitudes, behaviours, and reactions that form a comfort zone. To escape this zone requires tremendous efforts (Schratz, 2006).

Educational change leads to conflict, and the deepest-rooted fears become apparent through the attitudes of the persons involved (Sonia, 2017). When a teacher possesses confidence but is incompetent, the necessary knowledge, skills, and values first need to be acquired for the teacher to further develop professionally (Schratz, 2006). Once teachers are consciously competent and confident in their practice, they are particularly helpful in challenging situations (Sonia, 2017). These situations include larger school-management-team situations, office administration, and even classroom challenges involving learner pedagogy (Schratz, 2006). Yet, at this stage, a teacher may lack an awareness of their incompetence or severely limited competence. Competence refers to capacity in terms of teaching practice. Board-writing is an important part of the teaching practice. In the unconscious incompetent stage, the teacher is unaware that their handwriting on the board is off par, as they have not viewed the board from learners' perspective. The sentences on the board may be written untidily and confusingly for learners to understand. The second stage is the teacher becoming conscious of their incompetence (Talamas,

2015). At this stage, as a teacher becomes aware of their level of incompetence, VSR becomes a tool of reflection. The teacher realises their incompetence regarding board writing through VSR or by viewing the board from the rear of the classroom. At this stage, the teacher becomes conscious of their incompetence concerning board writing. Between the second and third stage, the educator takes steps towards becoming competent in their practice. This can occur through some sort of feedback report, or reflection followed by action (Crawford, Higgins, & Hilburn, 2020). Here, the teacher begins to practise board writing, while continuously viewing and reviewing the videorecording to become competent. At the third stage, the educator is conscious of their newfound competence (Talamas, 2015). This creates a sense of confidence in the teachers, as they realise their value in terms of teaching practice (Fullan, 2006; Schratz, 2006). Here, the teacher is competent in board writing and tries to maintain this competency through continuous reflection. The fourth and last stage is when the teacher is competent yet unconscious of their new way of doing things, because it is a developed skill (Talamas, 2015). At this stage, the teacher is competent in board writing without continuously reflecting or trying, because it has become an unconscious skill. This is the case when a teacher or any other professional has mastered a skill to the point where they do not have to think about it. For Crawford et al. (2020), it is imperative that teachers continuously recognise where they fall in these stages, as over-confidence can be detrimental to personal and professional growth.

Newly attained knowledge and skills, together with experience, groom teachers who master their craft to the point where they become unconscious of their competence (Schratz, 2006; Sonia, 2017). As professional beings, teachers perfect themselves and their classroom practice, so that they eventually find nothing to improve, as they reflect. Such teachers can develop high levels of self-confidence (Fullan, 2006). In another scenario, this creates the risk of teachers

becoming unconscious and incompetent as time progresses. Therefore, the goal teachers should strive for is continuously moving from being unconsciously incompetent to being consciously competent through reflective practices (Schratz, 2006).

In the light of the above discussion, this study proposes a model like that described above. Teachers begin unconscious and incompetent in their classroom practices (Crawford et al., 2020). VSR, as a tool for self-reflection, can consciously bring to the fore aspects of their teaching practice that need further development. Self-reflection prompts a change in the teaching practice, to attain a state of improved competence.

1.7 Research methodology

1.7.1 The research approach

This study adopts a qualitative research methodology, with an interpretive slant.

1.7.2 Qualitative research

Qualitative research is defined as a method which focuses on obtaining data through open-ended and conversational communication (Jackson, Drummond, & Camara, 2007). It leaves room for deepened and detailed information gained through recorded events, orchestrated interactions, and carefully observed behaviour (Labuschagne, 2003; Sharma, 2013).

Different features of qualitative research distinguish it from quantitative research (Kawulich, 2005). In qualitative research, a problem should be explored to unpack its cause (Flick, 2018). According to Golafshani (2003), a good qualitative research study exists to help human beings understand information that would, otherwise, be ‒confusing. Kawulich (2005) states that in

qualitative research, objectives and questions are broadly directed towards the participants and their experiences regarding specific topics. Campbell (1997) notes that, in qualitative research, data collection is based on subjective experiences and the meanings that human participants assign to occurrences, since meaning depends on social and political contexts. A researcher should develop intimacy with the data, which is analysed upon collection.

Generally, qualitative research adopts an interpretive approach, which is mainly concerned with the centrality of human consciousness (Babbie, 2001). It attempts to separate the social sciences from the natural sciences in terms of research (Flick, 2018) and stems from disciplines such as history, philosophy, and anthropology. The interpretive approach recognises how humans make sense of reality and assign meaning to it. When they witness new experiences, humans interpret their realities accordingly (Babbie, 2001). With the introduction of new technologies, participants are allowed to make sense of its role in their teaching and learning experiences (Campbell, 1997).

Qualitative research remains necessary, in the pursuit of personal and PD (Travers et al., 2015). Qualitative methodologies have been at the forefront of research, with a focus on goal setting (Travers et al., 2015). This goal-setting mindset is motivated by the objective of measuring ongoing changes in performance. VSR allows the researcher and the participant to witness and pinpoint changes as they occur. These changes are internally dictated by the participants' new goals.

1.7.3 Data collection and sampling

In qualitative research, data are mainly collected through observation and interviews (Kawulich, 2005; Sharma, 2013). The teacher participants were interviewed in-situ and the recordings were

viewed afterwards by the researcher and the relevant teacher. Four teachers from two schools participated in the study. The mathematics teams from each school underwent training, to familiarize them with the entire VSR process.

This study is situated in two schools located in a Cape Flats suburb in Cape Town. Both are primary schools administered by the Western Cape Education Department. Convenience sampling is used, because these schools are accessible to the researcher in terms of geographical location. The participating teachers came from different educational backgrounds. The four teachers in this study are regarded as experienced teachers who have more than three years of teaching experience. The ages of these teachers vary between 25 and 65 years old. Two teachers per school were purposively selected, as they all teach in the intermediate and senior phases. Teachers were trained on how to conduct VSR during their lesson presentations. However, with Covid-19 regulations, learners attended schools in smaller groups of 15 to 25 per class. This meant that teachers might not have taught mathematics to the same group every day or the smaller classes might have altered these educators' teaching personalities. It is important to note that the possibility of different teaching behaviours might have depended on class sizes (Meier & West, 2020). Data collection consisted of observations and video recording of four mathematics teachers' lessons. This was undertaken to study the effects of VSR, which was used as a tool for teachers to relive their teaching experience from outside their bodies.

My initial analysis of the data has assisted me to assess if teachers adapted their teaching behaviours between the first and second cycles of video recordings, because of self-reflection. For each participating teacher, two entire mathematics lessons were video recorded. Thereafter, the researcher identified an episode or episodes for the VSR review. The researcher and the

participating teacher then viewed the selected video episodes, while the researcher prompted the teacher to reflect on why they decided on certain aspects of the lesson. These interviews were audio recorded. After some time, the entire process was repeated. The second cycle was compared to the first one, to assess any possible changes in teaching practice that might have occurred. After each cycle of video recordings, the researcher conducted semi-structured interviews with the participants, to establish if self-reflection occurred.

1.7.4 Data analysis

According to Campbell (1997), data analysis involves a number of steps. These include the examination of raw data and its sifting. Data collections are highly dependent on the methodology chosen for the research (Sharma, 2013). For instance, part of the methodology of this study is interviews. The latter constitute an instrument of qualitative research that is typically analysed by researchers (Sharma, 2013). Upon analysing data, the results from the study are thematically organised compared to those available on existing databases (Sharma, 2013). The identification of themes means that the data are no longer raw.

Flick (2018) argues that data collection and analysis should occur simultaneously rather than separately. This allows congruency between the processes of collection and analysis. This is because in qualitative research, they are required to interact (Flick, 2018). During this joint process, interaction is the main data extraction instrument. The interaction between the researcher and participant is thus important. In analysing the data, the researcher generates concepts and themes that help to examine the data within the study (Flick, 2018). In this study, data were partly collected and analysed simultaneously.

During data collection, the four stages of *the conscious competence matrix* were considered (Wilhelm, 2016). These stages are unconscious incompetence, conscious incompetence, conscious competence, and unconscious competence. While a lesson is being conducted, observation is undertaken by the researcher, to collect data and note down additional information observed in the lesson. During the first video observation, the participants identify how they want to develop their teaching practice. This is the conscious incompetence stage. During the second video observation, the researcher seeks to establish if the participant has changed aspects of their teaching practice and if they have moved to the conscious competence stage of their performance. Observation was undertaken with each video recording. In this study, observations of video recordings happened eight times – each of the two teachers in each of the two schools was observed twice. The teachers' levels of competence conscious were measured through the observation and the subsequent viewing of tapes. Consciousness was analysed using audio-recorded interviews and the competence established through the viewing of the videos. To measure the participants' consciousness, appropriate interview questions were posed to probe educators' teaching practice.

1.8 Significance of the study

The outcome of this study would be beneficial to educators, publishers, and the Department of Basic Education. Regarding teachers, experienced educators would be able to identify specific areas where they need to improve their teaching practice through self-reflection fostered by VSR. This is especially significant because teachers always have access to video-recording devices, such as mobile phones and tablets. After the study, this process could be used independently, to improve educators' teaching practice. In terms of curriculum development, subject advisors and

other officials of the education department would, hopefully, explore updated methods to initiate teachers' PD. VSR is used to trigger reflective practice which, in turn, could be a determining change factor in educators' teaching practice. PD initiatives could, hopefully, implement VSR in formal initial trainings and continuous trainings.

Chapter 1 outlined the background, the purpose, the context of the study and the theoretical framework used for this study. Chapter 2 provides an expansive review of the relevant literature and further discusses the theoretical framework of this study. Chapter 3 elaborates on the research methodology of this study. Chapter 4 discusses the data analysis undertaken in this study. Chapter 5 discusses the findings, limitations and the recommendations of this study.

Chapter 2: Literature review and theoretical framework

This chapter reviews the literature pertaining to the study and provides the theoretical underpinning of the research. The discussion starts with the conceptions of self-reflection, proceeds with continuous PD, and concludes with the role of VSR in both.

2.1 Self-reflection

Self-reflection is perceived as a key feature of PD and growth worth exploring in this study. Self-reflection is regarded as a key to self-awareness (Raelin, 2002; Habash, 2019), because it allows persons to dispassionately examine their own emotions, feelings, and actions with interest. Habash (2019) emphasises that self-reflection is an essential skill for personal growth. Reflection provides assistance in choosing healthier responses and changing behaviour in the future (Habash, 2019).

Farrel (2004) defines self-reflection as a systematic viewing process that enables all teachers to establish links between one experience and another. It is the teachers' responsibility to ensure that the process maximises learners' progress and classroom practice. Farrel (2004) emphasises that reflection should be a basic part of teaching and learning. Reflective practice makes one aware of innate professional knowledge and actions (Raelin, 2002). It achieves this by challenging the assumptions underpinning routine teaching practices, and by critically evaluating teaching practitioners' responses after reflection on practice situations (Finlay, 2008).

Reflective practice, as a tool, is important for developing teaching. Practising reflection consists of much more than personal experience (Brengtsson, 1995). Reflection implies a conscious examination of all the factors that constitute professional experience (Mathew et al., 2017). These factors include emotions, experiences, actions, and witnessed responses. Through reflection, existing knowledge is established, and new information is added, to achieve a higher level of understanding. For teachers, the audience constitutes their learners. Some perceive reflection as measuring personal past experiences, against the outcome of current professional teaching experiences (Bragg, Walsh, & Heyeres, 2021). Simply put, in education, reflection is the act of thinking about one's teaching.

Yeung (2018) considers self-reflection as a compulsory element of daily teaching routines. Given the importance of self-reflection, it is astonishing to witness the lack of knowledge on this phenomenon (Yeung, 2018). This is perpetuated by many factors. One of such factors hindering teachers' self-reflection is time management. For Yeung (2018), timely/daily reflection should be considered as important as teaching and learning. Thus, reflection time should be reserved. Teachers should ask questions about their teaching habits and the predicted outcomes of their lessons. The answers to these questions may come from the relevant teachers or from those around them (Yeung, 2018). To improve the management of reflection time, teachers need to enhance their classroom management (Weber et al., 2018). Poor classroom management further disrupts fruitful self-reflection. Therefore, time management is an important element of self-reflection (Yeung, 2018). Proper time management secures adequate time for administrative duties, teaching, feedback to learners, and proper classroom management (Yeung, 2018; Weber et al., 2018). This is in addition to self-reflection.

Reflective practice is the intentional reflection on experience (Mathew et al., 2017). For example, a person receives an audio recording of him/her giving a speech to a large audience. After listening to the recording alone and being informed by the organisers that the speech sounded monotonous, this person delivers another speech a week later – which sounds the same as the first. This shows that the speaker has not at all addressed the event organisers' complaint. In this case, no self-reflection on the speech had been undertaken, because intentional reflection prompts change (Muir, 2010).

The organisation of thoughts is one of numerous possible outcomes of reflection. Reflection and self-reflection allow the identification and labelling of thoughts, while linking them to theory (Mathew et al., 2017). This works well when the reflection is linked to specific contexts, such as the classroom, in teachers' case. The identification of thoughts during reflection allows teachers to pinpoint weaknesses in their practices (Mathew et al., 2017). In the instance of a teacher presenting a new lesson, reflection allows the teacher to determine the areas of the lesson that need improvement. Examples of such areas include speaking in a monotonous voice or using a dialect which is unsuitable for the context. It suffices to indicate that, theoretically, a suitable dialect exists for each context or age within the classroom. This is how theory and practice are linked through reflection.

The value of self-reflection is measured by its ability to prompt teachers to evaluate their teaching practices (Cox, 2020). It enables them to analyse their own practices, to establish what works best in their classrooms. Self-reflection is deemed essential because it is unbiased. It is done whether a lesson was good or bad. Cox (2020) explains that, with self-reflection, whether a lesson was good or bad is irrelevant. This is because areas to be improved always exist. To

establish them, self-reflection is needed (Evans, 2014). Self-reflection is a tool used to effect improvements to teachers' preferred teaching strategies.

Self-reflection is a process rather than an instant occurrence (Boud, Keogh, & Walker, 2013). Cox (2020) describes the self-reflection process as diagnosing a particular problem in teaching strategies that may hinder effective teaching and learning. In identifying the problems in the teaching strategies, classroom information needs to be gathered. TeachHub, a resource and support platform for teachers globally, suggests some ideas to improve self-reflection (Cox, 2020). One self-reflection method involves teachers reflecting on their own, through self-observation. This is basically when the educator recognises their own feeling during their lesson presentation, while observing learners' reactions in the different parts of the lesson. To avoid forgetting these reflections, it is suggested that teachers create journals of all observations, to self-reflect after lessons (Boud et al., 2013). When teachers self-reflect, some important elements of their lessons should be considered (Cox, 2020). These include lesson objectives, learners' understanding of the content taught (this might be measured through formative assessment), and any other related problems. Moreover, the self-reflection should establish whether the materials used in the lesson kept learners engaged and if other materials should be added. Lastly, teachers should ask reflective questions about their teaching practices. Questions pertaining to the overall effectiveness of the lesson, sensitivity to learners' educational needs, and the teachers' overall attitude and delivery during lessons are central (Cox, 2020). As self-reflection is practised regularly, teachers may find specific areas in their practice that need improvement. Simultaneously, they may identify areas where they are performing excellently in their teaching practice. The goal of self-reflection is to improve educators' overall teaching practice.

This section has examined the role of digital observation in teacher education, particularly as a means of engaging experienced teachers in reflective practice, during their school hours. Research has repeatedly highlighted the importance of self-reflection for improving novice teachers' effectiveness and enhancing their efficacy in their classroom environment.

2.2 Reflection and continuous professional development

Around the world, education communities aim to improve teaching quality and student learning. This includes ensuring the continuous PD of teachers, teacher educators and school leaders, which is regarded as a key to enhancing instruction. Educators and researchers are interested in understanding how the best teachers learn to develop and refine their practice (Hollingsworth & Clarke, 2017). Reflection is a process that facilitates teaching, learning, and the understanding of processes (Finlay, 2008). The practice of reflection plays a – "central role" in teachers' PD (Mathew et al., 2017, p. 126). Reflection is also described as an inquiry within oneself. When teachers inquire in this way, they begin to better understand themselves, their teaching practices, and their learners (Mathew et al., 2017). Constantly examining their own experiences and actions can trigger teachers' professional growth.

Reflection is at the forefront of teacher training and development, to the extent that it trumps over formal education in certain areas (Saylor & Johnson, 2014). As stated before, reflection consists of more than personal experiences. However, personal experiences in the workplace may be defined as professional experiences (Mathew et al., 2017). The latter facilitate professional learning. Hence, professional experiences enable professional learning that may otherwise not be possible. Professional experiences facilitate learning that cannot be attained in

formal instructional settings such as teacher education institutions (Mathew et al., 2017). Reflective practice is conceived by some as the most efficient source of PD (Saylor & Johnson, 2014).

PD is defined as a tool to develop teachers' teaching practice throughout their career (Mizell, 2010). The result of PD should be an emphasis on the needs of learners by teachers (Adey, 2004). PD is often overlooked because it is not regarded as a priority. Yet, Mizell (2010) argues that PD is the only means of improving educator performance and learner achievement. PD is linked to the formal training of novice and experienced teachers. This implies being at a college, university, or workshop, to receive formal training. Evans (2014) and Mizell (2010) reject this narrow-sighted view of continuous PD. This is because the reflective practice is a process that may also occur informally (Evans, 2014). Informal PD may occur during reflective discussions between teachers and learners, self-reflection activities, and peer evaluations (Mizell, 2010). Self-reflection and in-class research are distinguished as –individual research‖, or as typical modes of PD (Mizell, 2010 p.9).

Reflection is crucial for teachers' PD. It provides novice and veteran teachers with new insights into their teaching practices (Marvel, 2018). Teachers are viewed as professionals who know how important quality instruction is. They are trusted in making the most beneficial professional decision for their classrooms. In their own classroom contexts, teachers reflect on possible solutions to existing challenges (Marvel, 2018). Reflection contests teachers' existing beliefs. It allows the birth of new strategies, to solve individual classroom problems. The PD process has no drawbacks. It is beneficial to both teachers and learners. All forms of effective teaching are possible, that is, reflection, reflective practice, and analysis are done in the classroom (Adey,

2004; Mizell, 2010). It is impossible for teachers to know enough about their teaching practice, as well as how students react to and learn from it (Adey, 2004). All learner classes have their low, average, and high-achieving learners. This divides learners into different groups of teaching practice, learner-reactions, and lesson outcomes. PD through reflection is the only method that ensures that teachers remain updated concerning such information (Mizell, 2010).

PD through reflection is regarded as the most effective way to improve teaching and learning (Adey, 2004). Many teachers reject the existing IQMS form of PD because it adopts a universal approach consisting of being graded, with feedback provided by the departmental head (Evans, 2014; Mizell, 2010). Traditional methods of reflection do not address the core challenges that both teachers and learners encounter in the classroom (Matherson & Windle, 2017). For instance, departments enforce PD programmes that target the larger group of educators from many different school contexts. Some teach in poorer schools, while others teach in semi-private schools. At these schools, learners have different educational needs (Mizell, 2010). Reflection within individual classrooms adopts a more personalised approach to PD.

Matherson et al. (2017) view PD as most useful when it collectively focuses on active teaching, assessment, observation, and reflection. The most useful PD experiences are related to active participation rather than abstract discussions. The former comprises observations, peer observations, feedback, and interactive feedback (Matherson et al., 2017). Evans (2014) highlights the possibility of considering ―personal‖ experience in PD (p. 30). In terms of PD, for teachers, personal experience might be much more than that, as it outlines teaching practices (Matherson et al, 2017). A pair of critical factors should be considered when the success of PD is the teacher's motivation to engage in self-reflection, and the process by which teachers'

cognitive discourses occur. For Matherson et al. (2017), the PD process should be a steady progression that occurs over time. This is only possible if the process is continually reflected upon and, when this happens, the success of both teachers and learners becomes evident.

Reflective practices have been integrated into tertiary education, more specifically in teacher training. Cambridge University, in the United Kingdom (UK), lists reflective practice as a compulsory module for all streams of its Bachelor of Education programme, citing its promising properties (Farrel, 2004). The module outline represents the process of reflection as a cycle consisting of five steps (see Figure 1; Finlay, 2008). Step one is the initial teaching attempt. Step two is the self-assessment during which a teacher needs to consider the effect of their teaching practice on learning. Step three regards the consideration of new ways to improve the quality of educators' teaching practice. Step four concerns the implementation of these ideas in the classroom. Step five is about evaluating the changes and repeating the process, if necessary. Finlay (2008) defines reflection in education as the journey towards new insights of self and practice, through experience. The figure below illustrates the self-reflection process.

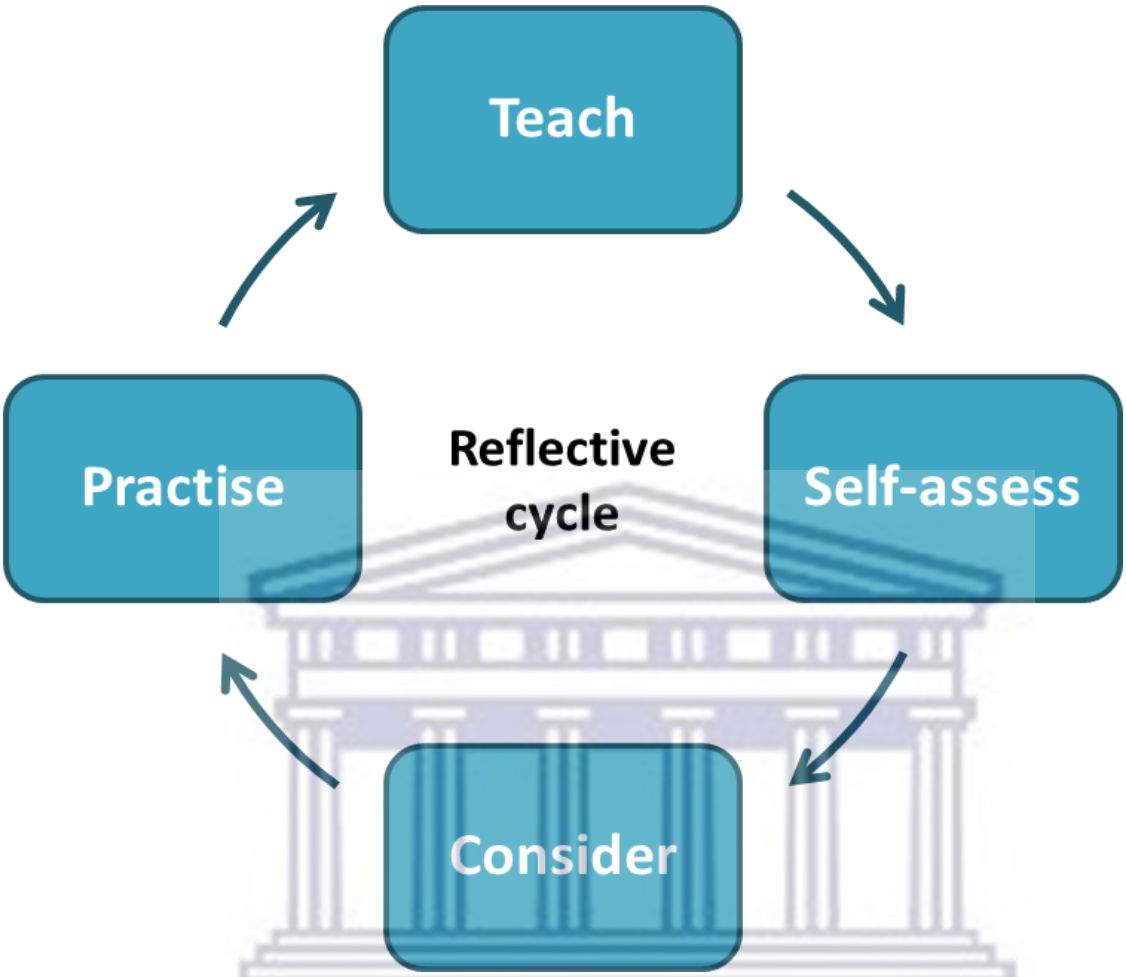


Figure 1.1: Process of self-reflection (Finlay, 2008, p.8)

In addition to the outcomes of reflective practice discussed previously, many other benefits are evident within the pedagogical setting. Finlay (2008) lists the development of more confident teachers, a sense of responsibility towards learners, encouragement of innovation, and the overall improvement of classroom practice. These benefits are also listed in the expected outcomes of the reflective practice course at Cambridge University (Farrel, 2004).

