



# Teachers' professional development shaped through self-reflection using video-stimulated recall



## Authors:

Geoneal W. Williams<sup>1</sup>   
Benita P. Nel<sup>1</sup> 

## Affiliations:

<sup>1</sup>School of Science and Mathematics Education, Faculty of Education, University of the Western Cape, Cape Town, South Africa

## Corresponding author:

Benita Nel,  
bnel@uwc.ac.za

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**Background:** Self-reflection is seen to be a key factor to individual improvement and development, and thus commendable of investigating. The challenge however is what tools to use to reflect effectively. This study examined the professional development of in-service Mathematics teachers through self-reflection using Video Stimulated Recall (VSR) as a reflective tool.

**Aim:** The aim of the study was to contribute to the body of knowledge of professional development of teachers through VSR.

**Setting:** This article describes an intervention where VSR was incorporated in two primary schools on the Cape Flats, Western Cape.

**Method:** This study implemented the qualitative research paradigm involving four teachers. Data collection consisted of video recordings of lessons and semi-structured interviews after watching the video recording of their own lessons. A minimum of two cycles of observations and interviews were conducted per teacher.

**Results:** After self-reflection, some of the participants altered their classroom practices to enhance the teaching and learning of mathematics while some reflected superficially. The lack of reflecting on their learners' mathematical thinking and reasoning might have been ascribed to the limitation of viewing only two recorded lessons, the possible inability of the interviewer to probe the participants further or the participants' inability or unwillingness to reflect deeper.

**Conclusion:** Video-stimulated recall allowed participants to self-reflect. However, this tool should be used over a longer period to significantly influence practice.

**Contribution:** Video-stimulated recall as a reflective tool can be used as an in-house professional development initiative that is customised to the needs and context of the participants.

**Keywords:** continuous professional development; self-reflection; teachers; conscious-competence model; video-stimulated recall.

## Introduction

Self-reflection is seen to be a significant component of individual improvement and development, and thus this is a commendable field of investigating. This study examined in-service mathematics teachers' professional development through self-reflection by implementing video-stimulated recall (VSR) as a reflective tool. Self-reflection can be used as a form of professional development where the teacher's unique context is incorporated contrary to generic professional development activities where their unique context and needs are not recognised. Although the participants in this study were mathematics teachers, this study is not limited to the mathematics education field. The aim of reflecting upon one's instructional practice is an attempt to enhance instructing practice yourself, putting the teacher in the driving seat of their own development. The VSR process is as follows: a lesson is video recorded; thereafter the recording is examined by researcher and participant as a stimulus to reflect on the lesson (Muir 2010). The process is then repeated in a second round of recording of a lesson followed by reflection when the lesson recording is watched again. It is important to consider that teachers teach with an array of skills, knowledge and experiences, and that self-reflection is very personal.

Mathew, Mathew and Peechattu (2017) emphasise the significance of reflection within the instructional field. The convolution of teaching requires reflection on teaching practices (Mentz et al. 2020). 'Reflection is central to professional development', which points to exploring this specific tool to empower teachers to reflect upon their educational practices more effectively

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(McArdle & Coutts 2010:201). This study seeks to investigate the following research question: How can the use of VSR as an in-house professional development initiative, support mathematics teachers' development in under-resourced schools in the Western Cape, South Africa?

## Literature review

Raelin (2002) and Habash (2019) characterised self-reflection to be the foundation of self-awareness. It permits people to delve into their feelings, sentiments, and activities with intrigue and interest in an unbiased manner. Habash (2019) underscores that self-reflection may be a capability; a capability that is basic for individual development. Reflection provides support in choosing more advantageous responses and altering conduct in future endeavours (Habash 2019).

Self-reflection is further characterised as a structured process for teachers to create connections between one occurrence and another (Farrell 2004). The teacher's responsibility is to create an environment beyond any doubt that the methods used in the classroom boost learning advancement and teachers' classroom practice. Farrell (2004) accentuates that reflection ought to be regarded as an essential portion of instructing and learning. Intelligent teaching practices make one mindful of natural proficient information and activity (Raelin 2002). It accomplishes this through challenging the presumptions of ordinary educating practice whereas basically assessing instructing practitioners' reactions after reflection on practice circumstances (Finlay 2008).

