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Professional learning by mathematics teachers through video-stimulated recall

Abstract

This article reports on mathematics teachers' professional learning prospects through video-stimulated recall (VSR), a tool for in-house professional development. Providing timeous feedback to teachers on aspects of their teaching that they should improve are greatly beneficial. Two Mathematics teachers at a rural high school in a province of South Africa, implemented VSR. The research question was: What is the effect of incorporating VSR on the professional learning of these two mathematics teachers? This qualitative study used the conscious competence learning model as its conceptual lens. VSR-related interviews served as data collection instrument. The findings revealed that the teachers reflected differently and on different aspects of their lessons. Their professional learning varied were they adapted their teaching on some of the aspects noticed and one some not/ to a limited extend. VSR put them in the driving seat of their own learning, allowing them to develop professional as noticed through reflection.

Key words: *reflection; videos; professional learning; mathematics teacher education; in-service education*

1. Introduction

Most professional development initiatives in South Africa are off-site and not customised to the specific needs of the participants (Luneta, 2012). In addition, interventions have been largely detached from the hands-on classroom analysis. This might be because the biggest teacher union in South Africa did not allow anyone to access classrooms for any visit perceived as linked to evaluation. Supporting teachers in the classroom arose suspicion and was not encouraged. However, teachers needed to direct the professional development (PD) initiatives so that they could be relevant to their specific classroom context. The challenge, therefore, is how to balance the unique context of an individual teacher and their real-time reflection on how to improve teaching and learning.

The research question explored in this regard was: What is the effect of the incorporation of video-stimulated recall (VSR) on the professional development of mathematics

teachers? VSR is a professional development tool that enables teachers to watch recordings of their own lessons and reflect on their own teaching.

Creating opportunities for teachers to watch live recordings of their own lessons placed them on the other side of the video lens. This engendered the possibility of gaining a new perspective on their practice. This new perspective can enable teachers to notice aspects of their teaching that they were unaware of or those that need adaption. The new lens that teachers use to observe their lessons puts them in control of their own PD by fostering their eagerness to be lifelong learners. Revisiting their lessons create learning opportunities that enable teachers to rethink how they apply their skills and expertise. The aim thereof should always be to enhance teaching and learning in their classrooms. Therefore, a shift to a teacher's own classroom, in PD initiatives, is explored.

The question is whether PD initiatives translate into professional growth that might improve the quality of mathematics teaching and learners' related performance. By providing insight into the effects of VSR-based teacher professional development interventions, this study attempts to contributes to the establishment of more effective in-house PD initiatives.

2. Literature Review

Research indicates that self-reflection, where "deliberate and consistent examination of (one's) teaching practice" (Pellegrino & Gerber, 2012: 1) occurs, is a critical component in developing teachers' instructional practice and decisions on "what to teach and how to teach it" (ibid). The emphasis should be on a view of teachers' learning and self-reflection on their classroom practice as a means of fostering PD (Muir & Beswick, 2007). Reflection as "a self-critical, investigative process wherein teachers consider the effect of their pedagogical decisions on their situated practice with the aim of improving those practices" (Rich & Tripp, 2012: 678). Nel (2015 14) also accentuates that "the lessons learnt by teachers from their exposure to reflective practice in their teaching should result in their engagement in new practices". Therefore reflective practice is a continues professional development (CPD) tool that might enhance teaching and ultimately learning. The VSR technique "is an introspection procedure in which videotaped passages of behaviour are replayed to individuals to stimulate recall of their concurrent cognitive activity" (Lyle, 2003: 861). This reflection occurs in the natural setting of the teachers' classrooms and is thus attached to their workplace and customised for specific individuals and their development needs.

This technique steers away from the one-size-fits-all style frequently used in PD initiatives. It also counteracts the top-down model of staff development where the impoverished notion that wisdom is only derived from the experience of others is questioned (Zeichner, 1994). VSR entails observing teachers' current practices, while striving to develop the best pedagogical practices (Muir, 2010). VSR creates an opportunity for immediate and specific feedback on what transpired in a teacher's own practice in his/her classroom. The feedback is provided by the teachers themselves and serves to improve what they observe about themselves. No judgements or evaluations are at play. Becoming an effective teacher requires a reflection that involves a consistent and deliberate introspection of teaching practices. This is necessary in improving instructional practice and promoting active learner participation (Pellegrino & Gerber, 2012).

