Chapter Five: Using Participatory Action Research to Change the Landscape of Mathematics Word-Problem-Solving Instruction

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Introduction and background

Mathematics word-problem-solving is one of the most complex processes in mathematics education (Swanepoel 2022). Not only does it include the basic mathematics addition and subtraction operations (Morales et al. 1985; Swanepoel 2022), it also relies on instructional practices that allow for creativity and critical thinking. The current landscape is not conducive to creativity and critical thinking, as Verschaffel et al. (2020: 908) attest, explaining that the current landscape of mathematics word-problem-solving is restrictive. Teachers are resistant to teaching mathematics word-problem-solving; they are also intimidated by, and uncomfortable with teaching the subject (Kakoma 2016). The current landscape of mathematics word-problem-solving is problematic and concerning. Botha et al. (2005) and Nel (2012) attest that learners' performance in mathematics word problem-solving can be traced back to teachers' performance in this area. Guo (2024) elaborates that learners' performance in solving mathematics word problems is an indication of teaching effectiveness.

One of the reasons that mathematics word-problem-solving is deemed unsuccessful, is due to the implementation of ineffective instructional practices used for mathematics word-problem-solving (Agwagah 2013; Gersten et al. 2009). The instruction of mathematics word-problem-solving is a multi-faceted practice that entails the 'interplay between language and mathematics' (Hagena et al. 2017: 4057), where both mathematical and linguistic elements must be mastered for successful problem-solving to take place (Jitendra et al. 2015; Kong and Swanson 2019; Morales et al. 1985). Instructing mathematics word-problem-solving is often associated with negative connotations owing to traditional methods of instruction being employed, which are not universally appealing to teachers. Both teachers and learners are resistant towards these so-called demon problems (Weber 1966); therefore, not all instructional practices of mathematics word problems lead to feelings of success. In fact, such instructional practices lead to feelings of frustration and inadequacy.

A significant concern in the current practices of instructing mathematics word-problem-solving is that learners do not understand the mathematics register, which is the language dedicated to mathematics (Swanepoel 2022). Nel (2012) highlights that although mathematics is a visual language of symbols and numbers, it is also expressed and explained through written and spoken words. The challenge of successful instruction of mathematics word-problem-solving can only be addressed if teachers are purposeful in constructing learning experiences that direct learners' attention to specific words and their meanings (Nel 2012). However, for this to be done, there is a need for a new landscape that accommodates different instructional practices that accommodate both the teacher and the learners.

Swanepoel (2022) refers to teachers' concerns about their ability to teach mathematics word-problem-solving and the challenges associated with the task itself. These concerns were anchored in Fuller's (1969) concerns-based model of teacher development (CBMoTD). The participating teachers highlighted concerns about their own understanding of mathematics word-problem-solving, their limited knowledge of different instructional practices to teach mathematics word-problem-solving and their negative attitudes towards mathematics word-problem-solving instruction. These concerns emphasise the need for a changed landscape of mathematics word-problem-solving, where it is made accessible and understandable for teachers and learners. This change is possible by relating mathematics word-problem-solving to learners' "lifeworlds" and making the content relatable to what learners are familiar with through interactive, engaging and creative learning instructional approaches that are embedded in critical thinking.

This chapter forms part of a larger study by Swanepoel (2022), who investigated how Grade 3 teachers' mathematics word-problem-solving skills could be supported through participatory action research (PAR). The research question this chapter is built upon, is 'How can Grade 3 teachers' mathematics word-problem-solving instruction be enhanced through a professional development initiative?' The focus of the current study is to place the spotlight on critical instructional practices of mathematics word-problem-solving that elicit joy and fun from both the teacher and the learner. Aspects such as setting the context of the word problem, unlocking the background of the word problem and vocabulary instruction are important for both the teacher and the learner to understand the word problem.