Practising reflection comprises much more than mere individual involvement (Bengtsson 1995). Reflection is taking a cognisant review of all variables that make up a well-versed encounter (Mathew et al. 2017). These components incorporate the feelings, encounters, and activities, which coincide with the reactions seen. The existing information is built up where new information is included to attain the next level of understanding. Generally speaking, reflection is the exercise of contemplating one's teaching.

Self-reflection is an obligatory component of day-to-day instruction regimen (Yeung 2018). Considering the significance of self-reflection, it is surprising to witness the need for information related to this marvel (Yeung 2018). This can be maintained by numerous impacting components. One element that ruins self-reflection in teachers is time administration (Scheib 2003). For Yeung (2018), day-to-day reflection ought to be considered as vital as instructing and learning in instruction itself. Teachers are to pose questions about their instructing propensities and the anticipated results of the lesson. The answers to the given questions may come from within or from those around these teachers (Yeung 2018).

To refine time administration after reflection, teachers have to make strides in their classroom administration (Weber et al. 2018). Productive self-reflection disturbs poor classroom administration. Subsequently time administration is a critical

component of self-reflection (Yeung 2018). In addition to self-reflection, Yeung (2018) and Weber et al. (2018) accentuate that proper time management allows for better administrative duties, teaching, and supportive feedback to learners and proper classroom management.

In teachers' case, this works well within the classroom setting. The recognisable proof of considerations amid reflection permits teachers to pinpoint shortcomings in practice (Mathew et al. 2017). Within the occasion of a teacher watching a new lesson, it permits the teacher to determine the aspects of the lesson that require enhancement, for instance, talking in a monotone voice or utilising the wrong lingo, which isn't reasonable for the setting (hypothetically, there's an appropriate dialect for each setting or ages inside the classroom). This can be how hypothesis and practice are connected through reflection.

The value of self-reflection is deliberated by its capacity to allow teachers to assess their educational practice (Cox 2020). It permits the examination of their own practice in arrangements to set up what is most productive in their classrooms. Self-reflection is considered fundamental because it is non-biased (McArdle et al. 2010). Also, self-reflection can be practiced on lessons whether the lesson went well or not. Cox (2020) clarifies that with self-reflection, it is unimportant whether a lesson was good because there are still parts that can be refined. Self-reflection is required to set up areas that require advancement (Evans 2014).

Self-reflection is considered groundwork instead of a one-time occurrence. Cox (2020) portrays the method as diagnosing a specific issue in instruction procedures, which will ruin effective teaching and learning. In recognising the issues in instruction techniques, classroom data must be accumulated. A support platform called TeachHub for teachers universally proposes a few thoughts to improve self-reflection (Cox 2020). A strategy for teachers to self-reflect is through self-observation and considering their preconceptions. This can be fundamental when the teacher recognises their claimed feeling amid their lesson introduction whereas watching learners' responses amid distinctive parts within the lesson. To maintain a strategic distance from overlooking these reflections, it is proposed that teachers make diaries of all their observations to self-reflect after lessons.

When teachers self-reflect, a few vital components of the lesson ought to be considered (Cox 2020). To assess whether lesson objectives were met, and whether learners' understanding of content instructed was achieved (formative assessment is a manner to measure this), is another component of the lesson that ought to be considered. Furthermore, whether the learning materials utilised within the lesson retained learners' attention and if other learning materials may be additionally included remains uncertain until teachers self-reflect. Hence, teachers ought to include questions of reflective nature around their instruction

practices into their daily activities to enhance their self-reflection. These questions can relate to the adequacy of the lesson, affectability to learners' instructive needs and the teachers' state of mind, and conveyance amid lessons (Cox 2020). Self-reflection is practised on a customary premise where teachers find specific zones in their practice that require change. At the same time, they recognise ranges where they may well be doing exceptional in their educational practice. The extreme objective of self-reflection is to progress by and large through educational practice (Cox 2020).