The incorporation of videos in CPD is done more widely to enable teachers to notice and analyse their teaching practices more systematically (Sherin, Russ & Colestock, 2011). This

is because videos can capture teaching in its authenticity and complexity. Videos also help to zoom into the interactions occurring in the classroom (Van Es, 2011). Rich and Hannafin (2009: 53) observe that "video annotation tools offer the potential to support both reflection and analysis of one's own teaching and to link captured video with related evidence". Videos offer a 'new view' on what was taught and how it was taught and thus enable the reflection that helps to envisage how teaching can be done differently. Such a 'new view' was not necessarily envisaged by the teacher at the time of the video-recorded teaching (Lyle, 2003). Thus, through the VSR, reflection opportunities are provided to the teacher to rethink some of the decisions made during the lesson, and the teacher is also able to reconsider the selection of certain activities or examples, to mention a few.

The use of videos in conjunction with teacher professional learning and reflection is also on the increase globally (Gaudin & Chalies, 2015). Lawson *et al*. (2010) characterise the emergence of video-capable technologies as a 'tipping point' that helps to see the world differently. Therefore, the use of videos is a viable tool in PD initiatives. However, much more research is needed to understand the specific effects of this tool on teacher learning (Geiger, Muir & Lamb, 2016).

Videos have a number of advantages that are absent from the live viewing of a lesson (Reid *et al*., 2015), as they enable teachers to "see" their practices more effectively (Tripp & Rich, 2012). This is because they encapsulate the complexities of teaching as well as its richness that enhances the analysis of classroom practice (Borko, Whitcomb & Liston, 2009). More so, the video-recording occurs in teachers' own familiar classroom environment and captures their everyday practices (Hennessy, 2014). Video recordings, unlike live observations, have the advantage of enabling teachers to relive their completed lessons (Reid *et al*., 2015). In the context of the use of VSR as a PD tool, episodes of the video-recorded lesson can be played back to the teacher, during the video-stimulated interview. Thus, the researcher can elicit reflection by the teacher on different aspects of the chosen sections. Videos also display authentic images of teaching and thus enable an interactive interpretation of what is observed (Reid *et al*., 2015).

Muir (2010: 439) conceives the video-stimulated interview as a collaborative inquiry involving a teacher and a researcher, or as a dialogue aimed at providing the teacher with the opportunity of "thinking about aspects of (his/her) practice". Professional dialogue, or what might also be denoted as 'learning conversation', 'professional or collegial discussion', 'inquiry conversation' or 'reflective conversation' (Cochran-Smith & Lytle, 1999; Le Cornu, 2009), can be perceived as "a discussion between peers that allows the other to explicitly articulate, appreciate and extend their understanding of practice" (Nsibande, 2007: 4). Corrigan and Loughran (2008) claim that this dialogue can strengthen mathematics teams by ensuring that colleagues support each other in their own classrooms – an in-house PD initiative. They state that professional dialogue allows teachers to develop professionally. Indeed, Bereiter and Scardamalia (1993) observe that learning is slower in the absence of professional dialogue. Another advantage of inquiry within a community "involves both learning new knowledge, questions, and practices, and, at the same time, unlearning some long-held ideas, beliefs, and practices, which are often difficult to uproot" (Cochran-Smith, 2003: 9). Therefore, numerous advantages present themselves when teachers come together and adopt an inquiring stance. Professional dialogue combats the egg-shell classroom approach characterised by teachers who function in isolation, without any "outside" interaction. This isolation deprives teachers of valuable input from their peers.

The intent of reflective practice and professional dialogue have some commonalities. Indeed, the essence of professional dialogue is peer exchange, an aspect which can also enhance the worth of reflection (Rocco, 2010). Importantly, "dialogue coupled with reflection and moved to action creates the conditions for transformative learning" (Donovan, Meyer & Fitzgerald, 2007: 11). However, professional dialogue constraints include insufficient structural and social supports, the demands of immediate and multiple tasks, difficulties in making tacit knowledge explicit, and issues engendered by difference and disagreement (Horn & Little, 2010).