Other tertiary institutions across the globe, in alliances such as school-university partnerships developed and fostered the use of the notion of critical reflection (Shandomo, 2010). The

latter is rooted in the mission and vision aspects of education focusing on teachers' improved teaching practice, especially for mathematics and science educators (Shandomo, 2010). Critical reflection is contextualised in urban rather than rural areas (Saric & Steh, 2017; Shandomo, 2010). Urban areas are more developed than rural areas, which suggests the availability of almost endless resources and innovations to better the lives of the inhabitants of urban areas. The study done by Shandomo (2010) focuses on self-reflection among mathematics and science teachers, in an area where resources – such as libraries, computers, traditional books, and technology with open Internet access – are readily available. Critical reflection provides opportunity and leaves no room for excuses in terms of the improvement of teaching practice and learner performance.

According to Liu (2015), critical reflection is a means of facilitating introspective learning from the values, beliefs, and experiences of oneself to those of other individuals in the surrounding environment. Liu (2015) further argues that this practice is essential in the development of future teachers and the formal training of novice teachers, as recommended by the school-university alliance and Cambridge University (Farrel, 2004). The aim is to professionally develop teachers to the point where they can critically reflect, and present productive and participative lessons demonstrating impeccable time management (Liu, 2015).

Brandt (2008) examined the importance of reflective practices in the method modules of all teaching training programmes and PD (p. 38). Method classrooms help to illustrate the importance of professional introspection and growth. Brandt (2008) suggests that teachers maintain the inquiry and reflection habits they developed when they first started as teachers. These inquiry and reflection habits will continuously move teachers forward. Shandomo (2010)

encourages that teachers become life-long learners, an attitude and skill enabling them to become the most professionally developed versions of themselves. Therefore, my study focuses on the value of self-reflection for enhancing practising mathematics teachers' lifelong learning.

2.3 Video-Stimulated Recall and teaching mathematics

Video-Stimulated Recall (VSR) is the viewing of live recorded footage of a lesson presentation, which fosters self-reflection. VSR basically consists of teachers observing their current practices and striving to develop suitable pedagogical practices to improve their teaching (Muir, 2010). This allows for immediate and specific feedback which might lead to the effective development of an individual, with the support of the teacher educator/researcher/critical friend. The use of video tools yields many advantages for teaching and learning. Investigations have revealed a concern regarding VSR's ability to support self-reflection (Muir, 2010). Thus, the goal is to ground PD through reflection on teachers' specific classroom practices. The greatest chance for success is when teachers' learning happens in their own classroom environment (Muir, 2010). Teachers learn through feedback received and reflection on experiences, to enhance their teaching practices. The continued engagement with professional learning offers an opportunity for a new and different approach to the teaching and learning of mathematics. For professional learning and reflection to occur, teachers need a tool to assist them with these practices in real time (Matherson et al., 2017). Marvel (2018) discusses video learning teams where teachers record themselves on video during lessons, to subsequently reflect on the latter. A collaborator or fellow teacher may view the video, to provide feedback for deeper reflection. Very often, the provider of the feedback learns just as much as the teacher, because both reflect on the lesson (Marvel, 2018).

McCoy and Lynam (2021) performed an analysis that provided strong evidence and concluded that VSR was extremely supportive of teachers' weekly self-reflection and the development of their self-reflective practice. All the participants in their study recognised the helpfulness of self-reflection. McCoy and Lynam (2021) quoted one participant who claimed that –reflection is quite a difficult thing so anything that can help you is brilliant…like, you think back on a lesson and you'll only pick out parts of it whereas with the video you'll see the whole thing‖ (p. 934). This is an indication of one teacher's perception of video tools for self-reflection in the classroom. The participant went further by stating: I suppose you'd like more time to really, really analyse the videos that you're recording …when you're on placement, it's so important, time. You haven't as much time as you'd like to, you know, go into the real detail of the stuff (McCoy & Lynam, 2021 p. 935). This indicates that teachers prefer to video record their lessons and then take them home for analysis and reflection.

Furthermore, McCoy and Lynam highlighted another participant's perceived VSR-stimulated progress (2021). The participant states: "I didn't like watching myself. Especially, you kind of, find things that you don't even know that you do. Like I was twisting my hair a lot when I was talking and I use my hands a lot when I'm speaking and I never would have noticed that. That was quite, like, horrible to watch. When you're watching yourself back…sometimes I've found it a little bit uncomfortable at times…did I really say that or did I really do that?" (McCoy & Lynam, 2021 p. 936). This process became effective after participants overcame the initial embarrassment and nervousness of presenting in front of a camera and observing themselves on video, at a later stage.

According to Hollingsworth and Clarke (2017), a video-recording of classroom practice can provide unique, rich and powerful opportunities for teacher learning and professional growth. As such, video-recordings constitute a valuable tool for stimulating teachers' self-reflection. Both authors have done extensive work involving the use of video-recordings of classroom practice in the promotion of teacher research. VSR supports the review of other teachers' teaching practices and the highlighting of the implications for teachers. The degree of teacher control is one of the focal points of their investigations (Hollingsworth & Clarke, 2017). The teacher determines what the focus of reflection is.

Hollingsworth and Clarke (2017) further reiterate that it is common for the most capable teachers to use a subtlety that renders their decisions and actions invisible to casual observers. This is often because the teacher's actions carry a significance that is shared with the class but is not readily apparent to outsiders. Videotape can be used to facilitate a finely detailed "data-driven" discussion about the nature and significance of such practices (Hollingsworth & Clarke, 2017 p. 458). Some of these practices are not even discussed at all. Our increasing use of video material to investigate these issues has contributed to this change. By facilitating teacher reflection on classroom practices, we might make visible some of the teachers' unnoticed practices. We might also develop a new vocabulary among the teaching community, by which we might describe teaching practices.

Video as a research tool, in addition to contributing to teacher learning through its role in research into teacher practice, facilitates a better understanding of teacher knowledge and expertise. This is achieved by recording and analysing classroom practice (Hollingsworth & Clarke, 2017). This can lead to recommendations for effective classroom practice. Video

recordings were used to study the classroom practices of mathematics teachers in seven high-achieving countries. As video-records of social interactions become more complex and richer, an opportunity to reinterpret, recode, and represent the information captured in the video exists. Several research studies conducted involved the collection and configuration of data. The intention is to realise the potential of classroom video data through multiple analyses (Hollingsworth & Clarke, 2017). Video is an essential tool for multiple analyses of the same educational setting, for research can achieve the closest match between the complexity of the situations and practices in those settings. With multiple analyses, the complexity of the educational setting is most accurately captured. Hollingsworth and Clarke (2017) suggests that as technology advances and the use of video in research ―grows more sophisticated‖ (p.459), we are closer than ever to realising this vision of using effective self-reflective tools for the PD of mathematics teachers.

Sherin (2003) claims that teacher educators have continuously investigating innovative methods to develop the teaching practice. As video technologies became prevalent in many countries, experts believed they had the potential to be used for teacher education. Consequently, many universities started incorporating video observations in their novice training and PD courses for veteran teachers (Sherin, 2003). The procedure is innovative, as it uses the ability to replay sequences and pictures as it happened in real life. For Sherin (2003) video observation serves a purpose to elevate novice teachers' practice, for them to start their careers as professionally developed as possible. This is made possible as these observations are the basis of reflection (Sherin, 2003). Video recordings are followed by observations by teacher and researcher. The video is viewed and analysed the way traditional VSR projects are usually conducted. However, Sherin (2003) recommends that the following be considered in observation analysis. The

mathematical concepts addressed, teaching method used, as well as the level of reasoning and understanding displayed by learners. With modern technological software, focus on the above-mentioned factors is effortless. These factors in both data collection videos may be compared directly, as opposed to observing entire lessons.

VSR provides researchers and teachers with effortless flexibility, according to Sherin (2003). Indeed, it is a lasting record of classroom interactions that can be analysed independently. When a video is recorded, it may be paused, played in slow motion, edited, and rewound. This makes it easy to analyse teaching practice. Furthermore, the analysis of interactions relies on the video for the improvement of teaching proficiency (Sherin, 2003). VSR is known to encourage and/or force self-reflection upon those who participate (Schmid, 2011). In this research, the VSR process is regarded as a collaboration between the teacher and the researcher/colleague(s). This collaboration is an inquiry of a professional nature, which is an interaction between the researcher and participating teacher (Muir, 2010; Powell, 2005). This reflective dialogue, stimulated by video recordings, allows teachers to control and recognise their thinking and feelings (Muir, 2010). This is achieved through a focus on inquiring about their professional practices.

The use of video footage to stimulate reflection has been studied by only a few researchers. Muir (2010) explains that the limited research conducted was done with practising experienced mathematics teachers. Other researchers focused on all other subject areas, to stimulate recall via video. In 2009, I unconsciously had a personal experience of VSR. As an 11-year-old school learner, I excelled at javelin and eventually progressed to compete at district and provincial level. Javelin is a sport that requires both strength and technique. During training, the coach, who was innovative in many ways, would watch the different age groups throw the javelin as hard as they

could. He would instruct them on the proper technique to throw the javelin. For example, he noted that the arms' range of motion must be 130 degrees. After realising that speaking and instructing did not yield results, the teacher used his phone to video-record each throw. After watching and analysing different people, as a team, dialogue began. Through watching themselves and reflecting upon their techniques, the entire team's throwing techniques improved in a very short time frame. One can relate this occurrence to the observations made by Muir (2010). The use of video allows specific observations to be made, focusing on the most important aspect of teaching, even if it is teaching correct techniques in sports.

TeachHub considered video recording as a principal method of self-reflection (Cox, 2020). VSR provides a valuable insight into one's teaching. It promises an unaltered and unbiased view, to measure the effectiveness of a lesson, from where the student is sitting (Cox, 2020). Video recordings may act as an additional set of eyes to identify areas of weakness in teaching practice. These identified areas may have been missed during other possible self-reflection sessions. TeachHub describes VSR as a valuable reflection tool for both experienced and novice teachers.

Building on the work of Powell (2005), Davies and Walker (2005) further emphasise the importance of reflective dialogue. The use of video footage alone might not lead to reflection but, with the guidance of the researcher, the teacher may learn to notice mathematical moments and practise reflection. With VSR, a lesson that is video recorded is played to teachers after the session. After the teachers view the video, they reflect on their lessons. During this process, teachers might explore different ways in which they might improve their lessons. The video recording process is repeated over two lessons.

Another term for VSR is online video coaching, as it is known in multiple education systems

(Choppin et al., 2020). Choppin et al. (2020, p.27) officially define this process as a ‒responsive model of coaching that utilizes communicative technology and videos, allowing a coach and teacher to engage in collaborative cycles of planning, instruction, and reflection for the purpose of increasing teacher's pedagogical and content knowledge to improve instruction from a distance‖. Technological integrations for the PD of mathematics teachers are deemed as essential modern tools for reflection (Nite & Bicer, 2020). Mathematics teacher education is a process that requires a collaborative and engaging inquiry (Glassmeyer, 2020). This PD inquiry assists teachers in addressing various learners at different levels of mathematical understanding (Nite & Bicer, 2020). PD is broadening mathematics teachers' competence in terms of instructional strategies through reflection, to address learners' mathematical needs (Choppin et al, 2020). Teacher PD has not only been a factor in teaching technique/method improvement, but it also impacts teachers' content knowledge in mathematics (Nite & Bicer, 2020). Reflective practices for PD allow teachers to identify and address gaps in content knowledge for themselves and the learners in their mathematics classrooms (Glassmeyer, 2020).

Knight (2014) views the improvement of teaching methods as resting on teachers; thus, their existing teaching methods must be understood. To understand the current teaching methods, thorough examinations must be undertaken. Thorough examinations of teaching methods can only be effective when done in real time (Knight, 2014). The classroom environment is far too dynamic and vibrant to reflect on during the lesson. Consequently, the lesson should be observed as it happened. Therefore, Knight (2014) offers a solution consisting of video-recording and observing the lesson, for PD.

McCoy and Lynam (2021) reported the results of the increased accessibility of digital video

equipment in mathematics classrooms. They explored how this equipment might support teaching practice and pedagogy across many education sectors. They focused their study on novice mathematics teachers. McCoy et al. (2021) suggest that prescriptive forms of surveillance in classrooms should be implemented whereby reflective practice serves as a basis. In most First World countries, such as the United States, the evaluation of teaching practice is done through the traditional face-to-face visits to the classroom. In recent years, teacher development has stepped into real-time self-observations through video tools for PD (McCoy & Lynam, 2021).

As with most subjects, teaching mathematics requires content planning and lesson preparation. VSR has a significant impact on these processes, according to McCoy and Lynam (2021). The digital camera greatly supported novice and experienced teachers in developing their classroom management skills. For a number of participants, viewing the video footage also led them to change the pace and content of their lessons. One participant stated that they –noticed that the kids were starting to get kind of loud and messing in between the transitions within a lesson. I was taking longer than I needed to by looking back on myself, it made me change my pacing of how I explained things and keep the lessons more on track and on pace‖ (in McCoy & Lynam, 2021 p. 935). The planning of the overall presentation of content is manipulated, through VSR and observations in the abovementioned ways, by the participant. Another factor manipulated by VSR is language delivery. One participant realised that the language used in a particular lesson was too advanced for learners' level. This participant stated that:

> –watching back, I was actually surprised. You know I just thought to myself the language that I was using, was just far too advanced for them. And I definitely think that if I didn't have the camera I wouldn't have noticed that. Video observation opened my eyes to what I was doing and what I could do differently, like, getting down to the kids'

> level and stuff like that. At the start I realised I wasn't doing that too much but after watching the first video I was like 'Oh, I need to get down to their level more', or 'I could have explained this better' (McCoy & Lynam, 2021 p.937).

It is widely acknowledged within the field of mathematics education that language plays an important (or even essential) role in the learning, teaching, and doing of mathematics. Vocabulary understanding is a major contributor to overall comprehension in many content areas, including mathematics. The language use in lesson presentation is an important factor to consider when teaching mathematics. This is because language plays an important role in the understanding of content (Morgan, 2013).

VSR influenced yet another factor of teaching practice and lesson presentation. According to McCoy and Lynam (2021), positioning and hand gestures are notable factors of lesson presentation. The participants stated that the video footage enabled them to see how their positioning may have been less than optimal and inclusive of all pupils. One participant mentioned that ―it did definitely inform my teaching. I really focused too much on the right-hand side of the class during that lesson and I had my back to this person or that other person too much, and I need to try and draw them into the lesson more. I actually explained the most vital part of that lesson with my back to half the class (learners)‖ (in McCoy et al., 2021 p. 936). This participant continued by saying that:

> the camera makes you feel how important it was to move around the classroom and engage with everyone. It definitely showed me the importance of walking around the classroom and making sure that you're looking at what the children are actually at. At different points, you can see in the videos that the heads kind of go down on some of the students they might be losing interest‖ (McCoy et al., 2021

p. 936).

Furthermore, a participant confessed: "I'm not as aware of the wider room as I thought I would have been there was one child that was, had their hand up for ages, and I don't even know if I got to his questions. And he was sitting there quietly. Whereas I was more aware of the children that were jumping up and down" (in McCoy et al., 2021 p. 936). This participant added,

> [I]remember that there was two – like, there was a few boys in the back of the class, kind of, messing in front of the camera and I had no idea that that was happening until I watched back the video. And I even said to the teacher, I said ─I can't believe I missed that, you know (in McCoy et al., 2021 p. 936).

After reflecting on the video footage, some teachers realised that their attention was narrowly focused on a subgroup of students, or that they did not notice that some pupils were not focused on the lesson.

Liang (2015) describes the traditional classroom observations as vital they have fostered significant strides in reflective practice in the classroom (p.236). However, these strides have been limited. Live video observation has the potential for furthering reflective practice in the mathematics classroom and teachers' PD. The act of observation involves one person monitoring another person's performance during any given task. The purpose of such observations is the provision of constructive feedback to prompt development (Liang, 2015). Further investigations into VSR or live video observations deemed the process effective in collecting information on teachers' classroom performance, while providing analytical data and evidence-based information. VSR as a tool in the mathematics classroom consolidates the role of classroom observation for professional mathematics teachers. Additionally, it is an effective way to support teachers in their quest to understand their teaching practices in the context of mathematical content delivery (Liang, 2015). VSR achieves all these goals by exposing teachers to themselves

and their teaching practices.

The literature pertaining to VSR has been discussed above. The discussion has highlighted the essence and role of self-reflection, through VSR, for continuous PD. In addition, VSR as a tool to improve self-reflection, PD, and mathematics teaching and learning has been discussed.

2.4 Noticing

Noticing encompasses the ways in which teachers are able, amid instruction, to observe important details in learners' reactions and decipher this information precisely and comprehensively, to adapt instruction within the classroom (Gibson & Ross, 2016). Initially, it may appear that we have no control over what we notice. Certain things tend to stand out more than others. This includes loud sounds, bright signs, and sudden movements. Environments in which we live continually bombard us with cues. During teaching, however, becoming aware of what is happening is not an incidental activity, but rather a professional one (Biccard, 2020). Nevertheless, the task of noticing in a classroom is a bit more complex. Therefore, to notice more or to develop a heightened sensitivity to notice, teacher must be deliberate in their efforts.

Observing important aspects of classroom instruction is a critical skill for teachers. Van Es and Sherin (2002) describe three significant aspects of noticing that constitute a basis for the conception of professional teacher noticing. These aspects include identifying what is important or noteworthy about a classroom situation, making connections between the specifics of classroom interactions and the broader principles of teaching and learning that they represent, and using one's context to reason about noteworthy events.

The importance of PD in co-teaching cannot be overstated. Giving teachers an opportunity to observe others' practices can encourage change (Sherin et al. 2008). An individual can observe

the practices of others in person or through a video recording. Videos can be effective and powerful tools for communication, collaboration, noticing, and reflecting. It has been shown that analysing videos of classroom instruction is beneficial not only to novice teachers, but also to experienced teachers (Van Es & Sherin, 2002).

Professional development not only changes what teachers notice, but it also makes a difference in how they interpret noticed moments (the development of their knowledge-based reasoning). Establishing how mathematics teachers' noticing develops was the focus of the afore-mentioned study. It is equally important to focus on the role played by teacher-noticing in educators' decision-making (Biccard, 2020). A PD programme was designed and implemented within teachers' own classes. Teachers' noticing is intimately related to their orientation (including beliefs) and resources (including knowledge). Clearly, it is a complex and integrated teaching competency. It is important to note that what teachers notice will impact their decisions. This, in turn, can affect their teaching methods (Biccard, 2020). Teachers' noticing involves observing classroom interactions, reflections, reasoning, decisions, and actions. Biccard (2020) further indicates that noticing includes what teachers observe, how they make sense of what they see, and the decisions based on their observations.

Teacher-noticing is the way teachers make sense of the enormous amount of sensory data that a classroom provides. Therefore, it is not a passive procedure (Biccard, 2020). Moreover, in the classroom setting, teachers are actively engaged in two processes: (1) attending to specific events in the classroom setting (what does a teacher attend to?) and (2) making sense of those events (abstracting these events). Teachers observe things according to their professional knowledge and experience. There is a possibility, then, that teachers with a deeper subject-matter knowledge and instructional-content knowledge may be better at noticing. Biccard (2020) suggests that the

ability to learn from teaching depends on the capacity to perceive. As such, teacher observation is a fundamental aspect of understanding teacher learning in teacher training. Teacher notes can be developed and refined, to ensure meaningful teacher development Van Es (2011) contends that learning new discourse is central to teacher awareness, and that perceptual discourse goes beyond explaining and assessing events. Interpretative discourse is needed to be noticed. It is unlikely that a teacher will create this kind of discourse on their own. Teachers must be given the appropriate space and time to make presentations. For this reason, teacher training programmes have been developed so that teachers can be aware of them while teachers are teaching. Indeed, Choy (2013) states that awareness often occurs retroactively and is not necessarily the "moment of", the reflection stage serves as a practical intervention designed for teachers. During this reflection phase, metacognitive introspection develops, and teachers' productive perceptions improve. Teachers can develop the inquisitive mind needed to learn through reflection (Choy, 2013). Many metacognitive processes are facilitated by allowing teachers to spend time observing lessons and being asked to look back to their observations. Through this reflexive meta-cognition, teacher awareness is improved.

Therefore, we have been guided to provide an explanation for the instructor's interest which includes essential processes. These include: (1) figuring out what is known as selective interest and (2) information-based questioning (Lesseig, Elliott, Kazemi, Kelly-Petersen, Campbell, Mumme, & Carrol, 2016). Interpretation, also known as selective interest, postulates that teaching entails taking note of some interactions, ignoring others, using different words, and figuring out essential events during a lesson (Sherin, 2007; Sherin, 2002).

Teacher noticing has become fundamental to educator PD and the development of competence

(Santagata, König, Scheiner, Nguyen, Adleff, Yang, & Kaiser 2021). Hence, noticing is supported by pre-service teacher education and experienced teacher PD. In mathematics teacher education, VSR has been found to support teacher noticing (Santagata et al., 2021). The video allows teachers to view their lessons and teaching practices by playing, viewing, and slowing down the playback. In other words, they can slow down instructional interaction and analyse it for themselves (Santagata et al., 2021). It further enables teachers to learn from their own practices as well as other teachers'. This makes it an ideal tool to support teacher noticing and PD.

After gathering data from 255 different studies, Gaudin and Chaliès (2015) discovered two common objectives of noticing for PD. In these two objectives, video is recognised as a professional tool for noticing and fostering of PD. The first objective is developing knowledge on how to reflect on and interpret and teaching episodes (Gaudin et al., 2015). These episodes refer to the different parts of and times in a lesson, whether it is the presentation, content delivery, or the conclusion of the lesson. The second objective is developing knowledge on what to do after noticing has occurred in the first objective. Similar to this study, Gaudin et al. trained teacher to practise selective attention to notice specific episodes within a lesson (2015). This is noteworthy because it mirrors the data collection and analysis methods used for this study. Training and execution is done in the same manner.

Noticing is not only regarded as the discovery of something, but it also involves other important mental processes worth considering. For Sherin (2017), noticing, observing, and making sense of videos involves advanced cognitive psychological processes. Sherin (2017) divided these psychological processes into three distinct parts. The first is the identification of important instances in a given classroom situation. Lesseig et al. (2016) identified selective interest as a

key word in this process discussed by Sherin (2017). Basically, it is important parts of the teaching practice that are noticed rather than missed. The second part is the linking of specifics in the classroom interactions and the teaching principles that represent mathematics teaching and learning as a whole (Sherin, 2017). This is essentially the reflective practice of teachers, whereby they measure their lesson outcomes through the interactions they view during video observation. The third and last part is linking one's teacher identity and moral values to the conduct displayed in the video by the teacher (Sherin, 2017). This is where teachers reflect on whether their practices match their identities and all that they represent. Sherin (2017) describes the psychological and cognitive processes that occur during noticing and teachers' reflections.