Video-stimulated recall was favourable for participating teachers' weekly self-reflection in a study conducted by McCoy and Lynam (2021) as well as the improvement of their self-reflective practice. All the members in their reflection saw the accommodating nature of self-reflection. McCoy and Lynam (2021) cited one member who claimed:

[R]eflection 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 provides evidence of one teacher's perception while including video tools for self-reflection in the classroom. This indicates that there are teachers who prefer to do video recordings and then take them home for analysis and reflection.

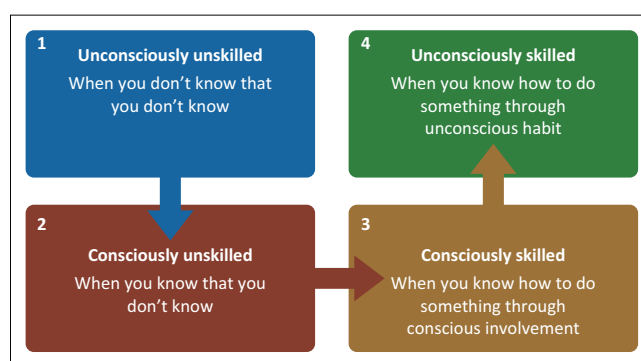
Gibson and Ross (2016) described noticing as the ability to observe important details in learners' reaction during instruction as well as deciphering information to actively adapt teaching practices. In pedagogical settings, teachers tend to think that they are in complete control of their lessons and have full surveillance in the context. While observing the video-recording of their teaching, some aspects of their teaching tend to draw their attention. These aspects include facets of the lesson that they might not have known before and imagined the situation or actions different from what they then see in the video. In teaching, noticing cannot be considered an incidental activity (Mackey 2006). Mackey (2006) further discussed how imperative it is for teachers to intentionally notice and in the process identify gaps in their teaching, which can, for example, be finding that second language learners do not understand mathematical terminology in the lesson because of language barriers. It is rather the act of intentionally becoming aware of the occurrences within the classroom than accidental occurrences (Biccard 2020). There are three pillars of noticing (Santagata et al. 2021): identification of noteworthy situations, making connections, and using one's context to reason noteworthy events within the classroom context that can be improved in future lessons. Furthermore, noticing through self-reflection is a form of professional development (Biccard 2020). The argument behind this is that teachers notice occurrences, interpret and reflect on them within the classroom environment and might act on it in future. Therefore, the use of videos in self-reflection can be a valuable means to strengthen noticing.

## Theoretical framework

The theoretical framework of this study was the conscious-competence learning model of Burch. Burch (1970) introduced the idea of the conscious-competence model where it was developed to explain how the human psychological state is related to our abilities to master skills. The four-staged model (see Figure 1) describes the different stages one goes through while learning a new skill or mastering an existing skill. At the *unconscious incompetence* stage, one does not comprehend how to do something, and does not necessarily identify the deficit. The *conscious incompetence* stage is when one does not comprehend how to do something, but now she or he is aware of the deficit in the skill or knowledge identified. The *conscious competence* stage is when one comprehends how to do something, although demonstrating the skill or knowledge requires attentiveness when using it. At the *unconscious competence* stage, one has had so much experience with the skill or knowledge, that it needs little thought and can be done while executing other errands. In this study, we will refer to these stages as stages 1–4, meaning the unconscious-incompetence stage will be stage 1, and so on. A teacher might progress through the different stages depending on their awareness of certain skills and competencies that they notice while reflecting on their lessons. This means that an individual can be at different stages of ability per skill or knowledge depending on the skill or knowledge in question.

This study explores teachers' self-reflection through VSR. This study might assist in understanding how teachers act on identified limitations in their classroom practices highlighted through self-reflection. This study also explores how teachers do self-reflection on their observed video-recorded lessons. As the process of self-reflection is a personal act, teachers reflect on distinctive perspectives of their instruction and to varying degrees, depending on their awareness. Exploring how teachers respond to what they take note of, is critical for reflective practitioners.