Follow-up observation can be used to establish if a teacher acted on what he/she noticed and could spearhead more learning (Amador *et al*., 2021). Although not all the teachers would choose to adapt or adjust their teaching methods, after noticing areas in which they can improve, the noticing in itself could be viewed as professional growth (Amador *et al*., 2021).

Thus, this study incorporated VSR as a tool that allows teachers to relive their classroom conduct, reflect on what they observe, and consider how they might adapt their classroom conduct accordingly. The reason for this incorporation was to investigate teachers' possible development prospects through VSR, and the probable value of VSR as an in-house PD initiative.

3.   Conscious Competence Learning Model as lens to measure learning

The conscious competence learning (CCL) model can be used as means to gauge learning along two dimensions, namely knowing and competence. This model was coined by Abraham Maslow (Harianto, 2021). Later researchers such as Noel Burch as well as Williams Howell (1982) and Schratz (2006) further worked with this model. In this study this model was adapted. This adapted model consists of four stages: 1) unknowingly incompetence, 2) knowingly incompetence, 3) knowingly competence, and 4) mastery. Stage 1 in the model, which is characterised by ignorance, is where the individual is unknowing of his or her lack of skill or knowledge about something. The individuals "do not realize that there is something that needs to be known and learned" (Harianto, 2021: 48). In Stage 2, marked by the realisation that he or she does not pose certain knowledge or skills, an individual therefore is becoming known of an existing gap. For the individual thus to close the gap, learning needs to take place. In stage 3, an individual knowingly endeavours to improve whatever s/he chooses, to enhance teaching and learning. Stage 4, characterised by mastery, is where the individual correctly applies a new skill effortlessly, efficiently, and competently. These four stages can be illustrated by the figure below.
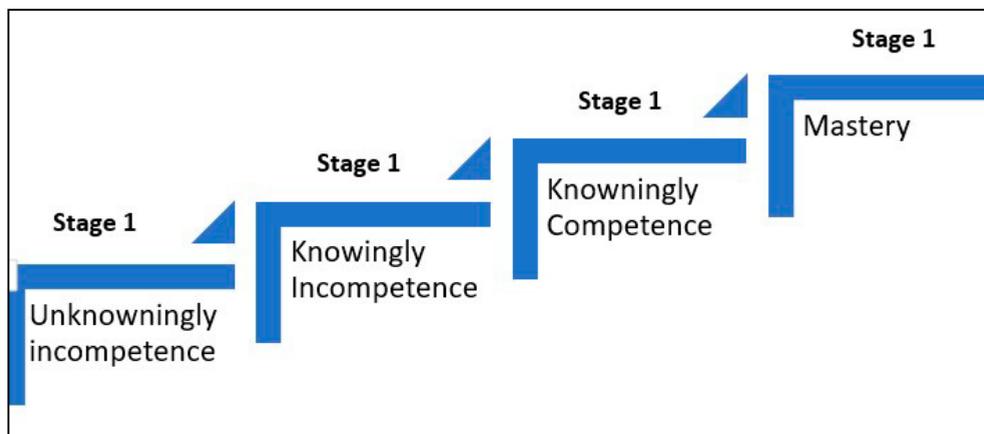
Figure 1: Adapted Conscious Competence Learning Model

This study investigates self-reflection through video-stimulated recall as a continuous development strategy which teachers can use on an ongoing basis to enhance their professional learning with various skills and knowledge identified my themselves, sometimes with the assistance of others. When a teacher watches a video recording of his or her own teaching, he or she can then reflect on his or her practice and learning can then take place when he or she move through the different stages of the CCL model. The CCL model can then be used to describe this learning process where teachers can pass through the different stages in order to master a certain competence (Harianto, 2021). Since reflection is a personal act, teachers can notice different aspects of their teaching and to varied degrees, depending on their awareness thereof. Investigating how teachers react to what they might notice is significant for teacher educators and teacher professional development.