Kaizer and König (2019) further developed the discussion of the cognitive and psychological processes of noticing for reflection. They introduced three interrelated skills: ‒attending to the details in children's strategies, interpreting children's understanding reflected in their strategies, and deciding how to respond based on children's understandings‖ (in Santagata et al., 2021 p.121). Kaizer et al. (2015) suggested that teacher noticing is situated in the instructional setting (classroom), decision making within it, and students' response to particular activities. Investigating the cognitive and psychological processes of teacher noticing, focusing on learners' thinking, would be too narrow and unable to prompt self-reflection (Bastian, Kaiser, Meyer, Schwarz, & König, 2022). In this approach, teachers have to magnify all other aspects of their teaching practice. The cognitive and psychological focus of teacher noticing creates a platform for video activities such as VSR, a platform for teachers to notice and for research to analyse data.

Mason (2011) proposed another lens from which to examine noticing. He argues that a

discipline-specific perspective to view noticing will improve teachers' presence within the classroom as well as their awareness of learners' understanding in specific subject contents (Mason, 2011). Mason (2011) further claims that teacher noticing is a ―collection of practices designed to sensitize one so as to notice opportunities in the future in which to act freshly rather than automatically out of habit‖ (p. 35). This links with the theoretical framework elaborated by Burch (1970), whereby the teacher changes existing habits to explore new ones by becoming conscious-competent. Mason (2011) emphasises the idea that teachers adapt interactions, after noticing, to attend to learners' ―needs in-the-moment‖ (p. 121).

Jacobs, Lamb, and Philipp (2010) provide another perspective on teaching noticing during classroom practice. The professional noticing of children or learners' mathematical thinking is a fundamental study area in PD. It focuses on unpacking more of the ―in-the-moment‖ decisions made by teachers (Jacobs et al., 2010 p. 169). Noticing forms part of an arsenal of interrelated skills that attends to learners' practice and understanding within the classroom. It also relates to teachers' interpretations of learners' understanding within a pedagogical setting. Noticing is a challenging and complex phenomenon. Once it has been mastered, it is effective in reflection and teacher education (Jacobs et al., 2010). Many different aspects and types of noticing have been discussed. Learning to notice enhances PD in such a manner that the direct expertise of professionals is enhanced, in any given profession (Davys & Beddoe, 2020).

The noticing of mathematics teachers aims to understand and make sense of complex classroom situations (Jacobs et al., 2010). Nonetheless, it is impossible to notice everything in a classroom situation, as it happens. Therefore, video tools are used to make teachers aware of their potential unnoticed occurrences within the classroom. Video tools prompt teachers to notice things in classroom practice, in the moment. This then creates a platform that enables teachers to notice

things in future lessons, without video stimulation (Jacobs et al., 2010). In a sense, noticing encourages reflection and prompts teachers to change the noticed aspects of their lessons that revealed room for improvement. Jacobs et al. (2010) further emphasised the importance of how teachers notice as well as what they notice within their own classrooms.

Teacher noticing has branched into a new area of research that focuses on learners' mathematical thinking (Jacobs et al., 2010). If a teacher notices and understanding learners' way of thinking, the instructional environment for learners becomes rich. In other words, teachers who notice and read facial cues from learners become informed of learners' thinking and understanding in the mathematics education context. Through professional noticing development, teachers are able to learn the mechanisms of learners' thinking. This further enables teachers to develop professionally, even after support is taken away. The support referred to, here, consists of video tools.

The idea of in the moment decision-making was further expanded by Jacobs (2010). She added three components regarding the professional noticing of learners' mathematical thinking (p.173). The first component is the investigation of a specific type of decision-making, the type of decision-making by a teacher when a learner provides –on-the-spot‖ type of feedback, whether it is verbal or not (Jacobs, 2010 p.173). In this instance, professional noticing occurs, and split-second decisions must be made by the teacher. This quick decision-making is in stark contrast with the conventional decision-making. The latter involves drafting lesson plans, as well as deciding on content delivery and types of interactions (Jacobs et al., 2010). The three components of the professional noticing of learners' mathematical thinking are "attending, interpreting, and deciding how to respond" (p. 173). After extensive data analysis, Jacobs et al. (2010) added that the professional noticing of learners' mathematical thinking requires far more

than simply attending. It requires the interpretation of learners' mathematical understanding and, afterwards, the reflection of said information.

To understand the mentioned components of the professional noticing of learners mathematical thinking, these components should be elaborated. Attending seems to be a skill that is widely overlooked and deemed unimportant, compared to the other two components (Jacobs et al., 2010). One possible reason for this is that those involved in PD assume that all adults possess the skills and capacity to attend to situations. This includes teachers in their practice and professional capacity. Attending is important because, without it, the other processes cannot even be initiated. For mathematics teachers, noticing is the basis of being attentive to learners in the classroom setting (Jacobs et al., 2010). What follows after attending is interpretation. The interpretation of learners' mathematical understanding is about knowing and understanding how to respond to situations in the classroom. After their study, Jacobs et al. (2010) concluded that many teachers lack the capacity to successfully interpret learners' mathematical understanding. This can hinder a clear conversation about understanding a child. Avoiding discussions about children's understanding of mathematics may indicate a lack of attention to learners' strategies. It could also suggest a lack of mathematical knowledge to understand those strategies. Thus, professional developers have to attend to these problems.

2.5 Theoretical framework

Noel Burch developed the conscious competence framework in 1970. The conscious competence model was designed to highlight two factors that affect thinking, as humans learn a new skill. Burch (1970) conceives humans' consciousness as their awareness and their level of skill at a specific task, or as their competence while learning new things. According to Burch (1970), the

conscious competence model represents how we move through the following levels, as we build competence in a new skill:

- Unconsciously unskilled – we do not know that we do not have this skill, or that we need to learn it.
- Consciously unskilled – we know that we do not have this skill.
- Consciously skilled – we know that we have this skill.
- Unconsciously skilled – we do not know that we have this skill, but we do not focus on it, because it is so easy.

Burch (1970) designed the new model with a figure that illustrates how the data may be interpreted, as presented below.

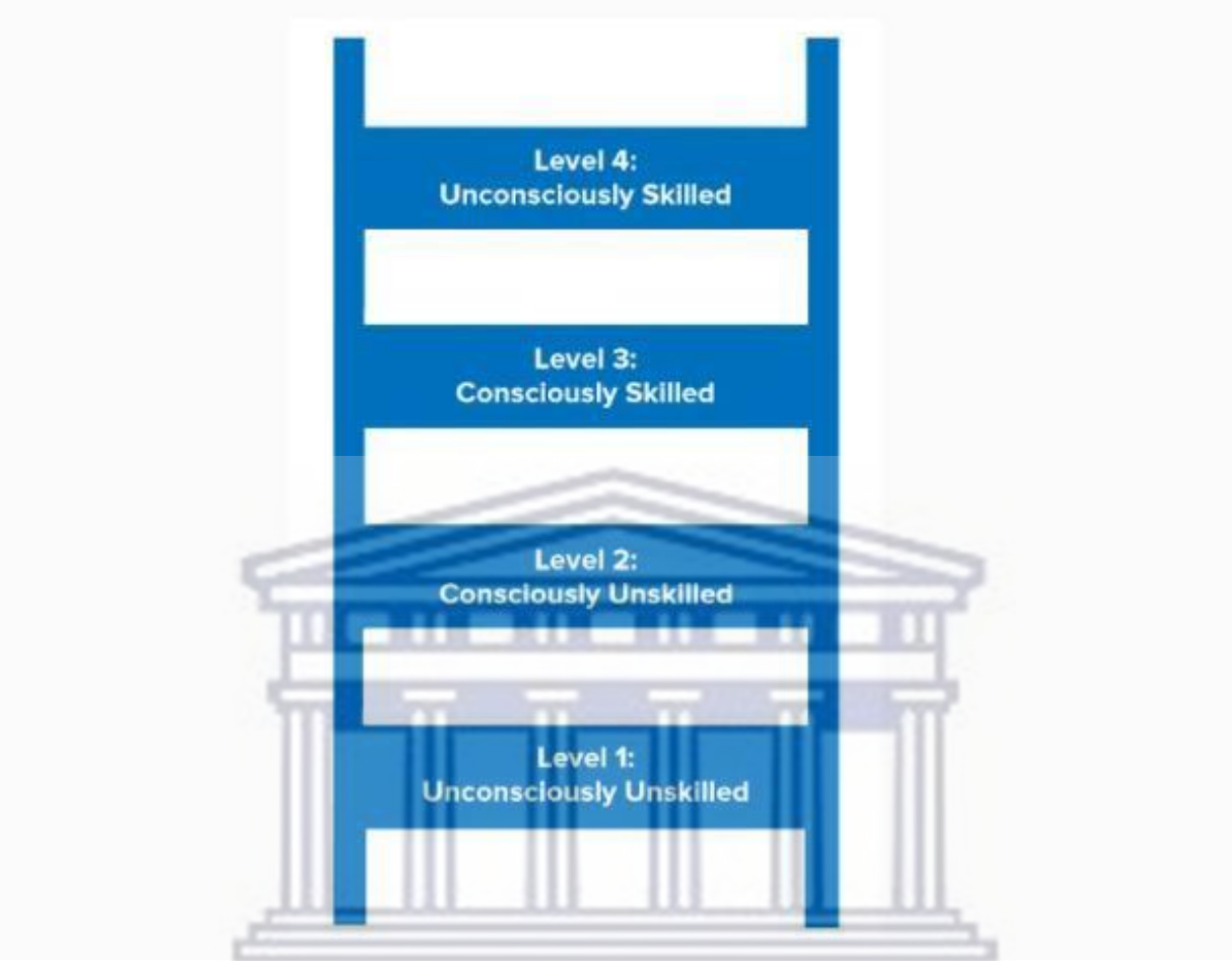


Figure 2.1: The conscious competence ladder (Burch, 1970, p. 2)

The conscious competence model is useful in many different ways. When learning or developing something new, this model prompts the understanding of emotions experienced during the reflective or developmental process (Burch, 1970). The model was designed to recognise emotions and to remain motivated in the development process. In the consciously unskilled phase, one can reassure oneself that, while learning this skill is difficult and frustrating presently, things will improve in the future. And, when one is unconsciously skilled, the model reminds one to value the skills that one has gained, and not to be too impatient with people who have yet to gain them (Burch, 1970).

For teachers, many factors have to be considered, when managing a classroom. These include discipline and effective teaching and learning. Teachers are required to continuously adapt to changes which are constituted by various educational factors (Roberts, Benedict, & Thomas, 2014). Stressful changes can include curriculum and policy changes. Teachers are required to adapt to these specific organisational changes at all times. This requires changes in teachers' educational practices (Bierwolf & Frijns, 2019). The process of change is a comprehensive matter of consciousness and competence (Schratz, 2006, p. 45). The exact inverse of this is unconsciousness and incompetence. The management and leadership of a classroom can constitute an organisational challenge for many teachers (Schratz, 2006).

The role of a teacher is to purposefully view themselves in their professional capacity in the classroom, which directly translates into their learners. Roberts et al. (2014) regard the ability to adapt as a professional trait of teachers. Therefore, the theoretical framework adopted by this study is transformation and change (Thompson & Pascal, 2012). Changes involve the history of education as well as the cultural and paradigmatic educational shifts regarding classroom leadership competence (Schratz, 2006). Bierwolf and Frijns (2019) consider change as a regular process to which humans have grown accustomed. This depends on consciously knowing if change is necessary. In this context, the ironic aspect of change in education is that teachers are often oblivious to the ongoing changes surrounding them. The changes contemplated here are at a macro level. For the purpose of this study, the focus is on the micro level of education, that is, the pedagogical environment. The latter takes the form of the classroom that comprises the interaction between teachers, learners and curricula.

PD constitutes the heart of educational change, because it is a major educational leadership issue (Schratz, 2001; Crawford et al., 2020). Change consists of many stages. It is important to note that everything and everyone has the potential to develop. As staff development became a priority for leadership, many theories regarding education development surfaced. Abend (2019) defines theories as formulations that explain, predict, and understand phenomena that often challenge existing knowledge. Theory, as visually illustrated in Figure 2, identifies the possible problems and their consequences, which are then linked with their solutions and successes. Schratz (2006) and Sonia (2017) note that teachers tend to become fond of familiar habits. These habits include attitudes, behaviours, and reactions that form a zone of comfort. To escape this zone requires tremendous efforts (Schratz, 2006). The systems theory claims that initiating development depends on the determination that the need for change is critical, as demonstrated in Figure 2 below.

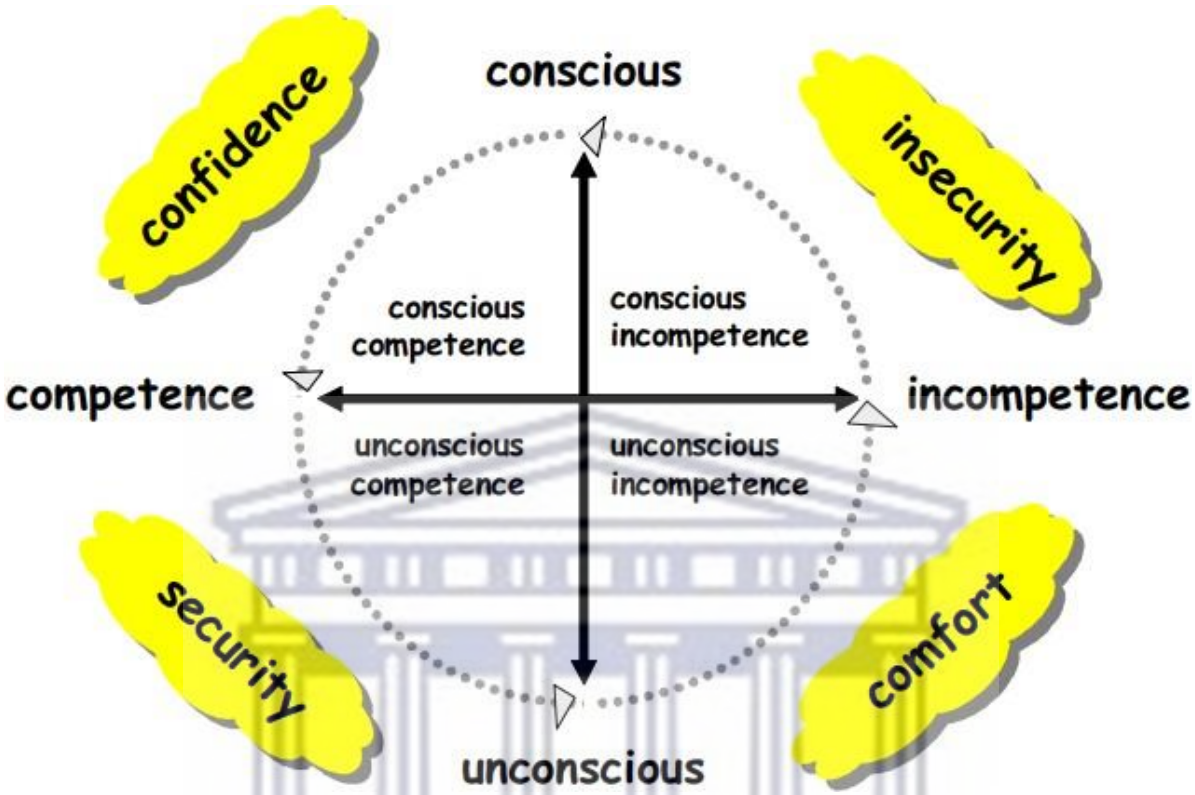


Figure 2.2: From unconscious incompetence to unconscious competence (Schratz, 2006, p. 46)

The above figure illustrates a Cartesian plane whereby each of the four quadrants across the y-axis and x-axis represents something. In this figure, the y-axis (vertical axis) represents the consciousness and unconsciousness, and the x-axis (horizontal axis) indicates competence and incompetence. What is needed for teachers to develop professionally is not always immediately evident to them. Many teachers may feel that change is unnecessary. The current situation in classrooms creates a mindset of safety and security for teachers (Schratz, 2006). For Schratz (2006), the current situation offers more satisfaction for teachers than the possible uncertainties that accompany the awareness of incompetence.

Educational change leads to conflict, and the most deeply-rooted fears become apparent through the attitude of the persons involved (Sonia, 2017). When a teacher possesses confidence but is incompetent, the necessary knowledge, skills, and values first need to be acquired, for this teacher to further develop professionally (Schratz, 2006). Once teachers are consciously competent and confident in their practice, they are particularly helpful in challenging situations (Sonia, 2017). These situations include larger school management team situations, administration in the office, and even classroom challenges involving learner pedagogy (Schratz, 2006). The figure below represents the conscious competence matrix.

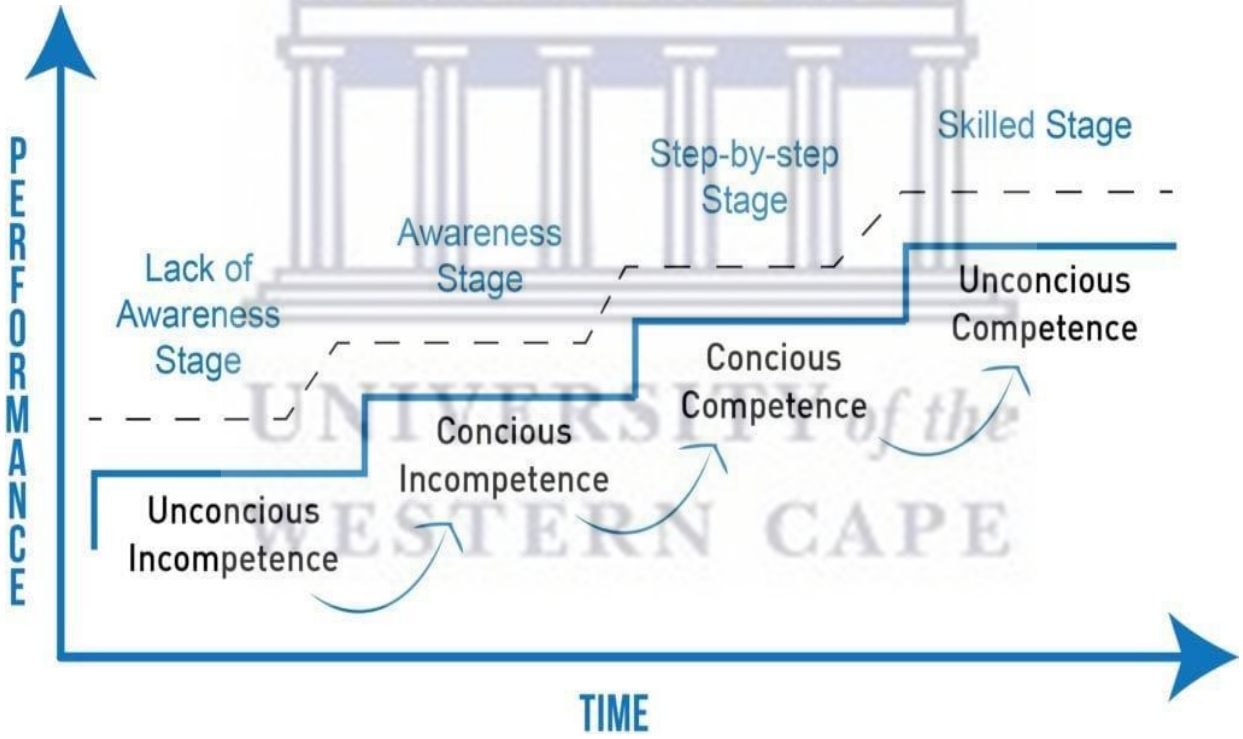


Figure 2.3: The conscious competence matrix (Wilhelm, 2016, p. 49)

The figure below represents the conscious competence model.

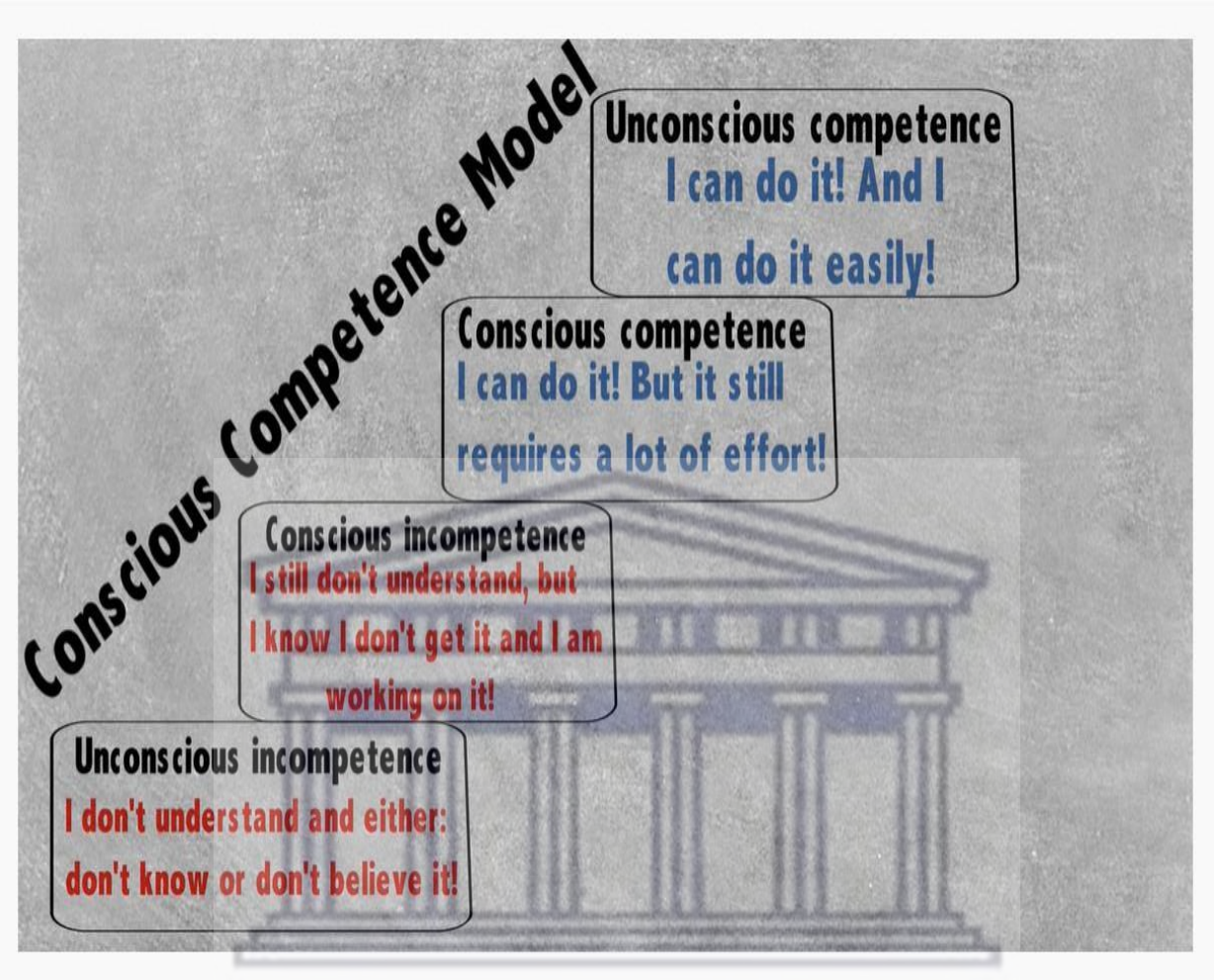


Figure 2.4: Conscious competence model (Talamas, 2015 p. 6)

Wilhelm (2016) used the four quadrants from Schratz's (2006) graph (Figure 2.2) to develop Figure 2.3 above representing the four stages of the conscious competence model in terms of time and performance. This is the development that this study seeks to investigate. Figure 2.4, as presented by Talamas (2015), explains conscious competence. The development starts with a person being unconscious and incompetent (Talamas, 2015). In this stage, a teacher may lack awareness of their incompetence or severely limited competence. Competence refers to skill in teaching practice. Board writing forms part of teaching practice and, therefore, it is an

appropriate example of competence. In the unconscious incompetent stage, the teacher is unaware that their handwriting on the board is off par, as they have not seen the board from learners' viewpoint. The sentences on the board may be written untidily and have become confusing for learners to understand. The second step is the person becoming conscious of their incompetence (Talamas, 2015). In this step, as a teacher becomes aware of their level of incompetence, VSR becomes a tool of reflection. In this step the teacher realises their incompetence concerning board writing through VSR or by viewing the board from the rear of the classroom. At this stage, the teacher becomes conscious of their incompetence in board writing. Between the second and the third step, the person initiates steps to become competent in their practice. This can occur through some sort of feedback report or reflection followed by action (Crawford, Higgins, & Hilburn, 2020). Here the teacher practises board writing while continuously viewing and reviewing it, to become competent. In the third step, a person is conscious of their newly developed competence (Talamas, 2015). This creates a sense of confidence in teachers, as they know their value in terms of teaching practice (Fullan, 2016; Schratz, 2006). Here, the teacher is competent in board writing and tries to maintain this competency through continuous reflection. The fourth and last step is when a person is competent yet unconscious of the new way of doing, because it is a fully developed skill (Talamas, 2015). At this stage, the teacher is competent in board writing without continuously reflecting or trying, because it has become an unconscious skill. This is when a teacher or any other professional has mastered a skill to the point where they do not have to think about it. For Crawford et al. (2020), it is imperative that teachers continuously recognise where they fall in these stages. This is because overconfidence can be detrimental to personal and professional growth.