Video-stimulated recall is a process whereby a lesson is video recorded and played back in order for the teacher to reflect. After the video observation, the participant, in this case the teacher, is interviewed to ascertain the level and the aspect of the skill or knowledge that the reflection took place on. This



Source: Woods, N., 2018, *The four stages of learning model*, viewed 01 June 2023, from <https://nathanwood.consulting/2017/11/23/the-four-stages-of-learning-model/>

FIGURE 1: Burch's four stages within the conscious-competence learning model.

kind of interview is called the video-stimulated interview as the interview (and reflection) is stimulated by watching the video-recording.

## Research methods and design

This study employed the qualitative research approach in order to collect thick descriptive data to answer the research question: How can the use of VSR as an in-house professional development initiative support mathematics teachers' development in under-resourced schools in the Western Cape, South Africa? This created a foundation to gather illustrative data from four mathematics teachers' self-reflection through VSR. Four teachers from two schools took part in the study. This study was conducted in two schools located in a Cape Flats suburb in Cape Town. Both were primary schools, which serve low socio-economic communities, residing under the administration of the Western Cape Education Department. Convenience sampling was used as the schools were accessible to the researcher in terms of geographical location of the school where the first author was teaching. The participants (teachers) came from different educational backgrounds. The four teachers in this study were regarded as in-service teachers who had at least 3 years of teaching experience. The ages of these teachers varied between 25 and 65 years.

Two teachers per school were purposely selected, as only those who agreed to partake in the study, took part where all participants were specialising in mathematics education. The data were collected during the COVID-19 pandemic when the schools implemented the rotational timetable system. This implied that learners attended schools in smaller groups of 15–25 learners per class as the classes were split into two groups to ensure social distancing. This means that teachers might not have taught the same group every day or the smaller classes may have had different teachers alternating to teach them. Classroom sizes may have altered the teacher behaviours, which is important to observe (Meier & West 2020), meaning that not the same method of teaching was necessarily employed with the smaller group compared with how teaching took place before the pandemic with the larger classes. However, the study was on self-reflection and hence the data collection within the COVID-19 context led to the researcher adhering to the COVID-19 regulations with social distancing, but did not necessarily affect the overall focus of the study. Whether teachers teach a small or larger group, does not have a major effect on how they perform self-reflection. The mathematics teams from each school underwent a once-off training session of 2 h conducted by the principal investigator of the larger research project to familiarise them with what the complete VSR process entails and how to implement it. Because of the COVID-19 regulations at the time, the training was performed in a bigger venue to ensure social distancing.

Data collection consisted of two lesson observations and video recordings per teacher with each of the four teachers'

lessons. Data collection was performed by the researcher. Biographical data of each participant was also collected through a questionnaire. A short while after each lesson recording (usually within a week), the participating teachers were naturally interviewed (with an average time of 20 min per interview) after the lesson recordings were observed by the researcher and teacher in question. This has been performed to investigate the possible effect of VSR on the reflection of mathematics teachers. To relive teaching experiences, VSR was used as a tool for teachers to now observe their lessons from the other side of the camera lens. Each individual lesson recording was followed by a VSR interview where the video recording was used as a stimulus for teachers to reflect on their own practice. Pseudonyms were used to ensure anonymity of the participants. The teachers were identified as Teacher D, G, O and V, respectively. Teachers D and G were teaching at school A and teachers O and V were teaching at school B. Data were stored in an appropriate way to ensure confidentiality and the necessary ethics approval was obtained from the relevant authorities. Table 1 provides the biographical details of the teachers.

## Results and discussion

The discussion of the data itself and the findings thereof are reported together, categorised according to the themes that arose during the data analysis. This was performed to answer the research question: How does the use of VSR enhance self-reflection for the professional development of mathematics teachers? The researcher probed the participants according to what transpired in the recordings of the lessons. Proposed probing questions were posed such as: What did you notice when you observed the video within the specified timeframe? What can you improve on if you present the same lesson to a similar group, etc.? The themes in the data analysis process were established through using the different aspects that the participants noticed in their self-reflection. This was combined with the different stages of the Conscious-Competence Model. The following themes arose from the data as aspects that the participants noticed when reflecting: time management, pedagogy, body language, and tone of voice.