4. Methodological approach

A qualitative research approach was used in this study. It enabled for the gathering of thick descriptive data from the two mathematics teachers' self-reflection through VSR. Both taught at a rural high school in the Western Cape. Two cycles of video-recorded lessons per teacher took place which was followed by a video-stimulated interview after a time lapse of a week in the first cycle and three weeks in the second cycle. This was to ensure that the school programme was not disrupted significantly, considering learners' rotational attendance as well as the availability of the teachers as they had little administrative periods in which the interviews could be done. These recorded lessons were all about thirty minutes long. After each lesson, the researcher identified the sections of a lesson that excluded individual pen-and-paper tasks where classwork was done for the teacher watched. This was to ensure that sufficient time is allowed for the teacher to reflect on the lesson after watching the video as the teachers only had single free periods to conduct the interview. It therefore meant that the teacher watched the entire recorded lesson, but the section where the learners worked on their classwork where excluded. These video-stimulated-recall interviews were audio-recorded. During this interview, the researcher prompted each teacher to reflect on what they noticed in the lesson, while and after watching the video episodes. No checklist was used during the interview, because the researcher wanted the teacher to identify noticeable aspects of the lesson her- or himself. This process was repeated, resulting in two VSR interviews per teacher. Ethical

approval was obtained from the relevant institution, with the reference number HS20/4/55. The school, teachers as well as learners and their parents signed informed consent forms.

The context of study was an averagely-resourced rural high school. The latter is a quintile 2 school, which means that it serves a low-income community. Hence, the government covers most of its running costs. The mathematics team consisted of five teachers, two of whom volunteered to partake in the study. The rotational system was in place at the time of the data collection, due to the COVID-19 pandemic. The classes included in the study were conveniently selected. This was to ensure that the researcher could video-record both classes in the same visit. Hence, the timetable was a determining factor in the selection of the grades that were included in the study. Due to the constraints mentioned above, the lessons were on different topics. The experienced teacher (Teacher F) had been teaching Mathematics and Science for the last ten years. He is a qualified Mathematics teacher. The video recordings of his Grade 10 class consisting of 22 learners were produced. The novice teacher (Teacher L) had a contract position. She had been teaching Mathematics for about three years. Her Grade 9 classes comprising about twenty learners were recorded.

A thematic approach based on deductive reasoning was used to analyse the data. The CCL model's four different stages were used as analytical themes.

5. Findings and discussion

The main goal of this study was to investigate the effect of incorporating VSR on the professional development of mathematics teachers. The teachers responded spontaneously to the video-recorded lessons while and after watching. Teacher L mostly perceived what she saw in the videos as a confirmation of what she already knew. Surprise was evident in experienced Teacher F's voice. This was evident when he talked about what he saw in the videos, displaying his unawareness. Compared to Teacher L, Teacher F observed more issues. However, more probes were needed to facilitate Teacher L's reflection. This is not surprising as during a professional dialogue the difficulty can be to make tacit knowledge explicit (Horn & Little, 2010). In presenting the findings, the Conscious Competence model guided the discussion related to the teacher being and staying unaware of their lack of skill or knowledge, the teacher being aware but deciding not to adapt their teaching, and the teacher acquiring new skills and competencies. Finally, teachers' views on VSR as a PD tool are presented below.

5.1 Teacher being and staying unaware of their lack of skill or knowledge

The first observed lesson of the novice teacher was on algebraic equations. It was conducted with a Grade 9 class and learners had to solve the unknowns. The lesson included all four mathematical operations as well as squared numbers in the equation, in a lesson that lasted for 30 minutes. It was a continuation of the topic introduced in the previous lesson. For a significant portion of the lesson, the individual learners worked on class activities, while the teacher moved around to support them.

Teacher L's first response after watching the first video was that she believed that the lesson went well, because she had learners' full attention. Her view was that most of the learners listened to her, although one or two were fidgety. This is not exactly what the researcher observed: some learners were busy with their own things during the lesson. Teacher L had difficulty in going deeper into the complexities of teaching mentioned by Borko *et al.* (2009).

Her second remark related to learners' answers to her questions. She believed that when she asked questions, some of the learners could answer her, "which means that they more or less have an idea how to do it" (Teacher L, First interview, 2021). These observations indicate that her focus was on the learners and not on herself. Later in the interview, she mentioned that she had to individually assist the learners who did not understand. This comment contradicted her previous claim that the lesson went well. This is an indication that she was in stage 1, in a comfort zone, being unaware that certain learners did not understand the work and that others were busy with their own things while she was explaining on the board. Teacher L's reflection tended to focus more on the learners than on herself, when she reflected. However, this teacher could have been in the stage of ignorance, as she could not see that some of the learners did not understand the work.