Newly attained knowledge and skills, coupled with experience, groom teachers who master their craft to the point where they become unconscious of their competence (Schratz, 2006; Sonia, 2017). As professional beings, they perfect themselves and their classroom practice so much so that they eventually see nothing left to improve, as they reflect. Such teachers can develop high levels of self-confidence (Fullan, 2006). In a different scenario, this creates the risk of teachers becoming unconscious and incompetent, as time progresses. Therefore, the ultimate goal teachers should strive for is continuously moving from being unconsciously incompetent to being consciously competent, through reflective practices (Schratz, 2006).

Communication consists of two parts, namely, verbal communication and non-verbal communication (Wedin, 2021). Non-verbal communication consists of gestures, facial expressions, clothing, postures, and head nods or shakes (Gulec & Temel, 2015). Body language is considered as one of the most important modes of communication (Williamson, 2022). More than 50% of our communication is conveyed through body language. For instance, we express approval when we nod our heads; and we express love when holding the hand of another person, all without uttering a single word (Gulec & Temel, 2015). Accompanied with words, body language has the ability to either enhance communication or confuse the target audience. Williamson (2022) underscores that the importance of body language within the classroom environment is exactly the same as in real life, and that body language creates synergy in communication. Gulec and Temel (2015) view body language as a significant part of education and training regarding communication. For them, education itself is one big communication activity. Williamson (2022) discusses certain non-verbal cues that need to be communicated

from teacher to learner. These cues need to convey ‒warmth and empathy‖ in the classroom, for learners to understand that the teacher is approachable, especially regarding an abstract subject such as mathematics (Wedin, 2021; Williamson, 2022 p. 2). Learners' perceived view of teachers' body languages is very important; it steers classroom management and learner achievement (Wedin, 2021).

In consideration of the discussion above, this study proposes a model similar to that described above. Teachers start out unconscious and incompetent (Crawford et al., 2020). VSR, as a tool for self-reflection, can consciously foreground aspects of the teaching practice that need further development. Self-reflection prompts change in teaching practice, to a state of improved competence.

Chapter 2 discussed the literature pertaining to reflection among teachers, self-reflection and its role in continuous professional development. Further discussions in this chapter addressed video-stimulated recall and the teaching of mathematics. The ability for teachers to actively notice in their classrooms was discussed, which directly informs self-reflection. Furthermore, the theoretical framework of Schratz's model of conscious-competence was expanded upon in depth and the stages of conscious-competence were introduced.

Chapter 3: Research Design & Methodology

3.1 Introduction

This chapter focuses on the design of the study and the explanations of the methods used to collect and analyse the data from the participating mathematics teachers, to answer the research questions. It suffices to reiterate that this study seeks to investigate the professional development (PD) of mathematics teachers, using VSR as a tool for self-reflection. The research is guided by the following research questions:

1. How does Video-Stimulated Recall enhance mathematics teachers' self-reflection?
2. How does the use of Video-Stimulated Recall, as a tool that enhances self-reflection, contribute to the improvement of the teaching and learning of mathematics in the classroom?

This chapter begins by explaining the research approach adopted for this study. This is followed by an in-depth explanation of the research design. Subsequently, the chapter elaborates on the observations and recording of lessons, the rigour in the research study, as well as the ethical issues involved. Lastly, the way in which the data were analysed is discussed in detail.

3.2 Research methodology

3.2.1 The research approach

This study was situated within the qualitative research methodology, with an interpretive slant.

3.3 Qualitative research

Qualitative research is defined as a method which focuses on obtaining data through open-ended questions and conversational communication (Jackson, Drummond, & Camara, 2007). Qualitative research leaves room for in-depth and detailed information gained through recorded events, orchestrated interactions, and careful observation of behaviour (Labuschagne, 2003; Sharma, 2013).

Different features of qualitative research distinguish it from quantitative research (Kawulich, 2005). In qualitative research, for instance, the problem should be explored to unpack its cause (Flick, 2018). For Golafshani (2003, p. 601), a good qualitative research study strives to help human beings to understand information that would otherwise be ―confusing‖. Kawulich (2005) states that, in qualitative research, objectives and questions are aimed broadly at participants and their experiences of specific topics. Campbell (1997) observes that, in qualitative research, data collection is based on subjective experiences and meanings assigned by human participants. As such, meaning depends on social and political contexts.

What is more, qualitative research adopts an interpretive approach. The latter is mainly concerned with the centrality of human consciousness (Babbie, 2001). The interpretive approach attempts to separate the social sciences from the natural sciences concerning research (Flick, 2018); it stems from disciplines such as history, philosophy, and anthropology. The interpretive approach recognises how humans make sense of reality and relate meaning to it. Thus, even when encountering new experiences, humans interpret their realities accordingly (Babbie, 2001).

With the introduction of new technologies, participants are allowed to make sense of the role of these technologies in their teaching and learning experiences (Campbell, 1997).

Qualitative research remains necessary, in the pursuit of personal and professional development (Travers et al., 2015). Qualitative methodologies have been at the vanguard of research, with such aims as goal setting (Travers et al., 2015). This goal-setting outlook is motivated by the objective of measuring ongoing changes in performance. VSR allows the researcher and participant to witness and pinpoint changes directly as they occur. The subsequent changes are internally dictated by participants' new goals.

3.4 Data collection and sampling

In qualitative research, data are mainly collected through observation and interviews (Kawulich, 2005; Sharma, 2013). Teacher participants were interviewed in-situ and the video recordings were viewed, afterwards, by the researcher and the relevant teacher. The mathematics teams from each school underwent training, to familiarise them with the entire VSR process.

This study was in two schools situated in a Cape Flats suburb of Cape Town. Both are primary schools administered by the Western Cape Education Department. Convenience sampling was used as the schools were geographically accessible to the researcher. The participating teachers came from different social and educational backgrounds. The four teachers involved in this study were regarded as experienced educators who had in excess of three years of teaching experience. The ages of these teachers vary between 25 and 65 years. Two teachers per school were purposively selected, as only those who agreed to partake in the study were included. Teachers were trained on how to conduct VSR during their lesson presentations. However, with Covid-19 regulations, learners attended schools in smaller groups of 15 to 25 per class per day.

This is because the included schools followed a rotational timetable at the time of the research. This means that teachers might not have taught mathematics to the same group every day, or the smaller classes may have altered the teachers teaching. It is important to note that the possibility of different teaching behaviours may have depended on class sizes (Meier & West, 2020). Data collection consisted of observations and the video recordings of four mathematics teachers' lessons. The purpose of the study was to investigate the effects of VSR on the teachers' lessons. It was used as a tool for teachers to relive their teaching experience from outside their bodies. Each individual lesson recording and related interview were conducted at one-week interval. The reason for this is for participants to have ample time to personally reflect on their lesson presentations.

My initial analysis of the data has assisted me to assess if teachers adapted their teaching behaviours between the first and second cycles of video recordings, as a result of self-reflection. For each participating teacher, two entire mathematics lessons were video recorded. Thereafter, the researcher identified an episode or episodes for the VSR review. The researcher and participating teacher then viewed the video episodes identified, while the researcher prompted the teacher to reflect on why they decided on certain aspects of the lesson. The interviews were audio recorded. The interview questions were not based on any formal guidelines. The questions were based on the specific recordings and trends in each lesson recording. After two weeks, the entire process was repeated. The second cycle was compared to the first one, to assess any changes that might have occurred in the teaching practice. After each cycle of video recordings had been completed, the researcher conducted semi-structured interviews with the participants, to establish if self-reflection was done.

3.5 Trustworthiness

In qualitative research, trustworthiness is of utmost importance, because it is the degree of confidence in a study (Connelly, 2016; Cloutier & Ravasi, 2021). Trustworthiness refers to the confidence in the interpretation and the methods used to ensure the quality of the study (Shenton, 2004). Experts agree that trustworthiness has been and continues to be an important component of research that enables readers to deem the research worthy (Connelly, 2016; Cloutier et al., 2021). Criteria to ensure the trustworthiness of a study are credibility, dependability, confirmability, and transferability. Credibility is the most important criterion of trustworthiness (Connelly, 2016) that can be described as the confidence in the truth of the study and the findings published. The credibility of this study was ensured through continuous engagement with the participants, persistent observation, and notes made during the observation. Dependability, which is the second criterion of trustworthiness, refers to the stability of the data over time and the conditions of the study (Connelly, 2016). The stability of the conditions does, however, depend on the nature of the study. To ensure the dependability of this study, regular evaluations of the conditions were undertaken, specifically between the two data collection sessions. The third aspect, confirmability, relates to the degree to which the findings should be consistent, even if data collection was to be repeated (Shenton, 2004). In qualitative research, as is the case with this study, regular logs of important decisions were kept on record and discussed with an experienced and respected qualitative researcher, the supervisor (Connelly, 2016). This was done for the purpose of feedback (Cloutier et al., 2021). In this study, the supervisor monitored the entire data collection process and was in contact with the researcher, to ensure confirmability. The last factor contributing to trustworthiness is transferability. This is the degree to which the findings of a study are useful in other settings (Connelly, 2016). Transferability is dependent on the beliefs of the readers of the study, or those of the practitioners to whom the findings of the

study may be applicable, in their own settings or contexts (Shenton, 2004).

3.6 Data analysis

According to Campbell (1997), data analysis involves a number of steps. These include the sifting and examination of raw data. Data collection is highly reliant on the research methodology chosen (Sharma, 2013). For instance, part of the methodology of this study was interviews. The latter constitute an instrument commonly used in qualitative research (Sharma, 2013). The analysis of the data, to generate the results of the study, involved grouping the categories into themes and comparing them to existing databases (Sharma, 2013). With these identified themes, data no longer remains raw.

Flick (2018) argues that data collection and analysis should occur simultaneously rather than separately. This allows congruency between the processes of collection and analysis because, in qualitative research, they are required to interact (Flick, 2018). During this joint process, interaction is the main instrument used for extraction. The interaction between the researcher and the participant is important. When the data are analysed, the researcher generates concepts and themes that help to examine the data within the study (Flick, 2018). In this study, data were partly collected and analysed simultaneously.

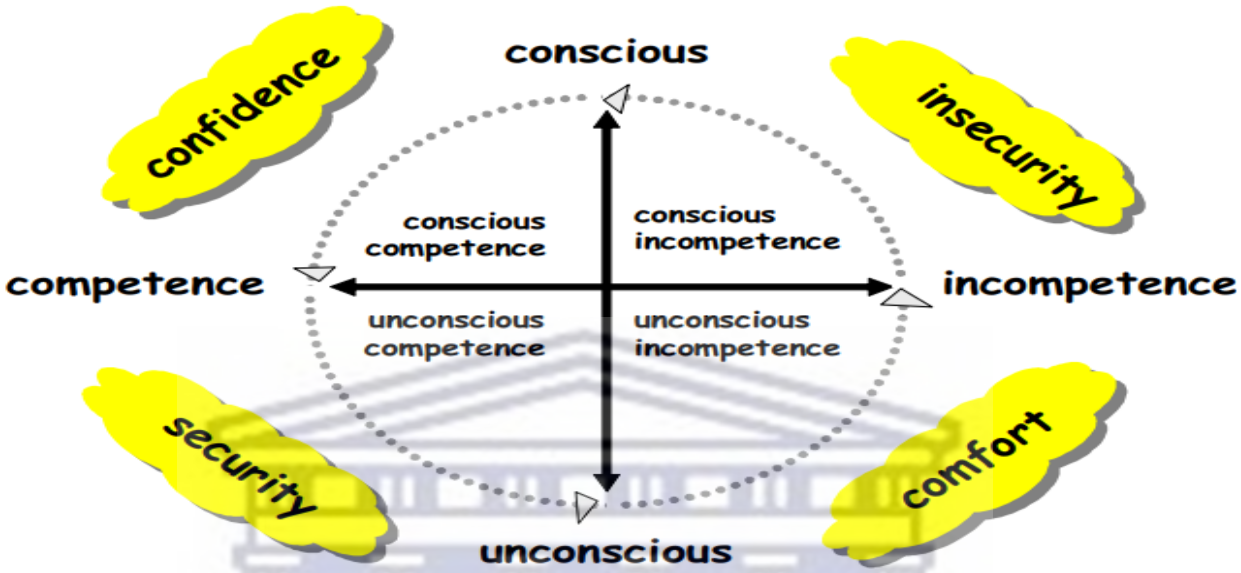


Figure 2.5: From unconscious incompetence to unconscious competence (Schratz, 2006, p. 46)

According to the Figure 2.5 above, we will use the different stages to analyze data. During data analysis, the four stages of *the conscious competence matrix* were considered (Wilhelm, 2016). These stages are unconscious incompetence, conscious incompetence, conscious competence, and unconscious competence. While a lesson was being conducted, an observation was done by the researcher to collect data and note down additional information observed in the lesson. During the first video observation, the participants noticed aspects in their teaching practice that needed further development. When a teacher noticed an aspect/skill in their teaching that was not developed and which s/he was not aware of before, that needed development, that aspect/skill would fall in the conscious incompetence stage (stage1) of development. During the next video observation, the researcher analysed the lesson to determine if the participants changed the identified aspect/skill in their teaching practice. If the teacher acted upon the noticed aspect that

needed development and improved it, the teacher then moved to the conscious competence stage (stage 2) of performance in that aspect/skill. If a teacher became aware and took action to develop an aspect/skill of their teaching practice, they moved in the conscious competent stage (stage 3) of performance in that aspect. If a teacher was unaware and continued improving and maintaining this aspect/skill in their teaching practice without additional effort, they moved to the unconscious competent stage (stage 4). Observation happened with each video recording. In this study, eight observations of video recordings were undertaken – two teachers in each of the two schools were each observed twice. The teachers' levels of consciousness and competence were measured through the observation and the viewing of tapes, afterward. Consciousness was analysed through audio-recorded interviews, and competence was measured though the viewing of the videos. To measure the participants' consciousness, suitable interview questions were set, probing the participants' teaching practice.

3.7 Ethical considerations

Ethical codes dictate what is deemed acceptable and unacceptable in specific contexts (Resnik, 2015). The behaviours of researchers are regulated by certain ethical codes that provide guidelines. These guide researchers on how to deal with potential problems during research and outline codes of professionalism to be followed (Resnik, 2015). Ethical norms are taught in various social settings. Thus, ethical considerations provide a set of moral guidelines that regulate actions, professions, and institutions (Resnik, 2015). Resnik (2015) further emphasises that these ethical norms apply to scholarly activities such as writing and data analysis. These ethical norms solidify the aims of research, to present knowledge and truth, and to avoid unnecessary errors (Resnik, 2015).

For this research project, permission and approval were sought from the University of the Western Cape (UWC) and the Western Cape Education Department (WCED). The four teachers approached to participate in this study were asked to complete written consent forms before their involvement in this study. The schools, teachers, parents and learners were thoroughly informed about the aims and objectives of the research project and were not forced to participate. This was achieved by giving all the participants information letters about the study. All the participants were informed that they were free to stop participating in the study, at any time and without any negative consequences.

For Latha (2020), privacy plays a critical role concerning moral codes and ethics. Although privacy has an unsteady foundation in philosophy, it is accepted as a legal and moral notion to be adhered to (Latha, 2020). In research, the privacy of the participants must be ensured at all costs. Data collected should be safely stored and only be accessible to the researcher. Therefore, the responses of the participants should be kept confidential, and the participants should remain anonymous. Confidentiality is ensured by controlling the access to the data collected. In this study, the participating teachers remained anonymous as they were represented by a number and/or letter. This allowed these teachers to answer questions freely and reveal their feelings or opinions on the implementation of VSR as a reflective tool in their mathematics classroom practice. Upholding the rights and privacy of teachers in schools, when conducting observations and interviews, is paramount. The data collected as part of this research will be discarded after five years.

Chapter 3 firstly discussed the research approach and how the qualitative research paradigm was

used to collect and analyse the collected data in this study. The background and geographical area of the participating schools were also introduced in this chapter. Chapter 3 further discussed the instruments used to collect data for this study as well as the ethical considerations. Lastly, it discussed how data was sampled and stored and how trustworthiness would be ensured.

Chapter 4: Data Analysis

4.1 Introduction

This chapter provides an analysis of the data obtained through the video VSR interviews and the lesson observations conducted with the four teachers in the two schools that formed part of the study. The data analysis aimed to answer the following research questions: (i) How does VSR enhance mathematics teachers' self-reflection? And (ii) How does the use of VSR as a tool that enhances self-reflection contribute to the improvement of the teaching and learning of mathematics in the classroom? The conscious- competence model designed by Burch (1970) and adapted by Schratz (2006) was used as theoretical framework to guide the data analysis in this study. This theoretical lens was used to analyse the participating teachers' responses (self-reflection) to their recorded lessons. The interpretive approach was used to analyse teachers' responses during the VSR interviews. I begin by elaborating how the framework was to be used to analyse the collected data. This involved working forward and backward between the lesson observation and the interviews. The video recordings of the lessons were done by the researcher, who subsequently viewed the recordings. Thereafter, a VSR interview took place where the teacher watched his/her entire recorded lessons with the researcher. After that, the researcher prompted the teacher to reflect on his/her lessons. The interviews were audio-recorded and transcribed by an external party, to ensure an accurate capturing of the interviews. The interviews were analysed thematically, using Burch's (1970) lens. Throughout the analysis, evidence of the way in which the framework was applied to analyse the self-reflection and possible PD that occurred was provided. The analysis section started by providing the profiles of the participants. Then, it proceeded to analyse the data under the following themes that

immerged from the data:

1. Time management
2. Lesson management
3. Body Language
4. Board writing
5. Tone of voice
6. Usefulness of VSR

4.2 Profiles of Participants

Participant profile table:

SCHOOL 1	
Teacher D Teacher D is a male teacher who teaches mathematics in School 1. He holds an Honours degree in mathematics education and aims to pursue his master's degree in the near future. Teacher D has 20 years of teaching experience. This teacher's Grade 6 mathematics class was video-recorded. Teacher D claims to be	**Teacher G** Teacher G is a female teacher who also teaches at School 1. She holds a master's degree in music, where her interest is. Teacher G has 28 years of teaching experience. Her Grade 7 mathematics class was video-recorded. Teacher G also teaches extra-curricular mathematics classes after school and on

passionate about mathematics teaching and learning. Teacher D presented a mathematics lesson on measurements, in which he explained the different types of instruments and units used. In his second video-observation lesson, Teacher D covered the area and perimeter of 3-Dimensional objects. He used many props and practical examples. The learners in this Grade 6 class were approximately 22 in total.	weekends, for extra income. Teacher G introduced the area and perimeter of circles at Grade 7 level, a new concept that the learners appeared eager to learn. For the second lesson recording, she introduced and revised shapes with her Grade 7 learners. Both recordings were introductory lessons.

SCHOOL 2	
Teacher O Teacher O is a relatively young teacher, with 5 years of teaching experience. She is a female teacher at School 2, which is situated in the same area as School 1. At the time the study was conducted, she was busy with her Honours in mathematics education. Her Grade 6 mathematics class was video-recorded.	**Teacher V** Teacher V is also a young female teacher employed by School 2. She holds a Bachelor's in Education Degree. This teacher has no desire to pursue postgraduate studies. She has 9 years of teaching experience. Teacher V currently teaches Grade 4 mathematics, the class that was video recorded. Teacher V did

Teacher O tutors mathematics in her spare time. During the first round of recording, Teacher O did 2D and 3D geometry with her Grade 6 class. In the second video recording, Teacher O introduced the area and perimeter of 2-Dimensional shapes to her Grade 6 class.	her first recorded lesson on different types of fractions, with her Grade 4 class. During the second lesson recording, she covered time and different time zones, with the same Grade 4 class.

4.3 Foundation for data analysis

The analysis of the data was undertaken to assist in answering the research questions that guided the study. The first research question was: How does VSR enhance mathematics teachers self-reflection? the second research question was: How does the use of VSR, as a tool that enhances self-reflection, contribute to the improvement of the teaching and learning of mathematics in the classroom? To answer these research questions, the observation of the video recorded lessons and subsequent interviews with the participants were used. The facial expressions and reactions of participants, which were documented by the researcher during the joint video observations, formed part of the data that were analysed. The following themes arose during the data analysis process: time management; lesson management; body language; board writing; tone of voice; and usefulness of VSR.

4.3.1 Time management

Time management is the effective and productive use of time, which most teachers strive to achieve (Weber et al., 2018). During the data collection process, most participants noticed this as an aspect that needs improvement in their lessons. The first concern Teacher D noticed, during the lesson, was his time management. Teacher D stated:

> *I noticed that I might, when learners are given a chance to write things down, I might be… too in a hurry to carry on with the lesson and not wait for learners to first complete…* (Teacher D, Interview 1, 2021).

Watching his video-recorded lesson assisted Teacher D to enhance his self-reflection. This was evident when he observed that his time management showed room for improvement. It seems that he did not previously pick this up. Teacher D noticed and revealed the issue of time, in his lesson, as a factor that negatively influenced his teaching and learning. Learners were not given enough time to make notes, they were rushed to listen to the discussion that followed. Teacher D noticed this as an aspect that negatively affected teaching and learning. He attempted to remedy the situation during the second lesson recording. In interview two, Teacher D addressed the issue. He stated that:

> *...I gave the learners things to write down, yes, and I actually walked around and gave them a chance to complete. That was an improvement on the last lesson as well* (Teacher D, Interview 2, 2021).

This provides empirical evidence that Teacher D addressed the time management issue in his classroom, with the assistance of VSR, to improve teaching and learning. After interview one, Teacher D was in the conscious-incompetent stage, regarding his time management. This is because he became aware that his time management needed to be improved because his learners did not complete copying the notes from the board. However, after interview two, it appeared that the teacher moved to the conscious-competent stage with regards to his time management. This was evident when he allowed the learners more time to copy work from the board. At this stage, Teacher D was consciously moving around in the classroom. He provided more time to the learners, to enable them to copy their notes and possibly absorb new information. There were

signs of improvement in his teaching and therefore a better chance for learners to have copied the work in their books, to be used for revision and assessments.