**TABLE 1:** Biographical details of the teachers.

Teacher D	Teacher O
<ul style="list-style-type: none"> <li>• Male</li> <li>• 20 years teaching experience</li> <li>• Honours qualification in mathematics education</li> <li>• Grade 6 class lessons were recorded</li> <li>• Lesson 1 covered measurement and units used</li> <li>• Lesson 2 covered area and perimeter of 3D objects</li> </ul>	<ul style="list-style-type: none"> <li>• Female</li> <li>• 5 years teaching experience</li> <li>• Honours in mathematics education (in progress)</li> <li>• Grade 6 class lessons were recorded</li> <li>• Lesson 1 covered area and perimeter of the circle</li> <li>• Lesson 2 was a revision on shapes</li> </ul>
Teacher G	Teacher V
<ul style="list-style-type: none"> <li>• Female</li> <li>• 28 years teaching experience</li> <li>• Master's qualification in Music</li> <li>• Grade 7 class lessons were recorded</li> <li>• Lesson 1 covered area and perimeter of the circle</li> <li>• Lesson 2 was a revision on shapes</li> </ul>	<ul style="list-style-type: none"> <li>• Female.</li> <li>• 28 years teaching experience.</li> <li>• BEd degree qualification (Mathematics and English)</li> <li>• Grade 7 class lessons were recorded</li> <li>• Lesson 1 covered area and perimeter of the circle</li> <li>• Lesson 2 was a revision on shapes</li> </ul>



## Time management

Time management is defined as the productive and effective management of time, which most teachers strive to achieve (Weber et al. 2018). Without proper time management, teachers will find it difficult to complete their mathematics curriculum according to the year planning as stipulated in their Annual Teaching Plans (ATPs). These plans are compiled by the Western Cape Education Department (WCED) and stipulate, which topics should be covered per week per subject per grade. Deviating from these timelines can lead to other serious repercussions teachers are expected to adhere to this plan in order to complete the curriculum for the year.

After watching the video recording of his first video-recorded lesson: 'I might be ... too in a hurry to carry on with the lesson and not wait for learners to first complete [*writing their notes from the board*] ...' (Teacher D, M, Interview 1, 2021).

The teacher realised that he did not allow the learners sufficient time to copy the work from the board into their notebooks. Through listening at first and then copying the work in their notebooks, allow the learners to use different senses to process information. Also, these notes can be used by them to revise at home in order to enhance their conceptual understanding of the topic at hand. It became evident that Teacher D noticed an aspect of his classroom practice that could be improved on. In the second lesson, he acted on what he noticed in the first lesson observation as he mentioned the following in the second interview: 'I actually walked around and gave them a chance to complete. That was an improvement on the last lesson as well' (Teacher D, M, Interview 2, 2021).

Watching his video-recorded lesson assisted Teacher D to enhance his classroom practice as he observed that his time management showed room for improvement. In the second lesson, Teacher D came to the realisation that his time management improved as he spent the adequate amount of time on each lesson part. These parts are the introduction, presentation, activity, and the conclusion of the lesson. 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, while they were rushed to listen to the discussion that followed. This teacher was initially unaware (stage 1) of his learners not finishing copying work from the board, he became aware (stage 2) of it and in the subsequent lesson acted on (stage 3) his noticing and allowed for more time to copy the work. Teacher D thus moved from stage 1 in terms of time management to stage 3.

Another participant, Teacher G, also reflected upon her time management. Teacher G noticed that she 'spent time drawing ... it could be 3 or 4 min of your time and that's a long period of time, you know' (Teacher G, F, Interview 1, 2021). Here it was evident that she thought that 4 min was too much time wasted on drawing, time that could have been used better, realising that the incorporation of technology into the lesson,

could assist her in saving time. However, Teacher G did not include this point of interest in her second interview. It can therefore not be ascertained whether she acted on this aspect of noticing. She therefore moved from stage 1 (stage of unawareness) in Burch's model to stage 2 (becoming aware) in terms of time management.