The second lesson of Teacher L was on multiplying a monomial with a polynomial, where the exponents of variables were included. The teacher was asked how she perceived the learners' contributions to the lesson. Her response was: "… they are a strong group who always gives answers" (Teacher L, First interview, 2021). However, in the video, it is evident that the questions asked by the teacher were answered by herself, signifying that she is still in stage 1 of unknowingly incompetent. She was encouraging learners to answer questions in class; but she was unaware that the learners were not answering her questions. Indeed, in my observation, the learners were more passive than active during the lesson. It therefore seemed as if she was also unknowingly incompetent about transcending her class to be learner-centred. She needs to deepen her introspection into her teaching practice in order to promote active learner participation (Pellegrino & Gerber, 2012).

5.2 Teacher being/becoming aware but limited/no adaptation of teaching

Teacher L was unaware that she did not use mathematical terminology at times, or even used incorrect terminology. Yet, it is important for learners to be exposed to, understand, and use appropriate terminology to ensure that they build sufficient vocabulary to be able to communicate in mathematical language. In the first observed-lesson, coefficients were prominent; but the teacher never used the term 'coefficient' during the lesson. She would say, when referring to $3x = 12$:

> "*x is not standing alone. There is a number against x. To get rid of the number against the letter, …*" (Teacher L, First interview, 2021)

Consequently, the learners did not hear the terms 'coefficient' and 'variable' from the teacher. This incorrect or non-use of terminology happened frequently in the lesson. The teacher seemed unaware that she was not using mathematical terminology correctly or was not using it at all. The researcher made her aware of this at the end of the first interview. In the subsequent lesson, she incorporated the use of some mathematical terminology, to a limited extent. Regarding the use of mathematical terminology, she progressed from stage 1 to stage 2 of CCL model. This is because initially she was unaware of her not using appropriate mathematical terminology when dealing with that topic. She started to incorporate terminology in the subsequent lesson which allude to her becoming aware but not yet competent in doing so. The 'reflective conversation' she had with me created a learning opportunity which extended her understanding (Nsibande, 2007) of the importance of incorporating mathematical terminology.

When the learners did individual activities in class, Teacher L tended to check what individuals were doing. When she spotted errors, she explained the work on the board. Whenever she noticed that a learner had made a mistake, she explained the sum to the entire class. She expected the class to stop what they were doing and pay attention to what she was explaining. During the interview, she mentioned that her colleagues advised her not to overdo it (stop the entire class), but she insisted that it worked for her. However, she also observed that "later on then the time moves on", meaning that she spent excessive time explaining individual errors on the board. Hence, she could not finish what she prepared for that period. In response to my question on whether that was the most effective way of using the time, she was adamant that following this approach in class worked for her, because "for me, personally I understand them [the learners]". Teacher L was aware that her approach resulted in her not finishing the prepared lesson. Nevertheless, she decided to not change her practice. Amador *et al* (2021) alluded that all teachers would not necessarily choose to adapt or adjust their teaching methods after noticing areas that they can improve on. It can be categorised as being on the knowingly incompetent level, as she was aware of her time-consuming conduct but did not adjust her practice. However, learning is not a linear process and this teacher might need more time to develop this aspect of her teaching.

In Teacher L's second lesson on multiplying a monomial with a polynomial, she covered some examples with the class. She would multiply two factors separately and, thereafter, present the final answer. She referred to it as the spreading method. An example of this was:

$$2y(x + 2y - 3x + 4y^2) - 3$$

1. $2y \times x = 2xy$

2. $2y \times 2y = 4y^2$

3. $2y \times (-3x) = -6xy$ ... (Teacher L, Second interview, 2021)

At the end, she concluded with the final answer. However, in-between the question and the final answer were the steps, as indicated above. Clearly, there was a disjunction in the way the answer was structured. This can be confusing to the learners as they do not see multiplied by the polynomial as one step. They might focus on the "loose" steps and fail to realise that the final answer is the culmination of the individual multiplication of the monomials. This approach was discussed in the second interview. The teacher became aware of the challenge engendered by doing the sum in a fragmented way. Again, the collaborative inquiry provide opportunity to rethink her practice (Muir, 2010). I could not ascertain whether the recommendations were implemented in subsequent lessons, as I did not schedule any subsequent visits. Therefore, I characterise this fragmented way of multiplying a monomial by a binomial as becoming aware of the procedure, but not being competent in undertaking it.