Teacher G viewed her video and realised that time wastage with the old green chalkboard she had in the classroom. She commented that an interactive whiteboard would be a real timesaver (Teacher G, Interview 1, 2021). Teacher G stated:

> *I think the emphasis should be on the teaching…The emphasis should be on learning and with what we're doing at the moment. I spend time drawing and stuff whereas one never thinks that that split second would make a difference, but adding all those split seconds up, it could be three or four minutes of your time and that's a long period of time, you know. Four minutes is long* (Teacher G, Interview 1, 2021).

Teacher G realised that her time management in the classroom could be improved through the incorporation of technology. She identified technology as an avenue that would ensure that drawings are done in advance and not during the lesson. This would save time and allow for more opportunity to focus on other aspects of the lesson. She perceived her current non - incorporation of technology as an incompetence and possible developmental area. Teacher G did not include this point of interest (incorporating technology to free up time for other things) in Interview 2. However, from the researcher's perspective and video recording two, it seems that this challenge was addressed. Teacher G planned her time and stages of the lesson better. These stages encompassed the ice breaker/instruction, body, and conclusion. Learning materials were distributed swiftly and less time was wasted writing on the board. It is evident that VSR assisted the teacher to be more aware of her time management and act to enhance teaching and learning. Thus, the teacher can be perceive as having become conscious incompetent, after the first lesson

observation, as she noticed her incompetence. Furthermore, the researcher observed signs of improved time management. This means that Teacher G was leaning towards the next stage of competence and, in the process, improved teaching and learning through better time management

Teacher V noticed her improper time management. She used the mathematics apparatus for her lesson on fractions. She distributed charts and building blocks to learners as part of her lesson aids. She stated:

> *Also, to save time while I am handing out everything, I would prefer the learners to rather prepare their apparatus because we were working with fractions and they had to assemble all their fractions together in the form, the necessary form or needed form and that actually took quite a while. So, while I was maybe preparing mine, putting mine on the board, I would have maybe first handed out my kids" apparatus and let them do the same activity while I was doing it* (Teacher V, Interview 1, 2021).

Teacher V became conscious of her incompetence relating to time wastage in the classroom. In Interview 1, she commented that the distribution of worksheets, the use of the mathematics apparatus, and board writing should be done more synchronously. During the second recorded lesson, Teacher V tried her best to manage time better. In the video Teacher V did not waste time distributing the apparatus and writing on the board. This increased her teaching productivity. However, she admitted that her time management did not go according to plan. She stated:

> *Obviously, I would have wanted to save time because I went over time firstly and, but that's teaching. Nothing goes according to plan firstly and secondly also that the time you set out to teach a specific topic or concept are not always met*

(Teacher V, Interview 2, 2021).

Teacher V remained aware of her time management challenge. For her, it remains an ongoing issue which she intends to address effectively. Teacher V was in the conscious-incompetent stage and moved to the conscious-competent stage, to a certain degree.

After a third lesson observation and an interview were conducted, Teacher V noticed that even her second lesson seemed rushed. For her, it seemed rushed regarding mathematics teaching and learning. Teacher V added, during interview 3:

> *I think I should have structured it a bit better. Maybe, I should have just put it over two lessons or three lessons even because it is a very interesting lesson to have. However, it's definitely something you need to spend time with, and it's a, it's a timely lesson because of having to hand out the apparatus, but if you spend enough time to lay the foundation right then you don't have to come back and repeat it because the learners will have an understanding* (Teacher V, Interview 3, 2022).

The above is an important consideration, because this is Teacher V's point of view one year after interviews one and two. Teacher V noticed and reflected on what she missed during the previous interviews. Teacher V previously noticed that time management was a shortcoming, yet she did not notice it to this degree. She proposed to rather stretch the same lesson over two or three periods, to improve learners conceptual mathematical understanding of time, which was covered in lesson one. In this instance, VSR assisted Teacher V, on three different occasions, in terms of self-reflection and potential enhancement of the teaching and learning of mathematics, if time management improvements are made. Teacher V is in the conscious-incompetence stage, aiming

to move towards the conscious-competence stage.

4.3.2 Lesson management

During Interview 1, Teacher D reflected upon his lesson and disclosed many noteworthy facts about his noticing. Teacher D noticed that "*the learners were actually quite interactive… (some) were aware of some of the concepts*" (Teacher D, Interview 1, 2021). He noticed that learners "*had some background in the knowledge that (he) was trying to get across*" (Teacher D, Interview 1, 2021). VSR, highlighted some of the positive aspects that Teacher D noticed and reflected on regarding his lesson. Through this specific reflective session, his noticing provided him with the building blocks. These positive aspects show that he is consciously competent.

Teacher D disclosed another issue that he noticed, namely, his lack of awareness in the classroom. He stated: "*I'm not always aware of what everyone is doing*" (Teacher D, Interview 1, 2021). VSR provided the opportunity for him to see what he was aware of during the live lesson. Teacher D noticed that: "*I missed someone's hand that I didn't notice*" (Interview 1). Teacher D continued:

> *I went and I helped someone else. I didn't even notice that child that put up his hand. And then put it down but they didn't put it up again. So obviously they needed help but because I didn't notice them they didn't respond again. Oh, OK. So, for me to be (a) little bit more aware of uh, when I'm in the class my focus shouldn't be as narrow. I should try and widen my focus* (Teacher D, Interview 1, 2021).

During this interaction, the teacher transitioned from being unconscious-incompetent to becoming conscious-incompetent, with respect to noticing learners seeking his attention. During

the live lesson, when the video was recorded, I saw that the learner's hand was raised for 6 minutes, and the teacher did not notice it. During the video lesson observation, the teacher was ashamed when he first observed this learner's hand that he initially missed. Before the video observation, Teacher D was unconscious of his incompetence in this matter. After the video observation, Teacher D reflected and became conscious of his incompetence. He proceeded to address the issue. Teacher D reflected:

> *…I think the thing that really caught my (eye was) where I can improve (on), was if I ask a question. I notice my learners, those that know (and) often shout out andI didn't stop them and ask for hands (to be raised). And I think that's a major area in which I can improve on* (Teacher D, Interview 1, 2021).

Overall, Teacher D was pleased with the interaction during the lesson. He did, however, notice one issue. The interactions between him and the stronger learners were good and, to a certain extent, they obscured the interactions between him and the weaker or struggling learners. Teacher D revealed that he was in a comfort zone whereby it was

> *easier for (him) to teach and to allow those that know to answer, because then the lesson flows*. He continued: *… I think I have to take more control in that area. Don't shout out, put up your hands and then because that will allow me to see the ones who are not raising their hands* (Teacher D, Interview 1, 2021).

The video observations allowed Teacher D to self-reflect and come to the realisation that, because some learners answer, it does not mean the rest understand the content (Teacher D, Interview 1, 2021). With this realisation, Teacher D reflected and understood what needed to be done, to enhance mathematics teaching and learning.

Teacher G pinpointed one positive aspect of her lesson. She said the lesson was *–definitely positive‖* (Teacher G, Interview 1, 2021). This is positive in a sense that it can be built upon. Teacher G is able to build forth on this success, to improve future lessons. Teacher G boasted:

> *I think that those kids were captivated. They were not distracted in any way. Their attention span actually kept for the full half an hour* (Teacher G, Interview 1, 2021).

Teacher G reported that the communication between herself and the learners was on par. In the video, it can be observed that Teacher G tries to extract answers and existing (prior) knowledge from her learners. The learners responded very well to Teacher G by answering her questions and providing information without wasting. Through VSR, Teacher G reflected upon a good factor of the lesson that can be sustained and developed further.

Teacher G reported that her overall lesson went well. She acknowledged that there were *"certain things I picked up that I could improve on*" (Teacher G, Interview 1, 2021). In the second cycle of observation and interviewing, Teacher G reported to have reflected upon her entire style of teaching. She stated that her lessons had been reworked and were "*completely new*" (Teacher G, Interview 2, 2021). She described her first lesson as dull. She elaborated on what she changed in the second lesson thus:

> *I made use of placards which I made…I made use of my tab (handheld tablet) … it served its purpose, it got them interested in the song that was playing, although they couldn't view all the shapes perfectly on the screen, I decided to make big shapes so that they could be(visible). They could relate to what was going on the tab. song and for the lyrics for them to realize that songs can be used in learning as well. And even yesterday they were still singing the tune (Mathematics study*

> *tune). I find when you used visual apparatus the kids are really locked into your (lesson), because they were interested* (Teacher G, Interview 2, 2021).

Unlike in lesson 1, Teacher G made an attempt to visually stimulate learners by using *–contrasting colors‖* so that *–their mind could be fixated on that specific figure‖* (Teacher G, Interview 2, 2021). Here, Teacher G became conscious of a potential gap in developing learners' mathematical knowledge and endeavoured to enhance it through including visual stimulus. Teacher G further tried to include audio stimulation, when teaching mathematics. Teacher G became conscious and implemented her knowledge and music background to teach mathematics to her learners. During lesson 1, Teacher G reflected and became conscious of her incompetence. Teacher G remarked:

> *the pop music around you, you sing and you know those words so well, I wish you could learn your school work like that…I looked for a few songs on YouTube and I found this specific one and they really engaged with it* (Teacher G, Interview 2, 2021).

As mentioned before, Teacher G holds a Master's degree in music. Upon watching the lesson recording, she reflected and became conscious of the possibility to incorporate music into her future mathematics lessons. During the second lesson, she tried the incorporation of music into her lesson. This was positively received by her learners who thoroughly engaged and enjoyed the lesson. The observation enabled Teacher G to notice an opportunity to incorporate music to change the atmosphere in her classroom, creating an atmosphere that could better enhance teaching and learning. This is something she claimed she had never done in the past, as she never realised that it might be beneficial, before observing herself in the video recording.

Teacher O noticed some upsides to her lesson. One positive thing she had noticed was her lesson outcomes being reached. She stated: "*I've achieved my aim…for that specific period*" (Teacher O, Interview 1, 2021). She continued:

> *I found that they understood what 2D forms are. I felt the way I have explained it was good. I found it great that I went to the desks actually to see what they were doing and if they understood it like I've explained it. I felt my pace was good and my knowledge of the subject was good* (Teacher O, Interview 1, 2021).

Recognising the positive attributes of one's lesson is important. Teacher O recognised this and was able to build forth on it. In this case, it was continuously reaching the planned lesson outcomes. After reflection, Teacher O was in the conscious-competent stage.

Teacher O further noticed aspects of the lesson that needed improvement. First, Teacher O noticed that there was limited interaction between her and the learners. She stated that *–there wasn't really much interaction‖* (Teacher O, Interview 1, 2021). She further suggested that:

> *They weren't really interested in the topic. They were not; they were just ready to write from the board and not wanting to interact* (Teacher O, Interview 1, 2021).

Teacher O noticed, on the video, that their interaction was not as she would have wanted it to be. She became conscious of her incompetence to nurture good interactive behaviour in her classroom. Teacher O further elaborated on what she noticed about the lack of interaction and how it altered her mood. She confided:

> *My mood changed after their (non-)interaction, after I saw their mood. So, beginning of the lesson, I feel I was ready for it. I was, I was in a great mood to*

> *start the lesson, but I mean after they (learner), they didn't (respond). They weren't interested. So that made my mood (to) go down* (Teacher O, Interview 1, 2021).

Here, Teacher O found herself in a situation where she allowed the lack of interaction to steer the trajectory of the lesson. It is evident in the video that Teacher O started the lesson enthusiastically and ended it unenthusiastically. However, her body language and her presentation changed, as she improved her interaction with her learners as well as overall classroom engagement during lesson 2. She became conscious of her incompetence in classroom management, specifically in terms of lesson presentation and enhancement of learner interaction. During the second round of video observations, Teacher O noticed a better classroom interaction. She stated that learners "*had more confidence*" and that their interaction with her was on point. She further suggested that: "*if I was a learner in the class, I would have understood everything*" (Teacher O, Interview 2, 2021). This classroom interaction is one area that Teacher O improved on immensely by altering her presentation. Teacher O became conscious-competent in creating an interactive classroom environment that evidenced an improvement on the first round of video recordings. Teacher O reflected upon her classroom management and made adjustments to enhance the teaching and learning of mathematics. During Interview 2, Teacher O remembered something interesting regarding the first lesson. She contrasted:

> *Previous lesson, uh I asked the learners. I specifically asked a specific learner, because if I just ask randomly then they (are)… too shy* (Teacher O, Interview 2, 2021).

Teacher O then indicated that she had changed this in the second lesson. She claimed that in the second lesson, she "*pointed out learners"* who had to respond to questions, which made the

interaction more efficient (Teacher O, Interview 2). Teacher O altered her presentation by choosing to communicate and ask questions to specific learners, rather than waiting for learners to answer her. Teacher O changed the dynamics of the interaction in her second lesson, which had a positive impact. This is because the learners were notably more interactive in the second lesson, compared to their engagement in the first video recording. Teacher O described the communication during the first lesson thus:

> *The communication…I do most of the talking. I"ve seen, I think I need to maybe allow them to communicate with me more and so I can know, do they understand? I see I didn't ask them. In the, like in the middle I just went on with my lesson. I didn't stop to ask; Is there anything that anyone wanted to ask? So yeah, I think I need to work on the communication skills, Teacher/learner communication* (Teacher O, Interview 1, 2021).

In the first video lesson observation, Teacher O became conscious of herself speaking too much during the lesson and not providing learners the opportunity to speak. Her lesson was teacher-centred. The teacher asked herself, during the observation, if that may be the cause of the lack of interaction, as discussed earlier. Teacher O reflected and consequently questioned if learners understood the content presented, after noticing this problem. Teacher O intends to continuously attempt to rectify this incompetence to enhance the teaching and learning of mathematics.

During lesson interview 2, Teacher V claimed to have reflected to a point where she had to *–change (her entire) strategy‖*(Teacher V, Interview 2, 2021). Teacher V noticed some good things that occurred in her classroom. She boasted:

> *Most of my learners interacted. I thought that maybe they'll be a bit shy with the*

> *camera in the class, but they were interacting well. They all understood, if a learner didn't understand, we would pause and help or assist the learner. But I think overall, they understood quite well. There was a good interaction, even my learners, that are more quiet or shy even they interacted and I feel like um, in the past what I have noticed…* (Teacher V, Interview 1, 2021).

Teacher V reflected upon the good that occurred within her lesson. She continued:

> *I'm actually quite satisfied with the lesson; however, there were a few things that I picked up on because there's no such thing as a perfect lesson* (Teacher V, Interview 1).

From the video lesson observation, Teacher V was quite shocked by a few things she saw in the lesson. She became conscious of a few areas of incompetence within her classroom, as articulated below:

> *So, the first thing was um because it is a new word, new mathematical word and it's quite a long word and a difficult word to pronounce. I would prefer leaving the word on the word board um, word wall for the learners to become familiar with* (Teacher V, Interview 1, 2021).

During the video observation, Teacher V noticed that she removed important things from the board prematurely. New mathematical key words were introduced to learners. These mathematical words included fractions, numerators, denominators, equivalence, and improper fractions. She did not allow learners to familiarise themselves with these new mathematical terminologies. For her, this had a direct impact on the learners from this Grade 4 class. Teacher V pondered:

> *(In addition) Maybe I should use different wording, because that now makes a learner feel maybe scared to-to interact or say if they don't understand anything or I should just not even say that that is what I'm going to do and just stop and maybe ask a few questions to make sure instead of just asking "do you understand?" cause maybe the learner is completely confused and doesn't even understand what's going on that they're not even realizing that they don't understand* (Teacher V, Interview 1, 2021).

Here, Teacher V seemed to experience conflict within her mind. She became conscious of her incompetence in terms of questioning techniques. She pondered on what she should do, as she was very unsure and uncertain how she should address this problem. She realised the need to ask specific questions in future lessons. She saw that her presentation and the wording structure used did not work for learners, as these left them very confused. After her presentation, she gave learners an activity. Walking around the desks, she discovered that many learners did not understand, even after she asked them numerous times if they understood the new concepts. That is a conscious incompetent level that this teacher was at, she did not know what to do regarding this incompetence. During the second lesson recording and related interview, Teacher V attempted to remedy the situation. In Interview 2 she explained:

> *I used scaffolding but I had to give too much of a structure for them and guide them too much to the answer, whereas I wanted the answer from them…I normally ask them, just to see if my learners are still with me… I didn't get the response I needed. So, it is definitely something that will still be worked on* (Teacher V, Interview 2, 2021).

Teacher V attempted to improve the interaction between her and the learners by using

scaffolding. It showed improvement from the first lesson recording. The interaction was a bit better, as learners interacted more confidently. Teacher V was still not content with it. She felt that the interaction could have been even better than it was. Teacher V remained conscious of the communication incompetence, and, to a degree, she had become confident in her ability to steer the lessons to enhance teaching and learning. She aimed to improve the interaction between herself and her learners even more. During Interview 2, Teacher V made a noteworthy revelation. She stated:

> *I was busy teaching "time". The kids had the apparatus with them. I"ve taught it the same way for many years. In the past the kids always understood, and they got the concept. But this time I had to go back to go back to basics where I-...I had to just change my whole lesson plan. I actually didn't use the apparatus because it seemed like it was confusing me and I had to use like a more visual thing on the board* (Teacher V, Interview 2, 2021).

With regards to the mathematical apparatus, Teacher V added, during Interview 3:

> *You automatically just learn it (Mathematics) better. I can draw a picture on the board, well it's not the same, but when you have the apparatus in front of you, you have a 3D object in front of you and automatically you can see what needs to happen and what happens when you work with it. So, we have kids that learn, that are visual learners, but we also have kids that are more practical. So, it's important to have apparatus* (Teacher V, Interview 3, 2022).

Through VSR, Teacher V reflected to a large extent and changed her entire lesson structure. All her years of teaching, she realised the need for the apparatus in every mathematics lesson.

During the observation of the recorded lesson, she decided against it. She decided that the apparatus should be used in specific lesson times and topics. Hence, she decided to do the illustrations on the board.

During Interview 3, Teacher V noticed things in her lesson that otherwise went unnoticed in the first two lesson observations and related interviews. Teacher V noticed that she could have done the mathematics lesson introduction differently. When asked, Teacher V responded:

> *Yes, I do…maybe if I stretched the lesson over two sessions or two periods it would have worked better and then maybe like just ice breaker with the… with either item that I cut, maybe like a piece of cake that I cut and then an apple that I cut into parts, the object size is exactly the same, but then the cuts are maybe more in the one and less than the other, and then I compare the two and then the kids have to tell me are they equal to each other or not, like when you're talking about the pieces. So, that would have been a nice icebreaker to have, but unfortunately, I didn't do that and I think it would also have gotten the kids attention, the learners" attention, and also maybe for them to engage better but, yeah. an icebreaker would have been nice because that would have gotten, that would have catched them off guard and I think that would have gotten them to engage better, just to create a better atmosphere in the class* (Teacher V, Interview 3, 2022).

Teacher V viewed lessons one and two and concluded that both her lessons started drearily. She figured that the solution to this was a nice and interactive icebreaker. In this specific segment, she mentioned the ability of an icebreaker to improve the atmosphere and engagement in the

classroom. Teacher V also believed that it would capture and keep learners' attention during the lesson. Teacher V further discussed the icebreaker's potential ability to improve learners' mathematical understanding of both time and fractions. She explained:

> *Brainteaser, especially because it's math. Something that they wouldn't expect… two pieces of or like, say the one cake is cut into eight pieces and the other cake is cut into four pieces. But now they maybe think that the more cuts the bigger pieces, but then when I put the two next to each other, then they see that it actually is the same equivalent or it's the same size. So, that would have been a nice interaction or nice icebreaker, and then you can maybe even tell them whoever gets the answer right they can have a piece of cake at the end of the period or in break time, so that would have been a nice ice breaker, I think would have made the lesson more interesting* (Teacher V, Interview 3, 2022).

Teacher V moved from the unconscious-incompetence stage to the conscious-incompetence stage, in terms of lesson introductions, when she realised that a brainteaser might be an important missing link in her mathematics lesson. Above, Teacher V explained how the inclusion of a brainteaser in the lesson introduction could have improved learner engagement, the lesson atmosphere, and learners' overall mathematical understanding.

Teacher V further reflected on a positive aspect in her lesson. Upon reviewing her lessons for a third time, she reflected and became conscious of a competence which she planned to sustain and improve on in future. Teacher V explained:

> *So, it was an Afrikaans lesson. So, the E was for Ewe… the E would be for Even, so that you know that the two will be an even amount. So, say it is, 4 eighths*

would have equal a half, you know, so the E stands for Even, so it's Even. It will equal, it will equal each other out. It will just be equal to one another like that so you can play on words. Something that's familiar with the learners and I do that, I tend to do that a lot in math because sometimes it's difficult for them to remember the rule, but if they can relate the rule, or they can connect the rule to the word and what it means, then it's easier for them to understand the mathematical rule or the formula that goes with it (Teacher V, Interview 3, 2022).

In the above extract, Teacher V explains what she reflected upon in Interview 3, her use of language to explain mathematics to learners. It was something she did not notice during interviews one and two. Teacher V remained in the conscious-competence stage.

Teacher V cited an instance, during lesson two, that was missed during interviews one and two. During the introduction, Teacher V failed to explain to the learners key mathematical concepts. During interview two, she noticed that she did not write it on the board for learners. In this instance, she noticed that she continued the lesson without teaching those concepts. She noted that:

Learners should have the understanding the difference and what I do with the two is normally I… the one I do on a watch and the other one I do on a straight line so that they at least know that when you work with the one you"re working with 12 hours and when you work with the other one you refer to 24 hours and when it passes a certain, when it passes the 12 it goes to PM. So, then they start counting by the 12"s. So, it's important to have the two words on the board so that they have an indication of which is which but also to add that the one you work

> *with a straight line and 24 hours and the one you actually work with the clock. So, for the visual learners it's a good idea to have the, the clock on the board and the line and for those that just understand automatically and know what the meanings is* (Teacher V, Interview 3, 2022).

In this lesson, Teacher V taught time. She failed to explain to the Grade 4 learners what the difference between analogue and digital time is. Teacher V used these terms throughout the lesson, yet learners were not knowledgeable about these mathematical terms. Teacher V reflected and admitted that these concepts should have been explained and accompanied with definitions on the board, to enhance the teaching and learning of mathematics. Teacher V moved from the unconscious-incompetence stage to the conscious-incompetence stage.

For many teachers, including Teacher V, classroom management and discipline are deemed important. During all interviews and lesson observations, it could be observed that learners in Teacher V's classes were shouting and telling answers. Teacher V commented thus:

> *Discipline is very important in my class and because it was still Covid that time, the class wasn't as full. Each learner had their own desk and I have a very important rule in my class that you have to put up your hand. I'm not sure if you could see it on the video, but you could definitely see it in the class. So, nobody shouted out, but their hands went up so only once I look at you and I say yes, you may speak then they will give an answer* (Teacher V, Interview 3, 2022).

In the video, it can be clearly heard that learners were simultaneously shouting the answers. Teacher V, however, blatantly denied this, as the above statement proves. Consequently, Teacher V remained in the unconscious incompetence stage.