Teacher V noticed and reflected upon her time management as well after watching the video-recording of her lesson, where she deemed to perceive room for improvement. When asked what she would improve in her lesson, she responded: 'to save time while I am handing out everything' (Teacher V, F, Interview 1, 2021).

This alluded to her handing out apparatus when she dealt with 'time' as a topic in her lesson. In the second lesson, Teacher V attempted to remedy her time management. She stated that she 'would have wanted to save time ... nothing goes according to plan' (Teacher V, F, Interview 2, 2021).

Teacher V reflected upon her second lesson and saw that her time management did not improve as she would wish to as she noticed that there was still room to improve her time management. A third VSR interview was carried out with Teacher V, where she reflected upon her time management once more. She stated that she 'should have just put it over two lessons or three lessons' (Teacher V, F, Interview 3, 2022) to remedy the time management situation in her mathematics classroom. Here it was evident that she noticed that she covered too much content in the lesson and that it would be best to spread the lesson over two sessions. It can therefore be concluded that Teacher V transitioned from stage 1 to stage 2 in terms of time management as she acted on what she noticed in the recorded lessons. She however did not reach stage 3 as she did not become competent in dealing with time management in her classroom.

## Pedagogy

Noticing also was observed in terms of lesson conducting. Teacher G reflected and reported that her first lesson overall went well, but her reflection was performed superficially as she did not pinpoint specific aspects of her lessons. Instead she acknowledged: 'certain things I picked up that I could improve on' (Teacher G, F, Interview 1, 2021), but did not specify what she was referring to. Also, the interviewer unintentionally did not probe her further to get more specific information on what she meant. This was only realised when the data were analysed. Teacher G reported having reflected upon her entire style of teaching during the second cycle of observation and interviewing. She stated that her lessons were reworked and 'completely new' (Teacher G, F, Interview 2, 2021). Teacher G's second lesson with the Grade 7 class was on shapes. Opposed to lesson one, Teacher G tried to visually stimulate learners by using contrasting colours on the board so that 'their minds could be fixated on that specific figure' (Teacher G, F, Interview 2, 2021). Here, Teacher G became conscious of a potential gap in developing the mathematical knowledge

and made an effort to enhance it through enhanced visual stimulus. Teacher G further tried to include audio stimulation while teaching mathematics. After the first interview, Teacher G reflected and explained the following:

*'[There is] 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, F, Interview 2, 2021)

Teacher G, holds a Master's degree in music. When watching the lesson recording, she reflected and became conscious of the possibility to incorporate music into her future mathematics lessons knowing that learners know pop songs' words by heart. She then found a music video on YouTube on shapes with a youthful rhythm where the song explains the properties of shapes. It became evident that the song resonated with learners and they remembered the tune and the words of the song even after the lesson. Through reflections, the teacher could improve her lesson by combining her expertise as a music specialist with mathematics, which assisted the learners in a playful manner to learn the properties of shapes. Thus, Teacher G developed from stage 1 to stage 3 in terms of her pedagogy.

Teacher O reflected and noticed that 'there wasn't really much interaction' in her first lesson (Teacher O, F, Interview 1, 2021) as the topic (2D and 3D objects) was a new concept for the Grade 6 learners. She also noticed that:

*'I am doing most of the talking. I need to allow them to communicate with me more so I can know - do they understand or lost me at some point? ... In the middle [of the lesson] I just stopped to ask if there was anything that anyone wanted to ask.'* (Teacher O, F, Interview 1, 2021)

In the second lesson, she said that '[t]hey don't interact as I want them to ... this is not a new topic' (Teacher O, F, Interview 2, 2021). It seemed as if the teacher did not implement her challenge with learner-centred teaching that she noticed in the first interview. She still had a challenge to have more interaction in the second lesson. She intended to continuously attempt to work on her communication skills to enhance mathematics teaching and learning.

In the second lesson she also revealed that the learners were not really interested in the topic, although she prepared herself well for the lesson and was more energetic in the second lesson. After reflecting, Teacher O consequently questioned if learners understood the content she taught after noticing this challenge. It can thus be concluded that she moved from stage 1 to stage 2 in terms of her communication, learner-centredness and interaction in the classroom because she did not act on her intention in the second recorded lessons in this study.