An ability that Teacher F displayed in the first reflection was the identification of the incorrect answers given by learners, when he marked their homework. It seemed that he was unaware that some of the learners gave incorrect answers during the lesson. Nonetheless, he only noticed it when he was reflecting while watching the video recording and could thus "see" his practice more effectively (Tripp & Rich, 2012). Teacher F subsequently proposed a way forward in addressing this matter:

> *… and I see too many mistakes because I've heard too many things that were not correct. Say (to the learners) go and look at that sum on your own – each one look at the sum … quickly look at your (trigonometric) relations … quickly see if you can work it out with what was given and what you are looking for …* (Teacher F, First interview, 2021).

Thus, he moved from unknowingly incompetence to knowingly incompetence. However, this proposed way of addressing the incorrect answers was not implemented in the second lesson. Hence, I would argue that he did not move to the knowingly competence level although he might have implemented the proposed strategy in subsequent lessons that I did not observe. Reliving his lessons allowed Teacher F the advantage of enabling him to improve his practice (Read *et al.*, 2015).

5.3 Teacher acquiring a new skill/competency

Teacher F's first recorded session was a Grade 10 trigonometry lesson on angle of elevation and depth, in which the homework was marked first. Thereafter, the new concept was introduced, followed by related exercises. Teacher F arranged his class during the COVID-19 pandemic period such that the learners faced the screen while his desk and laptop were behind the learners. This allowed him to use the data projector exclusively. He did not move between the learners' desks, to minimise physical close-contact with the learners, due to the COVID-19 pandemic. However, this arrangement resulted in him not having a good view of the learners' conduct and actions. This is one of the first things he noticed in the video. He was surprised to realise that one learner did not even take out her books even after he had already covered the third or fourth homework problem. He commented that "that child missed half of that exercise's questions – I can see it now". Later, Teacher F wondered that "maybe there are also others who also missed [out on the work]". It can be perceived that he was first at a stage of unawareness as he started the lesson while some of the learners were still settling down. Thereafter, he offered possible alternative ways of improving this practice. This is evident when he notes that:

> *With the marking of homework … the thing now told me that I will have to wait for … I will have to wait till all the children 100% are in their seats and their books are in front of them …* (Teacher F, First interview, 2021).

Through self-reflection, he became aware of this practice, thus moving from stage 1 to stage 2 of the CCL model. He acted on this awareness and worked on improving his practice in the second observed-lesson. He moved around the rows that were closest to his desk, to check if books were out and learners had settled down. This change in practice showed that he had moved to stage 3 (knowingly competent), because he was learning and acting on refining his practice. VSR assisted him in advancing his professionally learning.

Another observation was that Teacher F realised that he had progressed with the exercise without asking the learners if they had any questions. Again, he advanced from a stage of ignorance to a stage of awareness. It was evident that he knowingly made efforts and worked towards improving his practice in the second lesson. This became evident when he asked the class if there were any questions. Although questioning was not done frequently, he was learning to apply this new skill and thus moved to stage 2 of the CCL model.

Through self-reflection on the first lesson, using VSR, Teacher F became aware that he guided the learners excessively. This rendered them passive, since the teacher was talking the most. When a learner gave an incorrect response, after an episode was observed, he said:

> *He (a learner) could not even tell me why (reason). He said to me that he would use cos. Then I had to lead him: see what you have – do you have … Maybe I lead too much here and I should maybe give them more experience to see for themselves … See here, why do you use this thing?* (Teacher F, First interview, 2021).

Teacher F became aware that he was leading the learners beyond a reasonable limit and had to step back. This was so that the learners could figure things out more by themselves and, in doing so, teaching and learning would be enhanced. He later added that:

> *I basically lead them the whole time to that answer and with the next one, I see now I also lead them (too much)… So maybe that is the problem here. So maybe should I look at a sum and say … because I've heard too many things here … Say go and look at that sum on your own – each one of you – quickly do that – see what you have – look at the relationships – see if you can work it out* (Teacher F, First interview, 2021).