During the third lesson observation, the participant noticed an interesting aspect of one of her explanations in the mathematics lesson on time. This is interesting because she noticed this based on language differences. In 2021, Teacher V taught Grade 4 mathematics in Afrikaans; in 2022, she only teaches mathematics in English. She explained:

> *What I normally do is I try and simplify it as much as possible because I know that my kids can count in ones, they can count in units, and they can count in fives and they know what is 1/4. So that's basically the most important part that you need to know when it comes to time, and I know that they can all count from 1 to 24, so digital time is easy for them, because they know that you just continue when it goes to PM, it goes past 12, you just continue with 13, 14, 15 like that, you just add whatever it says. However, when you work with a watch itself it becomes very difficult. So, I normally work with, once it passes the 12 it is past and when it is before the 12, it is 2. So, it's going towards the 12 and it's going past the 12 and then you can either say, then you can count in your quarters. So, it's like the 15, 30, 45, 60 and if it's not in 1/4 instead of the child having to count all the small minutes 1, 2, 3, 4, 5, 6 like that I'll let them count in fives so that they can say it's five past or ten past or say it's easier because if they count in fives and this may be 17 minutes past they can at least go to the 15 and count the two digits, the two lines extra. So, that's what I do. I try and simplify it for my kids because I also know that they just came from foundation phase, and I've had them the year before that, so I know where they were at when it comes to their counting. And we*

have different levels and groups as well in the class, so I need to also accommodate all of them (Teacher V, Interview 3, 2022).

Teacher V noticed and reflected upon this positive aspect of explaining the mathematics to her learners. Since circumstances are different this year, Teacher V will attempt to adapt her teaching and explanations to this level, to enhance the teaching and learning of mathematics. In terms of mathematics lesson presentation, Teacher V remained in the conscious-competence stage.

During interviews one and two, Teacher V stated that she had reached the outcomes of her lesson. During interview 3, she reached a different conclusion. When asked if the lesson outcomes were actually reached, Teacher V commented:

Unfortunately, time (Topic in Grade 4 mathematics syllabus) and this is something that I've noticed, and I think that whether you're an educator or parent, you will see that it's quite a difficult concept for learners. It's something that you have to practice every single day because there are so many things that you need to remember. What are the lines that indicate it's an hour or which are the lines that indicate it's a minute? Now you're just talking about hours and minutes and the concepts of hours and minutes but then there's also a thing as a day, and there's a thing as a morning and afternoon, and there's a thing like a digital time and analogue time (Teacher V, Interview 3, 2022).

Interview 3 enabled Teacher V to notice the above situation through VSR, which would otherwise have been difficult to spot. After Interview 3, she questioned her entire lesson strategy and how she taught both fractions and time. For instance, Teacher V reflected upon her use of language and her explanation methods. Teacher V moved from the unconscious-incompetence stage to the conscious-incompetence stage.

To collect additional data and incorporate more mathematics, a third interview was added for Teacher D. During lesson recording 1, it was observed that Teacher D proceeded to introduce the key mathematical and historical mathematical concepts regarding the new topic, during lesson observation 1. Teacher D felt that this introduction could have been better, as discussed below. In this regard, Teacher D stated:

> (I)*... would have changed* (the introduction) *... would have been when I explained the imperial system and that I would have shown the learners that 30 centimeters is ... a foot. So, if 30 centimeters is a foot that came from the length of the ruler of the foot of the king. So, the King's foot was the official foot length that the Kingdom would use. So, and we still use the foot, but we have it in the form of a 30-centimeter ruler that everyone, that that we use as the standard. so that would be the easiest conversion…for kids to understand that the ruler that we are using currently, the 30- centimeter ruler is the last remnants that we still hold on to the imperial system, but we basically use the metric system* (Teacher D, Interview 3, 2022).

During the lesson observation, it was noted that a learner asked about the use of the imperial system of measurement. Teacher D briefly explained to the learner what it is, yet he felt his explanation could have been better, for all learners to understand. Teacher D even included in Interview 3 what he should have explained to learners. Here, Teacher D became conscious of his incompetence in terms of his lesson introduction and reflected on what he should have done differently.

In this introductory lesson, Teacher D noticed that he missed an important component in his lesson. He realised that he "*should have given, maybe used the dictionary…to show them the connection between metric and meter*" (Teacher D, Interview 3, 2022). Teacher D further explained that the use of dictionaries might have enabled learners to see "*different derivations of meter, metric, measurement, that it all comes from that same root word then it might have been for historical background*" (Teacher D, Interview 3, 2022). Teacher D moved from the unconscious-incompetent stage to the conscious-incompetent stage, in terms of proper lesson planning. Teacher D emphasised that this future alteration of lesson planning would improve learners' conceptual mathematical understanding.

Upon viewing lesson recording 1 for a second time, to extract more data, Teacher D noticed something he could have done better. Teacher D did not notice this during the first lesson observation. He noticed that he did not write the key mathematical and historical mathematical definitions on the board. He stated: "*I would have had them write that in their books as well, so I would have written it on the board so that they could have it in their books…it might have been better for them to understand*" (Teacher D, Interview 3, 2022). This is one of the aspects noticed by the participants that indicate a transition from the unconscious-incompetence to the conscious-incompetence stage and, later, to the conscious-competence stage.

Furthermore, Teacher D discussed the focus and time he invested in the proper use of language, when explaining mathematics. Teacher D indicated that he remembered the two different mathematics teachers he had in his final school year. The proper use of language separated learners in terms of average and great. That shaped him as a mathematics teacher. In his own words:

> *—I think or I believe that understanding starts with definitions. So I'm prone to use definitions before I show mathematical systems, because I think if you have a definition, there's a foundation to build understanding instead of just acquiring methods…builds his mathematical vocabulary then he also will have a better understanding of the mathematical concept… without the definition you always working with things that are floating in the air a bit mentally, learners don't always have a grounding. So once the definition is there, it seems the mind can also then understand calculations and methodology is more easily grasped if the learner understands the definition of the concept instead of just knowing how to do a calculation* (Teacher D, Interview 3, 2022).

Here, Teacher D reflected and noticed a positive aspect of the lesson. He is in the conscious-competent stage concerning the effective use of mathematical language within the classroom. This aspect should be thoroughly planned before the lesson. It was evident that Teacher D actively attended to this when doing his planning. Teacher D was ready to move to the last stage, unconscious-competence stage. This would ensure his autonomy in terms of the effective use of mathematical language. When asked about the selection of practical examples that he used in his mathematics lessons, Teacher D explained:

> *Preparing the lesson…You're always trying to imagine like the flow from one example to the other… scaffolding for the learner… think of the mistakes that learners have made in the past… I reflect in those moments. Obviously, you don't have the video at that time …preparing, thinking …learners usually make the following mistakes and I try to analyze to see what examples will allow learners to breach certain mistakes. That's how I choose examples… so preventative*

> *(measures). I think recording lessons like this (VSR) actually benefits that practice…I have like have the video to reflect it's easy to go back and see OK, So, what did I not include in my previous examples* (Teacher D, Interview 3, 2022).

During this reflection, Teacher D reflected positively on the effort he made to plan and choose the appropriate practical examples. He also admitted that his analysis of learners' understanding could be improved. Here, he was in the conscious-incompetence stage of lesson planning. In addition, he explained that the regular use of VSR could assist in his practice, as it allowed him to see learners' responses in real time.

During Interview 3, mathematical content delivery by Teacher D was discussed. He noticed the room for improvement and stated:

> *I think I could have improved, I think that maybe if I could reflect on the examples that I chose …reflect on the examples I chose and see if it was effective, I think that I would work on would be things like making eye contact, maybe not having my back to the learners. I noticed that I tend to complete the whole example and then turn around and talk to the learners. Instead of just doing and speaking with my back to them. I would like rather do a step, focus on the learners and then instead of rushing through the example on the board to get the example done* (Teacher D, Interview 3, 2022).

Teacher D noticed that his own mathematical content delivery could be improved. Lesson recording 2 showed that he "*used a box, the box and then also I point out like the board, point out the windows and those type of things was an improvement*", as practical examples from lesson recording 1(Teacher D, Interview 3, 2022). Therefore, Teacher D remained in the

conscious-incompetence stage, regarding the planning of appropriate mathematical examples.

During video observation 2, Teacher D covered the work on surface area and perimeter. He reflected and noticed the following about nets and colours:

> *When I watched it again, the video it would have been a lot better if the learners had nets also in front of them. Yes. And maybe coloured in or pasted the shapes over the different surfaces. Yes, you know with colours for the top and the bottom, the front and the back, left and the right, each having its own separate colour. It would, it would have given a better understanding. So, this yeah, I'm going to implement more of that* (Teacher D, Interview 3, 2022).

Teacher D noticed a void in his lesson in terms of mathematical content exercises. Nets are an important part of learning Geometry. The textbook includes Nets, yet Teacher D thought that having physical cut-outs could have improved learners' understanding. Here, Teacher D moved from the unconscious-incompetent to the conscious-incompetent stage in relation to board explanations.

. 4.3.3 Body language

During interview 1, Teacher D recognised that body language was significantly revealing, when conducting a lesson. As Teacher D put it: *"I noticed that I put my hands in my pockets too many times you know. So just things about my body language that I'm not aware of"* (Teacher D, Interview 1). During the second lesson recording and related interview, Teacher D addressed it directly by using hand gestures and referring to the board.

Teacher D revealed things that he could improve on in interview 1. I asked him, in interview 2,

to elaborate on it a bit. Teacher D stated:

> *I only put my hands in my pocket once for this lesson…I continuously did it for the other lesson. It was on my mind so that was an improvement* (Teacher D, Interview 2, 2021).

Teacher D noticed the body language during his lesson; he also noticed the changes, compared to the first video. Teacher D reflected and viewed it as an achievement and improvement. Therefore, he moved from the conscious-incompetence to the conscious-competence stage, regarding the effective use of body language. Teacher V also discovered the following, while reflecting on her video recorded lesson:

> *I also picked up that I don't smile a lot, or I should smile more. I just feel like I can smile more, and I should smile more* (Teacher V, Interview 1, 2021).

This slight incompetence concerning body language was discovered by Teacher V. Although the overall interaction in the classroom was good, there were times when she expected learners to answer and interact; yet, they did not. She felt that the cause of this was her body language and her not smiling in class (being more inviting to the learners). She stated that she did not know if it was "*fear or just them respecting*" (Teacher V, Interview 1, 2021). During the second lesson interview, Teacher V addressed this incompetence. She reviewed her body language. In this regard, she stated:

> *In the first lesson I didn't smile enough… I was too strict... those were the things that stood out the most. So, in this lesson I tried to smile more and be more… playful but yeah, make it more of a playful activity because you can learn and play, and also when you use the apparatus the child is actually learning while*

> *they are playing. I would like to be more friendly in class, but also keep my discipline. Also, the setting of the school, the type of child we work with. It's important to have a structure and have discipline because they, most of the kids don't get it from home. So, I will just have to find the balance between the two.* (Teacher V, Interview 2, 2021).

Teacher V had moved from the conscious-incompetence to the conscious-competence stage, in terms of managing body language during her lessons. According to Teacher V, she tried to make the mathematics more playful, as learners of this age learn through play. She managed to do so.

4.3.4 Board writing

Teacher O noticed that her board layout needed attention:

> *I saw that my class is very busy. The back, like when they see me, they see my board and the board was really busy. So maybe for some learners that may be confusing, or they wouldn't know where to look. So, I would think I should maybe rearrange my board or when I write something, write it more neatly and not all over the place, not be all over the place. So that is something I've also noticed* (Teacher O, Interview 1, 2021).

Teacher O noticed the board layout and realised that her handwriting on the board could be improved. She became aware that it could confuse learners, which would directly influence teaching and learning. Her incompetence in organising her writing board was evident to her at this stage. During the second lesson observation, Teacher O addressed the visual appearance of the classroom. She stated that her "*class wasn't too much cluttered*" (Teacher O, Interview 2, 2021). During Interview 2, Teacher O claimed that she ―*wrote neatly on the board*‖ (Teacher O, Interview, 2021), which was evident from the video footage. However, in the first video, Teacher

O stated, "***I** couldn't make out what I was writing on the board…That (board writing) was a difference*" (Teacher O, Interview 2, 2021). Teacher O addressed the problem she became conscious of during video observation 1. She became conscious-competent concerning the visual appearance (board and poster layout) of her classroom. While reviewing the video footage, Teacher V was horrified by what she saw. She remarked that:

> *I think I could have written in a neater format for them to understand, not understand, but to see the spelling and also um, yeah, just to help with their writing as well. I could have used that like cursive writing while I was explaining because they are busy with cursive writing* (Teacher V, Interview 1, 2021).

Teacher V reflected and noticed that her board writing was not on par. On the video, her handwriting looked somewhat skewed and rushed. She noticed this and became conscious of it. For her, this was a major incompetence. It directly influenced her writing, as well as the teaching and learning of mathematics in her classroom.

4.3.5 Tone of voice

Teacher G confided that one thing that certainly bothered her was her tone of voice. She suggested that she "*should tone down*‖ because she –*…[doesn't] want kids to get lost*" (Teacher G, Interview 1, 2021). Teacher G further vented her frustration:

> *I got a bit irritated with my continuous loud voice… I think it can be a bit nerve wrecking because it became nerve wrecking to me…Watching this video and realizing I speak at this high pitch all the time and high pitch is not always good…So I do think I need to, there must be variation in my tone, variation in my volume because that too obviously would improve the lesson greatly* (Teacher G,

Interview 1, 2021).

Teacher G reflected and became aware of her tone of voice, which she deemed unconducive to teaching and learning. She was especially annoyed because she is a Master of Music with a fine ear; yet she never noticed her tone of voice as VSR exposed it. After lesson observation 1, Teacher G became very aware and conscious of this issue. In interview 1, she vowed to address this issue in future. In the second lesson recording, Teacher G addressed the issue. In Interview 2, she shared that: "*I spoke softer…I was very aware of my volume*" (Teacher G, Interview 2, 2021). Teacher G was at first comfortably unaware, but after the first video observation, she became uncomfortably aware of her tone of voice. She moved from the unconscious- incompetent stage to the conscious-incompetent stage.

4.3.6 Usefulness of VSR

Teacher D expressed his thoughts on the usefulness of VSR in terms of the enhancement of PD. He suggested that VSR would:

> *Be effective as an evaluation tool for my own as a professional …because what I noticed was that there are often things that I do. Yes, that I don't realize I"m doing. So simple things like always saying right before I say a sentence. I use the word right the whole time to get the learners attention. So those things I pick up that I would never think I"m doing or saying certain things in a certain way. It will make a huge difference if I can use it as a tool for you know at least a quarterly self-evaluation as a tool. And maybe even as a tool for IQMS. Use it as a basis for IQMS to show that you are implementing tools… to improve my teaching methods and strategies* (Teacher D, Interview 2, 2022).

Here, Teacher D outline the possible use of VSR for self-evaluation and the external evaluation of teachers. The Internal Quality Management System (IQMS) is the professional scoring system used for teacher, under the Western Cape Education Department (WCED). With regards to the IQMS he pondered:

> *It might become more effective. Yes. For a video recording to be done and instead of having a senior in the class because I think it might make it more natural. Yes. When your senior is in the class observing a lesson, there's always that bit of tension where if you have a, just a tripod and record yourself…There isn't the fear of making a mistake…I think it would actually be a better tool for IQMS, a more honest tool…I am trying to learn what I'm doing wrong. And if they then can see and we can then agree that there's room for improvement. They might see things in the video that I don't notice about me, while even watching the video…* (Teacher D, Interview 2, 2021). *Right, yes for the purpose of professional development. I think it looking for lead to, it's more; it promotes integrity instead of me knowing that tomorrow is my lesson and so I am going to scrutinize my lesson plan...* (Teacher D, Interview 2, 2021).

Another issue noticed by Teacher G was the tolerance of distractions in her classroom. Teacher G's phone rang in the middle of the first lesson recording. When we viewed the lesson video, she admitted that that was very unprofessional of her. She stated: "*cell phone… I should have it off or on silent*" (Teacher G, Interview 1, 2021). When the cellphone rang, it disrupted the flow of the lesson, which was really important to Teacher G. To her, this incident was unacceptable because it reflected negatively on her professionalism. During Interview 2, she stated: "***I** switched off my cell …I switched off the phone*" (Teacher G, Interview 2, 2021). She developed

professionally, when she reflected upon this incident and realised that it was in her control, and it directly impacted on teaching and learning. She moved from the conscious-incompetence stage to the conscious-competence stage, because she put her cellphone on silent mode during contact hours.

Teacher G highlighted that VSR enabled her to pinpoint things that were not apparent to her before the video analysis. She suggested other ways she found VSR useful: "***I would like to (use VSR) … especially for my own development***" (Teacher G, Interview 2, 2021). Teacher G further noted that:

> *although being a teacher for 28 years, this is another method that could actually get us to say, OK, this is a way to actually better yourself without someone criticizing you because sometimes people don't really want to be criticized by other people…but if you watch it yourself then you can see and say oh my goodness, self-criticism that comes into play and I would be more approachable to me criticizing myself than someone else criticizing my lesson* (Teacher G, Interview 2, 2022).

Teacher G vented her frustration with the lack of technology and its uses. She noted that the use of technology was quite limited in her years of experience. Technology is known as a resource for lessons and not for reflection or evaluation. Teacher G emphasised that in her 28 years of experience, she has never seen another way to prompt self-reflection. She perceived VSR as a PD tool. She realised the value of self-evaluation, as opposed to being evaluated by another person in the traditional manner. She was comfortable with it and more receptive to self-criticism. This is the essence of VSR, as Teacher G preferred it as a self -reflection tool.

During Interview 2, Teacher O elaborated on the usefulness of VSR thus:

> *You can see what you do wrong 'cause if I go back, if I reflect, normally reflect without the video then you tend to forget things you do. But now with the video I-I …can physically see myself. Oh, I should have changed that, like I said I could, I wrote neater on the board. Because I don't see this when I reflect on my own without the video. I could see that my class was a bit cluttered and that may be distracting towards the learners* (Teacher O, Interview 2, 2021).

Here, Teacher O discussed her view on VSR as a tool for self-reflection. She perceived reflection without video as restrictive, because there were things she might have otherwise missed in this reflective process. Teacher O further expressed her views on VSR in terms of the evaluation of the IQMS. She affirmed that:

> *Definitely, it can be used for that (IQMS)… IQMS, regarding like the principal or your superior coming to sit in your class. Yes. It will be so much better because then they won't have to leave their class to come and sit in my class. They get a better perspective; they can go re-watch something that they have missed, so yeah* (Teacher O, Interview 2, 2021).

In terms of reflection and evaluation, Teacher O shared the views of Teacher D who was from a different school. The VSR could be used to improve quality management in education and should therefore be implemented for the particular purpose of enhancing PD and, consequently, the teaching and learning of mathematics.

Teacher V discussed her thoughts on VSR and self-reflection. She stated:

I think I'm a very happy and jolly and fun person, but I've seen that when I'm in the classroom, I'm actually a different person. I'm a strict and stern person. I'm very set in my morals and standards and discipline and method like yeah those types of things and class rules. So, it's important to actually see what you do and how you speak and your body language and what message you're portraying to the kids and will they actually engage. Yeah, like teachers are individuals and the person you are outside your classroom is different to the person you are inside your classroom or when you're standing in front of your learner. So I don't think that teachers actually know or see because the way they perceive themselves of the person they perceive when they're outside 'cause, that's the person you live with, that's maybe not the same person you are in class, so visual tools are good for reflection ...I'm talking about the child being confident and comfortable enough to engage with you, to be open with and to feel comfortable enough when they have an academic problem or when something is bothering them to come speak to you (Teacher V, Interview 2, 2021).

Teacher V admitted that VSR opened possibilities for teachers to discover aspects of themselves that they never knew. Teacher V further elaborated on the possibilities for evaluation. She stated:

It (VSR for evaluations) can be used, especially in these times with COVID, and to minimize the interaction of teachers and cross contamination and all of those type of things, but we also have to raise the question like is IQMS accurate and is it a true reflection of the teacher's abilities and what's really happening in the classroom (Teacher V, Interview 2, 2021).

4.4 Conclusion

Noticing through self-reflection, by all four teachers, was evident during this data collection cycle. Some participants noticed that their most significant challenge was lesson and time management. Participating teachers noticed that classroom interaction and overall awareness were challenging. Some participants noticed that body language and tone of voice were problematic. Many participants noticed challenges in their actual lesson delivery and board writing, while all the participants realised the usefulness of VSR concerning personal reflection and quality management evaluations. In summary, all the participants noticed their shortcomings and attempted to rectify them by moving from the unconscious-competent stage to the conscious-incompetent stage. Some eventually moved to the conscious-competent stage.

Participant	**Analysed Data**
Teacher D	Teacher moved from stage 1 to stage 2 (unconscious-incompetence to conscious-incompetence) in terms of their body language, lesson management and time management. Teacher later moved from stage 2 to stage 3 (conscious-incompetence to conscious-competence) in terms of body language, lesson management.
Teacher G	Teacher moved from stage 1 to stage 2 (unconscious-incompetence to conscious-incompetence) in terms of tone of voice, lesson management and time management. Teacher later moved from stage 2 to stage 3 (conscious-incompetence to conscious-competence) in terms of tone of voice and lesson management.
Teacher V	Teacher moved from stage 1 to stage 2 (unconscious-incompetence to

	conscious-incompetence in terms of board writing, body language, lesson management and time management.). Teacher later moved from stage 2 to stage 3 (conscious-incompetence to conscious-competence) in terms of board writing, body language, lesson management and time management.
Teacher O	Teacher moved from stage 1 to stage 2 (unconscious-incompetence to conscious-incompetence) in terms of board writing and lesson management. Teacher later moved from stage 2 to stage 3 (conscious-incompetence to conscious-competence) in terms of board writing and lesson management.

Table 4.1: Participant Profiles

Chapter 5: Findings, Conclusion, Recommendations, and Limitations

5.1 Introduction

The purpose of this research study was to gain insights into the reflective processes of experienced mathematics teachers, based on the use of VSR, and establish how the latter contributes to the improvement of the teaching and learning of mathematics in their classrooms. To examine participating teachers' reflective processes, the key features that teachers noticed during the viewing of their lesson recordings were considered. The research questions that guided this study were:

1. How does VSR enhance mathematics teachers' self-reflection?
2. How does the use of VSR, as a tool that enhances self-reflection, contribute to the improvement of the teaching and learning of mathematics in the classroom?

To answer these research questions, video recordings of lessons and semi-structured VSR interviews with experienced primary school mathematics teachers were undertaken. The lesson recordings and interviews were conducted in two stages. Each stage included a lesson being video recorded; thereafter, the researcher and the teacher watched the video. Wherein the process, the participating teachers could reflect on their teaching practices. The interviews were conducted immediately after the recorded lessons were viewed. Data were gathered through

lesson recordings, lesson observations, and interviews. Data were analysed using the conscious-competence framework that consists of four stages. These are the unconscious-incompetence, conscious-incompetence, conscious-competence, and the unconscious-competence.

5.2 Findings

The purpose of this section is to answer the research questions posed in this study. Section 5.2.1 focuses on the findings obtained during the video observations of the recorded lessons and the subsequent interviews conducted to answer research question 1. Section 5.2.2 is about the findings obtained from the video stimulated interviews undertaken to answer research question 2.

5.2.1 How does Video-Stimulated Recall enhance mathematics teachers' self-reflection?

VSR is known to encourage and/or force self-reflection upon the participants. The analysis of both video recording cycles and interviews indicated that VSR enhanced self-reflection among all four experienced mathematics teachers who participated in this study. VSR provided these teachers with the ability to view their lessons in real time. This, in turn, created self-awareness among them. Self-reflection is a key to self-awareness (Raelin, 2002; Habash, 2019). It allows persons to objectively examine their own actions and their learners' reactions, as well as to recall their emotions and feelings at the time, with interest and curiosity. Habash (2019) further emphasises that self-reflection is a skill that is essential to personal growth. Reflection assists in choosing healthier responses and changing behaviour in the future (Habash, 2019).