Teacher V had a challenge to assess if her learners understood the concepts covered in the class:

*'Yes, you can teach it, but does the learner actually understand. So, I wish I knew um, not where they were at but what method to use in the beginning. Because it started getting frustrating*

*towards the end and yes there were a few learners that understood but I wanted my whole class to understand.'* (Teacher V, F, Interview 2, 2022)

She doubted if all her learners grasped the concept that was introduced in the second lesson. She also found it challenging to ask questions that would assist her to assess if the learners understood the concepts:

*'... something I also picked up on was where my kids ... after everything I explained then I will stop and pause and I will engage with the class and I will ask them uh, is there anyone that you don't understand or I will say, OK, I'm giving an opportunity for somebody who doesn't understand. I think instead of saying that uhm, maybe I should use different wording, because that now makes a learner feel maybe scared 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, F, Interview 1, 2022)

Teacher V noticed that she does not know whether all her learners grasped the concept that she covered in the lesson. She therefore became conscious of her incompetence to effectively incorporate formative assessment to assess learners' understanding of a concept at a particular point in the lesson. She therefore is in the second stage of Burch's model in terms of formative assessment. She alluded to ways in which she can enhance her formative assessment by using better wording to pose to the learners, or not to pose questions to the entire class, as this does not give her an idea if they understand the concept. As this was the last data collection session for this teacher, it cannot be ascertained if she progressed to the third stage in the Conscious-Competence model where she might have implemented her own suggestions of improving her ways of doing formative assessment. It can thus be concluded that Teacher V had difficulty ensuring that the learners understood the concepts covered and also how to pose more appropriate questions to ascertain if they understood the concepts.

Teacher V reflected on her lessons and noticed that in her lesson on fractions in Grade four, she neglected to write important mathematical keywords on the board. These key mathematical concepts in this introductory lesson include numerators, denominators, equivalence, and improper fractions. She might have uncovered why not all the learners grasped the concepts as they need these key concepts on the board to assist them in understanding new words learnt. In terms of her pedagogy when introducing concepts, Teacher V transitioned from stage 1 (not aware) to stage 2 (becoming aware but did not act on it).

## Body language

Teacher D said during interview 1 that body language was a significant revelation when he saw himself in the video-recording:

'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, M, Interview 1)

During the second lesson recording and interview, Teacher D addressed it directly by using hand gestures when referring to the board:

'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, M, Interview 2, 2021)

Teacher D was consciously addressing the issue of body language in the next lesson. He also noticed the changes in the second interview compared with the video lesson one. After reflecting, Teacher D saw it as an achievement and improvement. Therefore, he transitioned from the conscious-incompetence (stage 2) to the conscious-competence stage (stage 3) in terms of effective body language.

### Tone of voice

Teacher G continued by explaining one aspect that concerned her when watching the video recording of her first lesson, which was her tone of voice. She said that she 'should tone down' and that she 'doesn't want kids to get lost' (Teacher G, F, Interview 1, 2021): 'I got a bit irritated with my continuous loud voice ...' (Teacher G, F, Interview 1, 2021).

After reflecting, Teacher G noticed her tone of voice, which she deemed not to be beneficial for teaching and learning. Teacher G was especially annoyed as she stated that she holds a Master's in Music with a fine ear, yet she never noticed her tone of voice as VSR exposed it. After lesson observation one, Teacher G became very aware and conscious of this issue. In interview 1, she vowed to address this issue in future lessons. In the second lesson recording, Teacher G addressed the issue and in interview 2, she stated: 'I spoke softer ... I was very aware of my volume' (Teacher G). Teacher G was at first comfortably unaware of her tone of voice, but after the first video observation she became uncomfortably aware of her tone of voice. Here Teacher G moved from the unconscious-incompetent stage (stage 1) to the conscious-incompetent stage (stage 3).