The second lesson was on the linear graph, particularly on the effect of the gradient and the y-intercept on the shape of the graph. Here, the teacher was visibly less prominent. He showed a few examples of how to change the equation into its standard form, and how to identify the gradient and y-intercept in order to draw the graph. Thereafter, he stepped back, letting the learners change the equation into the standard form and draw the graph. He identified individual learners who had to display their answers that had to be verified by the class. This approach clearly showed that the teacher led the class to a lesser extent and allowed the learners to step forward and do more. The teacher walked around to aid those who requested it. On observing this, in the first lesson, this teacher noticed that he led the class excessively. This confirms what Van Es (2011) claims that videos assist in zooming into interactions (or lack thereof) in the classroom. In the second lesson, he moved to the knowingly competence stage at which he managed to step back from the centre stage of the lesson, allowing the learners to do more on their own. Hence the lesson became more learner centred, an important skill for an effective teacher to have.

6. Guidelines for establishing more effective in-house PD initiatives

The use of VSR as an in-house CPD tool has a significant potential in developing mathematics teachers. Below are some implementation guidelines that put teachers in the driving seat of their own development.

A safe environment must be created for the interaction between the teacher and the other person(s) in the class, when implementing VSR. This can assist in ensuring that the teacher is more honest and comfortable to do self-reflection in an unpretentious manner. Professional dialogue should allow for robust probing, to assist with deeper reflection. In follow-up interviews, the researcher must probe why the teacher did not act on what was noticed in previous lessons. If the teacher is not going deeper into reflecting on mathematics, a probe becomes necessary. VSR should be implemented on a continuous basis, to support teachers in reaching a stage where they master skills and competences that they would have identified as requiring attention (stage 4).

7. Conclusion

Both participating teachers showed deeper awareness of their teaching practice, although not to the same extent. Having the opportunity to view their lessons from a different angle was received positively, because it allowed them to critically analyse their unique contexts.

The data for Teacher L provides evidence of not developing in terms of identifying if learners understand the concepts after it was covered. With that aspect she stayed on stage 1 of knowingly incompetence. She also did not transcend from the knowingly incompetence stage in terms of practicing a learner-centred approach. In terms of including mathematical terminology in her lessons, Teacher L progressed from stage 1 to 2 as her unknowingness developed to knowingness although still incompetent in incorporating relevant mathematical terminology. She was made aware of this practice that can be changed so that she is able to complete the prepared sections. However, she chose not to act on the suggested practice that can increase her effectiveness in completing the syllabus. Appearing to find herself in a comfort zone, she did not reach stage 3 of the CCL model, most probably due to her limited teaching experience or her inability to critically reflect on her practice.

Data for Teacher F revealed that he noticed a number of aspects that could be changed. He also went further and acted on certain aspects that he noticed. He realised that he started the lessons without ensuring that the learners were seated (stage 2) and acted on it in the next lesson (stage 3). He also noticed that he did not invite the learners to ask questions (stage 2), which he also acted upon in the subsequent lesson (stage 3). Another aspect that he identified and changed was his excessive leading/guiding of the learners (stage 2) and in the subsequent lesson, he allocated more time for learners to work on their own (stage 3). Hence his lesson was more learner centred.

These two teachers thus reflected differently. It can be argued that their years of teaching experience influenced what they reflected on.

None of the teachers reached stage 4, where they could implement new ways of doing things comfortably. It is possible that this stage would have been reached if observations had continued over a longer period.

In conclusion, the exposure to reflection using VSR makes the teacher aware of aspects that s/he can work on to improve his/her classroom practice. Some of these aspects were changed by the participating teachers, to enhance teaching and learning. Reliving the episodes of the lessons put the teachers in the driving seat of their own development. They identify the gaps in their teaching and can, as professionals, act on them independently. This does enhance teaching and learning in a context where teachers' own needs and unique circumstances interact. VSR can be a possible in-house PD initiative that schools can implement to enhance teaching and learning.

8. Limitation of the study

Due to time constraints, only two lessons per teacher were observed and video-recorded. The teachers did not reach mastery stage in the CCL model, due to this limited observation period. Future studies could observe more lessons, to allow for more reflections by the teachers and possibly more opportunities to establish whether the teachers implement improvements based on what they notice. Future studies can also consider to allow for more topic specific reflection.

9. Acknowledgements

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