Thus, it is important to investigate how the participating experienced mathematics teachers self-reflected through VSR. As discussed in Chapter 4, on data analysis, the participating teachers' reflections were categorised into specific themes. The participants noticed and reflected upon their classroom time management. The latter was reflected upon by Teacher D, Teacher G, and Teacher V. These participants self-reflected upon their time management practices, after they witnessed time wastage while observing the video recording (Yeung, 2018). During the VSR interviews, they reflected, admitted, and explained what they could have done better. They all moved from the unconscious-incompetence stage to the conscious-incompetence stage and, subsequently, towards the conscious competence stage. In agreement with Raelin (2002) and Habash (2019), VSR enhanced reflection and prompted the teachers to improve their time management through their newly gained self-awareness.

The second theme discovered during data analysis is lesson management. During data analysis, it became evident that all the participants reflected upon their lesson management. The latter was an umbrella term for different factors related to lesson management itself. Through VSR, Teacher D reflected on his learner interaction, lesson preparation, lesson presentation, and classroom awareness. Teacher G reflected upon learner interaction and the atmosphere in her classroom. Teacher O reflected on her learner interaction, questioning techniques, and the overall communication within her classroom. Teacher V reflected upon the atmosphere in the class, learner interaction, lesson preparation, questioning techniques, and the proper use of key mathematical concepts. VSR enhanced reflection to the point where the participating teachers made efforts to improve their classroom practices, as discussed above, confirming the views of Finlay (2008) and Mathew et al. (2017). These scholars explained how instructors, through self-

reflection, tended to review and alter their teaching practices, to enhance teaching and learning within the classroom environment.

VSR can be an appropriate tool for the reflection on teachers' body language. The latter is deemed significant in the teaching and learning of mathematics (Williamson, 2022). The video camera enables the viewing of real time footage by the participants (Knight, 2014; Matherson et al., 2017). Thus, they could witness and self-reflect on their body language. Teacher D and Teacher V reflected upon their body language during their lesson video observations. During these observations, they noticed that they did not have demeanours that were welcoming towards learners. Other observations were that they kept their hands in their pockets, an illustration of insecurity, defensiveness, or lack of confidence (Neff, 2011). Teacher D and Teacher V proved an important point made by Gulec and Temel (2015) and Wedin (2021). They realised the importance of body language in their classrooms. They argued that body language played an important role in the trajectory of a lesson in terms of teaching and learning. VSR enhanced reflection and prompted the participating experienced teachers to address their incompetence with respect to body language.

VSR is recommended as a tool to enhance teachers' self-reflection relating to the fourth theme, board writing. It seldom happens that teachers would step to the back of their classroom to reflect on their board writing. VSR provided a refined way for the participants in this study to reflect as they saw their board writing in real time. Teacher O and Teacher V both reflected upon their board writing competences (Talamas, 2015).

Due to the audio-visual properties of video recordings, one participant could reflect upon another theme. Teacher G reflected on her tone of voice, while viewing her lesson video. She solidified points made about the tone of voice by Cox (2020). Indeed, Cox (2020) recommended that monotonous projection be avoided, and appropriate dialects be chosen for different audiences. Teacher G listened to the sound of her presentation and realised that her voice itself could be distracting learners from the mathematics lesson. Therefore, video stimulation enhanced reflection and fostered the improvement of teaching and learning in mathematics.

Another interesting finding emanated from the interview data. This pertained to how the participants described the self-reflective properties of VSR. Teacher D and Teacher G mentioned the ability of VSR to promote their self-reflection. The possibility of exploring ways to use VSR to self-reflect and self-evaluate in the build-up to formal evaluations such as the IQMS was raised. Teacher G and Teacher V mentioned the possibility to self-reflect to monitor and develop professional practice. Teacher V advanced the idea of buying her own camera, recording herself presenting the lesson (as the researcher did), and watching her recordings afterwards. This is evidence of her serious intention to further her self-reflection, and her eagerness to use VSR to improve the teaching and learning of mathematics in her classroom. After analysing the data, it became clearer that the participants intentionally reflected (Muir, 2010) on their teaching practices. VSR spurred teachers to become better at noticing what happens inside their classrooms.

5.2.2 How does the use of Video-Stimulated Recall, as a tool that enhances self-reflection, contribute to the improvement of the teaching of the mathematics in the classroom?

For Cox (2020), the value of self-reflection is measured by its ability to prompt teachers to evaluate their teaching practice. If VSR is recognised as a tool that enhances self-reflection, the question that needs to be answered is how it improves the teaching and learning of mathematics in the classroom. Each of the four participating mathematics teachers, ranging from Grade 4 to Grade 7 reflected on their mathematics lessons. These reflections led these mathematics teachers to not only examine their general teaching practices, but also to specifically scrutinise their mathematical content delivery and presentations.

After the participants reflected upon their time management practices and became aware of certain things, they consciously tried to improve their practices in the subsequent lesson(s). Proper time management is important in the successful teaching and learning of mathematics within the classroom. Proper time management allows for improved and more efficient administrative duties, teaching, feedback to learners, and classroom management (Yeung, 2018; Weber et al., 2018). The aim is for teachers to develop professionally, to the point where they can present productive and participative lessons, with impeccable time management (Liu, 2015). Teacher D self-reflected and revealed, in the interview, that he was "*too in a hurry to carry on with the lesson"* (Teacher D, Interview 1, 2021). This participant reflected on the fact that he rushed the lesson. VSR allowed him to examine the entire lesson, to uncover this. During the second round of video recordings, Teacher D attempted to improve this time management aspect, despite existing time constraints. Better time management allows for better mathematical content

delivery and interaction in the mathematics classroom (Yeung, 2018). However, Teacher G reported time wastage. She stated that "*emphasis should be on the teaching…The emphasis should be on learning"* (Teacher G, Interview 1, 2021). Teacher G reflected on her unhappiness with the fact that she wasted time distributing notes and writing on the board. She suggested that schools implement technology, specifically smart-boards that can ensure that lessons are pre-saved, to improve time management. During the second lesson recording, she remedied the situation. For her, emphasis should be on the teaching and learning of mathematics. Similar to Teacher G, Teacher V reflected and improved her time management. During her mathematics lesson, she distributed notes and the apparatus, which contributed to improper time management. Teacher V vowed to continuously improve her time management. This would directly improve the teaching and learning of mathematics in her classroom.

Lesson management, as discussed earlier, is a general term for many different aspects of the classroom. It refers to how the teacher manages different aspects of the lesson. During the VSR lesson observation, Teacher D and Teacher G observed learner interaction during the lesson. Teacher D noticed that his learners were interactive. They were motivated to improve the interaction even more. These two teachers were in the conscious-competent stage; they aimed to move to the unconscious-competent stage. Teacher D, however, noticed his own unawareness in the classroom. He stated that he was "*not always aware of what everyone is doing*‖, when he –*missed someone's hand"* that was up for six minutes (Teacher D, Interview 1, 2021). Teacher D reflected on this unawareness and addressed it during the second video recording cycle. Hence, he moved from the unconscious-incompetence stage to the conscious-incompetence stage. During Interview 3, Teacher D reflected upon another aspect, while observing both video cycles. Teacher D reflected upon his choice of practical examples while conducting his lessons on

measurement. During the lesson regarding the surface area of 2-Dimensional shapes, Teacher D reflected and noticed the lack of physical nets cut-outs for learners. This meant that he lacked the necessary resources to support learning. According to Teacher D, having those nets would have significantly improved learners' understanding of the mathematical concepts and made teaching easier. He aims to review his examples and practices, to enhance learner understanding in future. This new awareness will play its role in improving the teaching and learning of mathematics in the classroom (Choy, 2013). Teacher G reflected and viewed her mathematics lesson as dull and unexciting to learners. With the second round of video recordings, Teacher G revamped her entire lesson, after reflecting and moving from the unconscious-incompetence to the conscious-incompetence stage. This made her new mathematics lesson more vibrant and interactive, compared to the previous lesson. She reported learners' improved understanding with the newly-implemented visual aids and approach.

Teacher O reflected through VSR and planned to build on the small successes in her classroom. These included effective discipline and reached lesson outcomes. She saw how disinterested learners were to her lesson on 2-Dimentional Shapes and, in the subsequent formative assessment, they did not do well. Learners' lack of interaction in the lesson was another incompetence noticed by Teacher O. She intends to, in the future, find more gaps and improve her teaching of such topics, so that learners may learn more efficiently. This agrees with Sherin's (2003) statement that teaching proficiency relies on the video showing the shortcomings in terms of interaction. Through VSR, Teacher O also realised that the learners' mood affected the entire lesson. She allowed their "negative" mood to alter her mood and, consequently, the entire lesson (Teacher O, Interview 1, 2021). This incompetence regarding her classroom management was noticed by Teacher O who eventually improved learner engagement by the second lesson

recording. Continuous improvement of teacher-learner interaction and classroom management has the ability to improve the teaching and learning of mathematics in her classroom.

VSR allowed Teacher V to reflect on her teaching strategy, when teaching mathematics. She reflected upon her introductory strategies to her Grade 4 learners. She omitted important information from the board. VSR enabled Teacher V to see this and improve it. Important mathematical information was showcased on the board, during the second round of recording. In addition, this participant noticed and reflected upon her questioning techniques and improved them for the enhancement of mathematical understanding among learners.

Another theme discussed earlier was body language. Through VSR, the participants were able to see their body language in real time and reflect upon it. Gulec and Temel (2015) view body language as a significant part of education and training, in terms of communication. For them, education itself is one big communication activity. Williamson (2022) discusses certain non-verbal cues that need to be communicated from teacher to learner. These cues need to convey ―warmth and empathy‖ in the classroom, for learners to feel that the teacher is approachable, especially with an abstract subject such as mathematics (Wedin, 2021; Williamson, 2022 p. 2). Teacher D noticed and reflected upon body language immediately, when observing the video recording. From the first lesson recording, Teacher D consciously improved his body language, while conducting his mathematics lesson.

Board writing is a non-verbal tool that teachers use to transmit mathematical content to learners. VSR allowed teachers to see their board writing in real time. Teacher O reflected upon her board writing and stated that she *"should maybe rearrange"* her *"board"* (Teacher O, Interview 1, 2021). Teacher O noticed the board layout and realised that her handwriting on the board could

be improved. She believed that it could confuse learners, which would directly influence teaching and learning in her mathematics classroom. Teacher V also reflected on board writing. She stated believed that she *–could have written in a neater format for them to understand"* (Teacher V, Interview 2, 2021). Teacher V explicitly admitted that her board writing influenced learners' understanding of mathematics. This is congruent with Talamas' (2015) argument about the importance of noticing incompetent board writing and reflecting on it.

Lastly, Teacher G reflected upon her tone of voice during her lesson. VSR provided her with the audio-visual opportunity to examine it. She viewed and listened to her lesson intensely. She became "*irritated with"* her *"continuous loud voice"* and "*there must be variation in my tone, variation in my volume because that too obviously would improve the lesson greatly"* (Teacher G, Interview 1, 2021). Teachers' tone of voice during mathematics lessons undoubtedly impacts on the teaching and learning of mathematics. Teacher G reflected, improved, and intends to continuously enhance this aspect of her lesson. This could only be beneficial to the teaching and learning of mathematics.

5.3 Limitations of the study

Due to time constraints, two lessons per teacher, for half the participants (two out of four), were observed and video recorded. The teachers did not reach stage four (unconscious-competent stage) of Schratz's model, due to this constrained observation period. Future studies might consider watching more lessons, to allow for more reflections by the teachers and possibly more opportunities to establish whether the participating educators actualise advancements based on what they notice.

5.4 Recommendations

While conducting this VSR study, the process produced a few highlights that prompted some recommendations for other researchers. When planning this type of qualitative study, they should ensure that participating schools' management teams believe in the research and fully support the participation of their members. For convenience, they should ensure that more teachers are willing to participate in such a study. This is so that a backup plan is always in place, if any participant, at any time, decides to withdraw from the study, which they are entitled to do. Another recommendation is to decide on recording and interviewing dates and times well in advance, for the participating teachers' convenience. Moreover, researchers should decide on alternative recording and interviewing dates and times, in preparation for unforeseen circumstances that may hinder the data collection.

When conducting interviews, researchers should create a safe space for the participants to be honest and comfortable with all feedback given to the researcher. To extract the most out of such a study, it would be beneficial to have more participants and conduct the study over a longer period of time. Once data collection commences, the lesson should be recorded as surreptitiously as possible, from the rear of the classroom, to avoid distracting the teacher in any way. It is important for the researcher to thoroughly observe the body language, facial expression, and the comments made by the participating teachers. During the interviews, researchers should probe teachers, to ensure that they focus on the mathematics. It is extremely disheartening to collect general data about education and classroom practices regarding mathematics. This leads to data devoid of a mathematics stance. Therefore, it is important for researchers to probe teachers and steer data collection and analysis towards the teaching and learning of mathematics.

5.5 Acknowledgements

I would like to acknowledge the National Research Foundation (NRF) for its financial contribution towards this study. Without the NRF, the completion of this study would not be possible. This institution provided our research team with the equipment for data collection and afforded us the opportunity to go on a writing retreat, to analyse our data effectively. The funding also assisted with the language editing of the thesis.

5.6 Implications of the study

This study has got significant implications for teachers, researchers and teacher educators. VSR allows teachers the authority to improve lessons in many aspects including classroom management, assessments, learner interactions and many more. Participants even discussed the potential of VSR in the use of IQMS. It could potentially be used to morph professional development initiatives to be less evaluative and more developmental. VSR can significantly improve effective in-house professional development.

Reference list

Abend, G. (2019). Thick concepts and sociological research. *Sociological Theory*, *37*(3), 209-233.

Adey, P. (2004). *The professional development of teachers: Practice and theory*. London: Springer Science & Business Media.

Arends, F., Winnaar, L., & Mosimege, M. (2017). Teacher classroom practices and Mathematics performance in South African schools: A reflection on TIMSS 2011. *South African Journal of Education*, *37*(3), 1- 11.

Babbie, E. (2001). *The practice of social research.* Belmont CA.: Wadsworth/Thomson Learning Inc.

Bastian, A., Kaiser, G., Meyer, D., Schwarz, B., & König, J. (2022). Teacher noticing and its growth toward expertise: an expert–novice comparison with pre-service and in-service secondary mathematics teachers. *Educational Studies in Mathematics*, 110(2), 205-232.

Bengtsson, J. (1995). What is reflection? On reflection in the teaching profession and teacher education. *Teachers and teaching*, *1*(1), 23-32.

Boud, D., Keogh, R., & Walker, D. (2013). Promoting reflection in learning: A model. In. Walker, D. *Reflection: Turning experience into learning* (pp. 18-40), Abington: Routledge.

Bragg, L. A., Walsh, C., & Heyeres, M. (2021). Successful design and delivery of online professional development for teachers: A systematic review of the literature. *Computers & Education*, 166, 104-158.

Brandt, C. (2008). Integrating feedback and reflection in teacher preparation. *ELT Journal*, *62*(1), 37-46.

Biccard, P. (2020). The development of noticing in primary school mathematics teachers. *The Independent Journal of Teaching and Learning*, 15(2), 92-106.

Bierwolf, R.E., & Frijns, P. (2019). Consciousness, competence, and organizational change. *IEEE Engineering Management Review*, *47*(4), 32-38.

Burch, N. (1970). Conscious Competence Learning Model: Four stages of learning theory-unconscious incompetence to unconscious competence matrix-and other theories and models for learning and change. Acedido em http://www. citehr. com/23983-conscious-competence-learning-model. html, 8.

Campbell, T. (1997). Technology, multimedia, and qualitative research in education. *Journal of research on Computing in Education*, *30*(2), 122-132.

Cloutier, C., & Ravasi, D. (2021). Using tables to enhance trustworthiness in qualitative research. *Strategic Organization*, *19*(1), 113-133.

Cox, J. (2020). *Teaching Strategies: The Value of Self-Reflection*. TeachHUB. Retrieved on July 23, 2021, from: https://www.teachhub.com/teaching-strategies/2014/10/teaching-strategies-the-value-of-self-reflection/.

Connelly, L.M. (2016). Trustworthiness in qualitative research. *Medsurg Nursing*, *25*(6), 435-439.

Choppin, J., Amador, J. M., Callard, C., Carson, C., & Gillespie, R. (2020). Synchronous online model for mathematics teachers' professional development. In University of Rocherster *Handbook of Research on Online Pedagogical Models for Mathematics Teacher*

Education (pp. 176-202). Rochester: IGI Global.

Choy, B. H. (2013). Productive Mathematical Noticing: What It Is and Why It Matters. Mathematics Education Research Group of Australasia.

Crawford, E.O., Higgins, H.J., & Hilburn, J. (2020). Using a global competence model in an instructional design course before social studies methods: A developmental approach to global teacher education. *The Journal of Social Studies Research*, *44*(4), 367-381.

Davies, N., & Walker, K. (2005). Learning to notice: One aspect of teachers' content knowledge in the numeracy classroom. In Clarkson, P Downton, A. Gronn, D. Horne, M. McDonough, A. Pierce, R & Roche, A. (Eds.), *Building connections: Research, theory and practice* (Proceedings of the 28th annual conference of the Mathematics Education Research Group of Australasia). Sydney: MERGA, pp. 273-280.

Davys, A., & Beddoe, L. (2020). Best practice in professional supervision: A guide for the helping professions. London: Jessica Kingsley Publishers.

De Clercq, F. (2013). Professionalism in South African education: The challenges of developing teacher professional knowledge, practice, identity, and voice. *Journal of Education*, *57*, 31-54.

Deed, C., Blake, D., Henriksen, J., Mooney, A., Prain, V., Tytler, R & Fingland, D. (2019). Teacher adaptation to flexible learning environments. *Learning Environments Research*, *23*, 1-13.

Evans, L. (2014). Leadership for professional development and learning: Enhancing our understanding of how teachers develop. *Cambridge journal of education*, *44*(2), 179-198.

Farrell, T.S.C. (2004). *Getting started with reflective practice. Reflective practice in action: 80*

reflection breaks for busy teachers. Retrieved 14 March 2021 from: https://www.cambridge-community.org.uk/professional-development/gswrp/index.html.

Finlay, L. (2008). *Reflecting on „Reflective practice"*. Milton Keynes UK: The Open University repository of research publications.

Flick, U. (2018). *An introduction to qualitative research*. Berlin, Germany: Sage Publications Limited.

Fullan, M. (2006). The future of educational change: System thinkers in action. *Journal of educational change*, *7*(3), 113-122.

Gaudin, C., & Chaliès, S. (2015). Video viewing in teacher education and professional development: A literature review. *Educational research review*, 16, 41-67.

Gazdag, E., Nagy, K., & Szivák, J. (2019). ―I Spy with My Little Eyes...‖ The use of video stimulated recall methodology in teacher training – The exploration of aims, goals and methodological characteristics of VSR methodology through systematic literature review. *International Journal of Educational Research*, *95*, 60-75.

Gibson, S. A., & Ross, P. (2016). Teachers' professional noticing. *Theory into Practice*, 55(3), 180-188.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The qualitative report*, *8*(4), 597-607.

Glassmeyer, D. (2020). Supporting mathematics teaching practices in online teacher education: An example using logarithms, pH, and synchronous course meetings. In Kennesaw State University Handbook of Research on Online Pedagogical Models for Mathematics Teacher Education (pp. 55-67). Kennesaw: IGI Global.

Gulec, S., & Temel, H. (2015). Body language using skills of teacher candidates from Departments of Mathematics Education and Social Studies Education. *Procedia-Social and Behavioral Sciences*, 186, 161-168.

Habash, C. (2019). What is self-reflection, and why is it important for self-improvement? *Thriveworks Counseling and Life Coaching.* Retrieved on 07 August 2021, from: https://thriveworks.com/blog/importance-self-reflection-improvement/.

Hollingsworth, H., & Clarke, D. (2017). Video as a tool for focusing teacher self-reflection: Supporting and provoking teacher learning. *Journal of Mathematics Teacher Education*, 20(5), 457-475.

Jacobs, V. R., Lamb, L. L., & Philipp, R. A. (2010). Professional noticing of children's mathematical thinking. *Journal for research in mathematics education*, 41(2), 169-202.

Jackson, R.L., Drummond, D.K., & Camara, S. (2007). What is qualitative research? *Qualitative research reports in communication*, *8*(1), 21-28.

Kawulich, B. (2005). Participant observation as a data collection method. *Qualitative social research*, *6*(2). 7-22

Knight, J. (2014). *Focus on teaching: Using video for high-impact instruction*. London: Corwin Press.1(1) (pp. 4-12).

Labuschagne, A. (2003). Qualitative research: Airy fairy or fundamental. *The qualitative report*, *8*(1), 100-103.

Latha, S.P. (2021). Ethics in doing research. *Advanced educational research and statistics*, *29*(1), 14-46.

Lakshmi, H.V. (2010). Classroom management in integrated school setup. *International Journal*

of Educational Sciences, *2*(2), 95-102.

Lesseig, K., Elliott, R., Kazemi, E., Kelley-Petersen, M., Campbell, M., Mumme, J., & Carroll, C. (2017). Leader noticing of facilitation in videocases of mathematics professional development. *Journal of Mathematics Teacher Education*, 20(6), 591-619.

Liu, K. (2015). Critical reflection as a framework for transformative learning in teacher education. *Educational review*, *67*(2), 135-157.

Lim, C.P. & Chan, B.C. (2007). Micro LESSONS in teacher education: Examining pre-service teachers' pedagogical beliefs. *Computers & Education*, *48*(3), 474-494.

Liang, J. (2015). Live video classroom observation: an effective approach to reducing reactivity in collecting observational information for teacher professional development. *Journal of Education for Teaching*, *41*(3), 235-253.

Marvel, A. (2018). The Place of Reflection in PD. Edutopia. *Professional learning: George Lucas Educational Foundation*. Retrieved on …, from: https://www.edutopia.org/article/place-reflection-pd

Mason, J. (2011). Noticing: Roots and branches. In Sherin, V. Mason, J. (2011). Noticing: Roots and branches. In Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers" eyes* (pp. 35–50). New York: Routledge.

Matherson, L., & Windle, T. M. (2017). What do teachers want from their professional development? Four emerging themes. *Delta Kappa Gamma Bulletin*, 83(3), 28.

Mathew, P., Mathew, P., & Peechattu, P.J. (2017). Reflective practices: A means to teacher development. *Asia Pacific Journal of Contemporary Education and Communication Technology*, *3*(1), 126-131.

McAlpine, L., & Weston, C. (2002). Reflection: Issues related to improving professors' teaching and students' learning. In Hativa, N. Goodyear, P *Teacher thinking, beliefs and knowledge in higher education.* Dordrecht: Springer, pp. 59-78.

McCoy, S., & Lynam, A. M. (2021). Video-based self-reflection among pre-service teachers in Ireland: A qualitative study. *Education and Information Technologies*, *26*(1), 921-944.

Meier, C., & West, J. (2020). Overcrowded classrooms – the Achilles heel of South African education? *South African Journal of Childhood Education*, *10*(1), 1-10.

Mentz, E., De Beer, J., Petersen, N., Van Vuuren, H.J., Botha, C., Botha, L & White, L. (2020). *Becoming a teacher: Research on the work-integrated learning of student teachers* .Durbanville: AOSIS publishers, pp. 470

Miller, P. (2012). Ten characteristics of a good teacher. *English Teaching Forum*, *50*(1), 36-38.

Mizell, H. (2010). *Why Professional Development Matters. Learning Forward*. Oxford: ERIC 45056.

Monaghan, J. (2004). Teachers' activities in technology-based mathematics lessons. *International Journal of Computers for Mathematical Learning*, *9*(3), 327.

Movementum. (2022). You Don't Know What You Don't Know | The 4 States of Competence — Movementum. [online] Retrieved on May 28, 2022, from: <https://movementum.co.uk/journal/competence>.

Morgan, C. (2013). *Language and mathematics: A field without boundaries*. European Society for Research in Mathematics Education. Cemeplary: Anakara.50-67

Muir, T. (2010). Using Video-Stimulated Recall as a tool for reflecting on the teaching of Mathematics. *Mathematics Education Research Group of Australasia*, *1*(1), 438-444.