The question under investigation was: How are teachers' professional development shaped through self-reflection using VSR as a reflective tool? The analysed data showed that VSR has significant potential in developing teachers who are self-reflective and driven to improve their classroom practice. This will however require honest introspection where deeper reflection should be assisted through probing by a peer or a significant other. However, in this case, the researcher should encourage the teacher that when incompetencies are noticed, concerted efforts should be made to act on them in subsequent lessons. Also, reflections through VSR should be practised on a regular basis in order to get more benefit from it.

### Ethical considerations

Ethical clearance to conduct this study was obtained from the University of the Western Cape Humanities and Social Science Research Ethics Committee (No. HS21/7/47).

### Conclusion

Video-stimulated recall did enhance self-reflection among all four mathematics teachers who participated in this study. Analysis of two and in other cases, three video recording cycles and interviews assisted the participants to develop in terms of different aspects of their teaching, depending on what they noticed in the video-recordings. In the study, a third record cycle was added to two of the participants depending on the richness of data that were collected in the previous sessions. These added reflection sessions show how the VSR process can be repeated several times to enhance continuous reflection and professional development. Therefore, VSR can provide teachers with the ability to see their lessons in real time, notice aspects where they can improve on (become conscious), and they can act on them in the quest to become more competent professionals. This in turn creates self-awareness among teachers.

Self-reflection through noticing by all four participant teachers was evident during the data collection process. Participants noticed and reflected upon numerous aspects of their lessons. The most significant was pedagogy and pedagogical aspects as all the participants observed and reflected upon these aspects. Other aspects were body language and tone of voice. Participants noticed challenges in their actual lesson delivery and board writing, while all participants saw the usefulness of VSR in terms of personal reflection. Video-stimulated recall allowed participants to self-reflect and consequently it enhanced self-reflection itself.

However, what was also evident was that the in-service teachers hardly noticed mathematical thinking and reasoning of the learners and focussed more on general issues. These issues include tone of voice, body language and mood during the lesson presentation. The concern is why that was the case? This issue where in-service teachers focus on general issues or events was confirmed by the work performed by Amador and Weiland (2015). It might have been that the interviewer did not emphasise the importance of focussing on learners' mathematical thinking or was not experienced enough to facilitate the interview to probe the participants adequately in terms of learners' thinking. It might also be that the participants were unable or unwilling to reflect deeper and were comfortable in focussing on the more general matters. All the participants had more than 5 years of teaching experience and their inability to reflect on the learners' mathematical thinking and reasoning cannot be because of their lack of experience as argued by Jacobs, Lamb and Philipp (2010). The authors would argue that more reflection sessions should have been conducted to allow for deeper reflection where the focus could be more on mathematical aspects. The authors also suggest that more focus should be given in terms of reflection to ensure that reflection is



focussed on mathematics and mathematical thinking in the classroom.

## Limitation of the study

Because of time imperatives and the COVID-19 pandemic restrictions, only two lessons could be recorded of two teachers. The other two teachers had three lessons recorded. None of the teachers reached stage four (unconscious-competence stage) of the conscious-competence model; maybe it was because of this constrained observation period. The data collection cycles only lasted a month, therefore the conscious-competence model could not be fully utilised in order to measure if teachers reached stage four in one of their identified skills or knowledge.

## Future research

Future studies might record more lessons, to allow for more reflections by the participants and possibly have more opportunities to reflect deeper. A bigger sample can also be used with variation in the experience of the participants. Including VSR as a joint reflection by subject teams can also be a possible future option. Future research can also focus on what can be perceived as conducive circumstances to allow for deeper reflection and more focus on learners' mathematical thinking and reasoning.

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### Competing interests

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### Authors' contributions

G.W.W. was responsible for the conceptualisation, methodology, data curation, first draft of the formal analysis and writing the first draft of the article. B.P.N. was the supervisor and further refined the formal analysis of the data, was the project administrator of the bigger research project and also the principal investigator who received the funding for the bigger project. B.P.N. also reviewed and edited the manuscript after the first draft and made changes to the structure of the manuscript to prepare it for possible publication.

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### Data availability

The data are stored safely at the University of the Western Cape, but not have accession codes.

## Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors and the publisher.

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