Neff, K. D. (2011). Self-compassion, self-esteem, and well-being. *Social and personality psychology compass*, *5*(1), 1-12.

Nite, S. B., & Bicer, A. (2020). Online Mathematics Teacher Professional Development. In

Handbook of Research on Online Pedagogical Models for Mathematics Teacher Education (pp. 203-215). Texas: IGI Global.

Osta., I., Laborde, C., Hoyles, C., Jones, K., Graf, K.D., & Hodgson, B. (1998). Computer technology and the teaching of geometry. In Herbst, P, Fujita, T,Stefan, Weiss ,M *Perspectives on the teaching of geometry for the 21st century.* Dordrecht: Springer, pp. 109-158.

Pacherie, E., & Mylopoulos, M. (2021). Beyond automaticity: The psychological complexity of skill. *Topoi*, *40*(3), 649-662.

Powell, E. (2005). Conceptualising and facilitating active learning: teachers' video-stimulated reflective dialogues. *Reflective Practice*, *6*(3), 407-418.

Raelin, J.A. (2002). I don't have time to think! (vs. The art of reflective practice). *Reflections*, *4*(1), 66-79.

Resnik, D.B. (2015). What is ethics in research & why is it important. In *Ideas*. National Institute of Environmental Health Sciences. Retrieved April 16, 2021, from: https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm?links=falseWijaya.

Roberts, C.A., Benedict, A.E., & Thomas, R.A. (2014). Cooperating teachers' role in preparing pre-service special education teachers: Moving beyond sink or swim. *Intervention in School and Clinic*, *49*(3), 174-180.

Santagata, R., König, J., Scheiner, T., Nguyen, H., Adleff, A. K., Yang, X., & Kaiser, G. (2021). Mathematics teacher learning to notice: A systematic review of studies of video-based programs. *ZDM–Mathematics Education*, 1-16.

Saric, M., & Steh, B. (2017). Critical reflection in the professional development of teachers: Challenges and possibilities. *CEPS journal*, *7*(3), 67-85.

Saylor, L.L., & Johnson, C.C. (2014). The role of reflection in elementary mathematics and science teachers' training and development: A meta-synthesis. *School Science and Mathematics, 114*(1), 30-39.

Schipper, T., Goei, S. L., de Vries, S., & van Veen, K. (2017). Professional growth in adaptive teaching competence as a result of Lesson Study. *Teaching and teacher education*, *68*, 289-303.

Schleicher, A. (2012). *Preparing teachers and developing school leaders for the 21st century: Lessons from around the world*. Paris: OECD Publishing.

Schmid, E.C. (2011). Video-stimulated reflection as a professional development tool in interactive whiteboard research. *ReCALL: the Journal of EUROCALL, 23*(3), 252.

Schratz, M. (2001). Personalentwicklung ALS pädagogische Führungsaufgabe. *Schulmanagement, 32*(5), 23-27.

Schratz, M. (2006). Leading and learning: Odd couple or powerful match? *Leading and Managing*, *12*(2), 40.

Shandomo, H.M. (2010). The role of critical reflection in teacher education. *School-University Partnerships*, *4*(1), 101-113.

Sharma, S. (2013). Qualitative approaches in mathematics education research: Challenges and possible solutions. *Education Journal*, *2*(2), 50-57.

Shenton, A.K. (2004). Strategies for ensuring trustworthiness in qualitative research

projects. *Education for information*, *22*(2), 63-75.

Sonia, G. (Ed.). (2017). *Educational research and innovation pedagogical knowledge and the changing nature of the teaching profession*. Berlin: OECD Publishing.

Sherin, M. G. (2003). New Perspectives on the Role of Video in Teacher Education. In Brophy, J.*Using video in teacher education*. Bingley: Emerald Group Publishing Limited.(pp.1-27)

Sherin, M. G. (2017). Exploring the boundaries of teacher noticing: Commentary. In Schack, E., Fisher, M., Wilhelm, J. Teacher noticing: Bridging and broadening perspectives, contexts, and frameworks (pp. 401-408). Springer, Cham.

Talamas, S. (2015). *Understanding the conscious competence model*. Retrieved on May 13, 2021, from: https://www.youtube.com/watch?v=UhN2JUMWG6s.

Thompson, N., & Pascal, J. (2012). Developing critically reflective practice. *Reflective practice*, *13*(2), 311-325.

Tlali, T. (2019). Creating an environment that nurtures deep learning: how does the National University of Lesotho fare? *The Independent Journal of Teaching and Learning*, *14*(1), 19-31.

Travers, C.J., Morisano, D., & Locke, E.A. (2015). Self-reflection, growth goals, and academic outcomes: A qualitative study. *British Journal of Educational Psychology*, *85*(2), 224-241.

Van Es, E. A., & Sherin, M. G. (2002). Learning to notice: Scaffolding new teachers' interpretations of classroom interactions. *Journal of technology and teacher education*, *10*(4), 571-596.

Van Es, E. A. (2011). A framework for learning to notice student thinking. In Jacobs, V. Philipp, R . *Mathematics teacher noticing* (Ed.). (pp. 164-181). New York: Routledge

Weber, K. E., Gold, B., Prilop, C. N., & Kleinknecht, M. (2018). Promoting pre-service teachers' professional vision of classroom management during practical school training: Effects of a structured online-and video-based self-reflection and feedback intervention. *Teaching and Teacher Education*, *76*, 39-49.

Wedin, Å. (2021). Language in mathematics classrooms. *Mathematics Education*, *26*(2), 67-85.

Wilhelm, J.D. (2016). Working toward conscious competence: The power of inquiry for teachers and learners. *Voices from the Middle*, *23*(3), 58-60.

Williamson, B., (2022). The Importance of Body Language in Teaching. [online] EverFi. Retrieved on July 4, 2022, from: <https://everfi.com/blog/k-12/the-importance-of-body-language-in-teaching/>.

Yeung, S. A. [TedX Talks (University of Hong Kong)]. (2018). *Reflective Teaching: an Element of Life-Long Learning | Solomon Au Yeung | TEDxEdUHK* [Video]. YouTube. Retrieved on 27 May 2021, from https://www.youtube.com/watch?v=N9OSBpiwofk

Appendix A:

INFORMATION LETTER TO THE SCHOOL PRINCIPAL/ GOVERNING BODY

DATE: 17 May 2021

Dear Sir or Madam,

My name is Geoneal Williams. I am an MEd student in the Faculty of Education at the University of the Western Cape (UWC). I am doing research on the use of video-stimulated recall (VSR), as a tool for professional development (PD) and support to the mathematics team, in the development of individuals. I would like to invite your school to participate in the study. The title of the study is: *The impact of Video-Stimulated Recall on the professional development of experienced mathematics teachers.*

The reason I have chosen your school is because it has a connection with the UWC in different ways, and I would like to collaborate with you in my research endeavours. My research involves the observation and recording of individual mathematics teachers and the use of VSR as a tool for PD. The teachers will also be asked to assist with their biographical information, through interviews. I would like to ask two mathematics teachers to participate in the research, in the course of which video recordings will be made of two to three of their lessons. Footnotes will also be made, but the lessons will in no way be interfered with – only video recorded. This

will be followed by a face-to-face interview with the teacher during which a section of a recorded lesson will be shared with the teacher involved. After a period of time, another video recording of a lesson or two will be conducted, with a follow-up interview. I would like to audio record the interviews.

The running of the school will not be interrupted at all and the teachers and learners will not be disadvantaged in any way. Timeous, prior arrangements will be made with the HOD and teachers involved. There are no foreseeable risks in participating in this study. The identity of the school and the teachers involved will be kept anonymous at all times, in all academic writings about the study. The data will be kept confidential, on my password protected computer. All research data will be destroyed within five years, after completion of the project.

Please let me know if you require further information. You can also contact my supervisor, Dr. Benita P. Nel at 021 959 3796 or email bnel@uwc.ac.za, or the UWC 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 look forward to your response, as soon as is convenient.

Geoneal Williams

Appendix B:

Teacher consent form

Please fill in the reply slip below, if you agree to participate in my study titled: *The impact of Video Stimulated Recall on the professional development of experienced mathematics teachers*.

My name is: _____

1. Permission to video record lessons	**Circle one**
I agree that a few of my mathematics lessons may be video-recorded.	YES/NO
2. Permission to share biographical details	**Circle one**
I agree to share my biographical details with the researcher.	YES/NO
3. Permission to conduct an interview	**Circle one**
I agree to do the interview for this study.	YES/NO
I give consent that the interview may be audio-recorded.	YES/NO
I know that I can stop the interview at any time and do not have to answer all the questions asked.	YES/NO

Informed consent

I understand that:

- My name and information, as well as those of the school, will be kept confidential and will not be revealed.
- I do not have to answer every question and can withdraw from the study at any time, with no negative consequences.
- All the data collected during this study will be destroyed within three to five years, after the completion of the project.

Sign_____Date_____

Appendix C:

School consent letter

I, ……., the principal of ……., give consent that the mathematics teachers in this school may participate in the following study at our school: *The impact of Video Stimulated Recall on the professional development of experienced mathematics teachers.*

I give permission that:	**Circle one**
The mathematics teachers can be supported as a team.	YES/NO
Two of the teachers' lessons may be video-recorded.	YES/NO
Two of the teachers may be interviewed.	YES/NO

Informed consent

I understand that:

- My school's name and information, as well as the names and information of the teachers involved, will be kept confidential and not revealed.
- The teachers involved can withdraw from the study at any time, without any negative consequences.

- All the data collected during this study will be destroyed within three to five years, after completion of the project.

Sign_____Date_____

Appendix D:

INFORMATION LETTER TO THE TEACHER

DATE: 17 May 2021

Dear Sir or Madam,

My name is Geoneal Williams. I am an MEd student in the Faculty of Education at the University of the Western Cape (UWC). I am doing research on the use of video stimulated recall (VSR), as a tool for professional development (PD) and support to mathematics teachers. I would like to ask you to participate in the study. The title of the study is: *The impact of Video-Stimulated Recall on the professional development of in-service mathematics.* The reason I have chosen your school is because it has a connection with the UWC in different ways, and I would like to collaborate with you in my research endeavours.

My research involves the observation and video-recording of individual mathematics lessons and the use of VSR as a tool for PD. Teachers will also be asked to complete a biographical information sheet and to participate in an interview. I would like to ask two mathematics teachers to participate in the research, in the course of which video recordings will be made of two to three of their lessons. Footnotes will also be made, but the lessons will in no way be interfered with – only video recorded. This will be followed by a face-to-face interview during which a section of a recorded lesson will be shared with the teacher involved. After a period of

time, another video recording of a lesson or two will be made with a follow-up interview. I would like to audio-record the interviews.

There are no foreseeable risks in participating in this study. The identity of the school and the teachers involved will be kept anonymous at all times, in all academic writings about the study. The data will be kept confidential, on my password protected computer. All research data will be destroyed within five years, after completion of the project.

Please let me know if you require further information. You can also contact my supervisor, Dr. Benita P. Nel at 021 959 3796 or email bnel@uwc.ac.za, or the UWC 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 look forward to your response, as soon as is convenient.

Yours sincerely,

Geoneal Williams

Appendix E:

INFORMATION LETTER TO LEARNERS

DATE: 17 May 2021

Dear Learner,

My name is Geoneal Williams. I am an MEd student in the Faculty of Education at the University of the Western Cape (UWC).

I am doing research on the use of videos as a tool for the professional development (PD) of teachers. I would like to ask your school to participate in the study. The title of the study is: *The impact of Video Stimulated Recall on the professional development of in-service mathematics teachers.*

The reason I have chosen your school is because the mathematics team has a connection with the UWC in different ways, and I would like to collaborate with them in my research endeavours.

My research involves me video recording a maximum of four of the mathematics lessons that you will be part of. The lessons will not be disturbed in any way, besides the fact that someone will be at the back of the classroom, video recording the lesson. Your face will not appear on the recordings. If it does happen accidentally, we will blur your face out in order not to reveal your identity.

The running of the school will not be interrupted at all, and the teachers and learners will not be disadvantaged in any way. Timeous, prior arrangements will be made with your school. There are no foreseeable risks in participating in this study. If you choose not to participate in the study, arrangements will be made to accommodate you in another venue and to catch up missed work. The identity of the school, the teachers, and the learners involved will be kept anonymous at all times, in all academic writings about the study. The data will be kept confidential, on my password protected computer. All research data will be destroyed within five years, after completion of the project.

I am, therefore, asking you to join in this study.

Please let me know if you require further information. You can also contact my supervisor, Dr. B. Nel at 021 959 3796 or email bnel@uwc.ac.za, or the UWC 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 look forward to your response, as soon as is convenient.

Thank you.

Yours sincerely,

Mr. Geoneal Williams

Appendix F:

INFORMATION LETTER TO THE PARENTS

DATE: 17 May 2021

Dear Sir or Madam,

My name is Geoneal Williams. I am an MEd student in the Faculty of Education at the University of the Western Cape (UWC). I am doing research on the use of video-stimulated recall (VSR), as a tool for professional development (PD) and the support to the mathematics team, in the development of individuals. I would like to ask your child's school to participate in the study. The title of the study is: *The impact of Video-Stimulated Recall on the professional development of in-service mathematics teachers*.

The reason I have chosen your school is because the mathematics team has a connection with the UWC in different ways, and I would like to collaborate with them in my research endeavours. My research involves me video recording a maximum of four of the mathematics lessons that your child will be part of. The lesson will not be disturbed in any way, besides the fact that someone will be at the back of the classroom, video-recording the lesson. Your child's face will not appear on the recordings. If it does happen by accident, we will blur his/her face in order not to reveal his/her identity.

The running of the school will not be interrupted at all, and the teachers and learners will not be disadvantaged in any way. Timeous, prior arrangements will be made with the school. If you do

not wish for your child to participate in the study, arrangements will be made to accommodate him/her in another venue and for him/her to catch up missed work. There are no foreseeable risks in participating in this study. The identity of the school, the teachers, and the learners involved will be kept anonymous at all times, in all academic writings about the study. The data will be kept confidential, secured in a locked cupboard in my office and on my password-protected computer. All research data will be destroyed within five years, after completion of the project.

Please let me know if you require further information. You can also contact my supervisor, Dr. B. Nel, at 021 959 3796 or email bnel@uwc.ac.za, or the UWC 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 look forward to your response as soon as is convenient.

Yours sincerely,

Geoneal Williams

Appendix G:

Parent consent form

Please fill in the reply slip below, if you agree to participate in my study titled: *The impact of Video Stimulated Recall on the professional development of in-service mathematics teachers.*

My name: _____

My child's name: _____

Permission that my child's mathematics lesson may be video-recorded.

I consent that my child's lessons may be video-recorded. YES/NO

I am aware that I can change my mind at any time throughout the project, without any negative consequences.

Informed consent

I understand that:

- My child's name and information will be kept confidential, and my child's name and the name of the school will not be revealed.
- I can withdraw my child from the study at any time.

- If I do not consent to my child participating in the project, he/she will be accommodated in a different venue during the recording and the lesson will be made up at another time.
- All the data collected during this study will be destroyed within three to five years, after the completion of the project.

Sign_____Date_____

Appendix H:

Learner consent form

Please fill in the reply slip below, if you agree to participate in my study titled: *The impact of Video Stimulated Recall on the professional development of in-service mathematics teachers.*

My name: _____

Permission that my mathematics lesson may be video-recorded.

I give consent that my lessons may be video-recorded. YES/NO

I am aware that I can change my mind at any time throughout the project, without any negative consequences.

Informed consent

I understand that:

- My name and information will be kept confidential and that my name and the name of the school will not be revealed.
- I can withdraw from the study at any time, without any negative consequences.
- If I do not give consent to participate in the project, I will be accommodated in a different venue during the recording and the lesson will be made up at a different time.
- All the data collected during this study will be destroyed within three to five years, after completion of the project.

Sign_____Date_____

Appendix I:

15/11/2022

To whom it may concern,

Re: Language editing & proofreading certificate

I hereby confirm that I completed language editing and proofreading work on Geoneal Wade Williams' (student nr: 3640826) Master's dissertation titled "The impact of VideoStimulated Recall on the professional development of mathematics teachers" on 15 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)

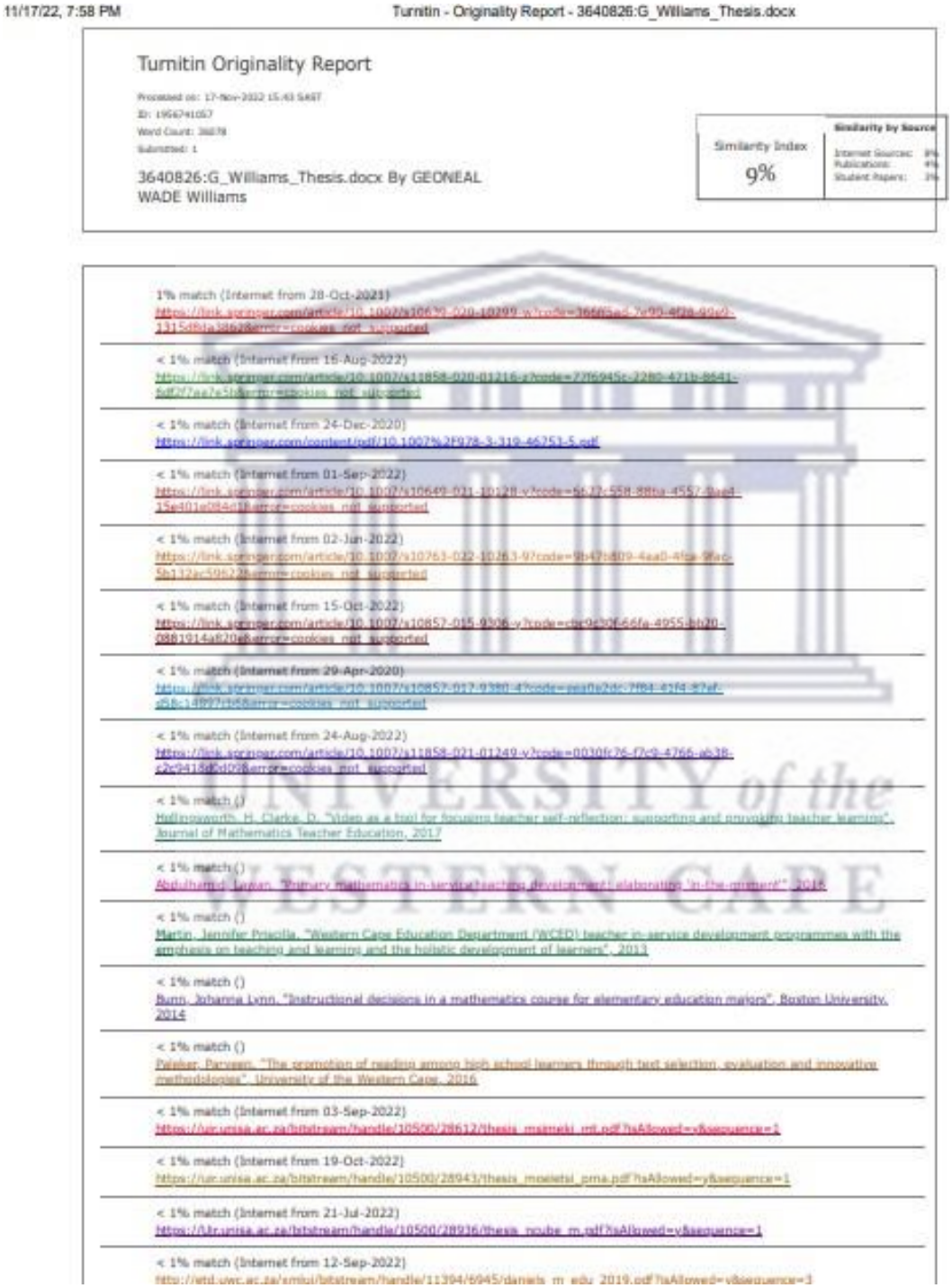
Cell: 0824898108

Email: mitoumba2000@hotmail.com

City: Johannesburg

Country: South Africa

Appendix J:



11/17/22, 7:58 PM Turnitin - Originality Report - 3640826:G_Williams_Thesis.docx

Turnitin Originality Report

Processed on: 17-Nov-2022 15:43 SAST
ID: 1956741057
Word Count: 36078
Submitted: 1

3640826:G_Williams_Thesis.docx By GEONEAL WADE Williams

Similarity Index 9%

Similarity by Source
Internet Sources: 8%
Publications: 4%
Student Papers: 3%

1% match (Internet from 28-Oct-2021)
https://link.springer.com/article/10.1007/s10639-020-10299-y?code=36665ac2-7c99-4f28-99e0-1315d9da3b62&error=cookies_not_supported

< 1% match (Internet from 16-Aug-2022)
https://link.springer.com/article/10.1007/s11858-020-01216-z?code=77f6945c-2280-471b-8641-6df2f7aa7e5b&error=cookies_not_supported

< 1% match (Internet from 24-Dec-2020)
https://link.springer.com/content/pdf/10.1007%2F978-3-319-46751-5.pdf

< 1% match (Internet from 01-Sep-2022)
https://link.springer.com/article/10.1007/s10649-021-10128-y?code=5c12c558-98ba-4557-9aed-15ed01a984d8&error=cookies_not_supported

< 1% match (Internet from 02-Jun-2022)
https://link.springer.com/article/10.1007/s10763-022-10263-9?code=9b47b809-4aa0-4fda-9fac-5b112ac59622&error=cookies_not_supported

< 1% match (Internet from 15-Oct-2022)
https://link.springer.com/article/10.1007/s10857-015-9306-y?code=cbc9e30f-66fa-4955-bb20-08819144820e&error=cookies_not_supported

< 1% match (Internet from 29-Apr-2020)
https://link.springer.com/article/10.1007/s10857-017-9380-4?code=eaafa2dc-7f84-42fd-87af-a5fc14897c68&error=cookies_not_supported

< 1% match (Internet from 24-Aug-2022)
https://link.springer.com/article/10.1007/s11858-021-01249-y?code=0030fc76-f2c9-4766-ab38-c2c9418d0d08&error=cookies_not_supported

< 1% match ()
Hollingsworth, H. Clarke, D. "Video as a tool for focusing teacher self-reflection: supporting and provoking teacher learning", Journal of Mathematics Teacher Education, 2017

< 1% match ()
Abdulhamid, Lygan. "Primary mathematics in-service teacher development: collaboration 'in the moment'", 2018

< 1% match ()
Martin, Jennifer Priscilla. "Western Cape Education Department (WCED) teacher in-service development programmes with the emphasis on teaching and learning and the holistic development of learners", 2013

< 1% match ()
Bunn, Johanna Lynn. "Instructional decisions in a mathematics course for elementary education majors", Boston University, 2014

< 1% match ()
Paleker, Parveen. "The promotion of reading among high school learners through text selection, evaluation and innovative methodologies", University of the Western Cape, 2016

< 1% match (Internet from 03-Sep-2022)
https://uir.unisa.ac.za/bitstream/handle/10500/28612/thesis_mameki_mt.pdf?isAllowed=y&sequence=1

< 1% match (Internet from 19-Oct-2022)
https://uir.unisa.ac.za/bitstream/handle/10500/28943/thesis_moeletsi_pma.pdf?isAllowed=y&sequence=1

< 1% match (Internet from 21-Jul-2022)
https://uir.unisa.ac.za/bitstream/handle/10500/28936/thesis_noube_m.pdf?isAllowed=y&sequence=1

< 1% match (Internet from 12-Sep-2022)
http://etd.uwc.ac.za/xmlui/bitstream/handle/11394/6945/daniels_m_edu_2019.pdf?isAllowed=y&sequence=1