Literature review

The integration of creativity and critical thinking

Creativity and critical thinking are two aspects needed to make mathematics word-problem-solving more enjoyable for all. Creativity extends to understanding that mathematics does not belong only in the classroom, it is also found in the world around us (Orton and Frobisher 2004). Creativity interwoven with mathematics is a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements and disharmonies (Guilford 1967; Torrance 1966). Essentially, 'creativity is the heart of solving a problem' (Vuong and Martin 2014: 312). Creativity is an essential ingredient needed in critical thinking and reasoning (Swanepoel 2022) and should be made part of the daily routine and integrated into everyday living (Ismunandar et al. 2020; Runco and Acar 2012; Runco and Jaeger 2012). Alongside critical thinking, creativity can be integrated into the instruction of mathematics word-problem-solving, because creativity and critical thinking are about finding new solutions and thinking away from the usual idea (Runco and Acar 2012). Hasan and Khan (2020) emphasise the notion that change in the way mathematics word-problem-solving instruction is executed, needs to take place. More specifically, a culture of creative thinking and reasoning, and creative teaching and learning should be cultivated (Hasan and Khan 2020).

Teaching and learning must be adapted to enable learners to experiment freely and discover open creativity within themselves. This can only be done if learners' creativity is taken into account and different ways of learning are considered (Swanepoel 2022). For this to happen, however, teachers must be guided on how to unlock learners' mathematical creativity. Mathematical creativity is defined as the capacity to employ the skills and contents of the arts to focus attention and create interest in mathematics to pursue defined mathematical goals (Ariba and Luneta 2018). Creativity and critical thinking work together for people to understand the world and find new solutions and thinking that deviate from the usual idea (Boccia et al. 2015). Teachers who employ creative teaching techniques are seen as creative teachers. Such teachers critically appraise teaching and learning methods and discern the best teaching practices (Swanepoel 2022). Creative teachers are effective teachers, because they are willing to try new practices and ideas that vary from traditional educational beliefs to improve practice (Henriksen 2016).

Critical thinking is the deliberate use of skills and practice that increase the probability of a desirable outcome (Henriksen 2016). Moreover, critical thinking is a core component of problem-solving, transcending normal thinking and reasoning and diminishing discipline boundaries to involve a combination of different types of knowledge (Henriksen 2016). With reference to critical thinking, Dayal and Chandra (2016) emphasise the critical importance for teachers to understand the process of mathematics word-problem-solving, so that they can adapt their thinking and think beyond the known confines of the instruction of mathematics word-problem-solving. Critical thinking extends to teachers having to be trained to become critical and creative thinkers in teaching mathematics word-problem-solving (Henriksen 2016). Teachers are exposed to critical thinking when they teach mathematics word problems, as mathematics word-problem-solving is part of everyday life (Sepeng and Webb 2012). Being involved in the teaching and learning of mathematics word-problem-solving means that the problem poser and problem solver are developing mental processes that assist in the formation of logical and critical thinking and accuracy, which contribute to decision-making and getting to a feasible solution (Department of Education 2011). According to Ariba and Luneta (2018), insufficient attention has been accorded to creativity in mathematics education. This can be rectified through the introduction of creative mathematics practices that are built on critical thinking.

Traditional versus alternative practices to teaching mathematics word-problem-solving

Most teachers use the traditional teaching practice by providing an outline of the activity, demonstrating a few techniques to solve the problem, and providing the learners with a one-size-fits-all method to solve the problem (Barker 2012). The result of teaching using the traditional practice is that both the teacher and the learners are left discouraged, disheartened and unmotivated. This elicits negative affective emotions towards solving mathematics word problems on the part of both the teacher and the learner (Di Martino and Zan 2001). The traditional teaching practice influences learners' attitudes towards the subject, which may be useful to them in their future lives (Bates et al. 2013). This traditional practice restricts learners' creativity and imagination, as the content taught through this practice is seen as a universal set of facts (Cohrssen et al. 2015; Stipek et al. 2001). Mathematics taught to learners through the traditional practice is seen as a discipline, not content. In this practice, there is a belief that content should be conveyed through regulated teacher-directed instruction (Finlayson 2014; Whyte et al. 2018). The most favoured way to teach within the traditional practice is to provide learners with worksheets and textbooks to practise the skills taught continuously. The end goal is for learners to generate an answer (Stipek et al. 2001). The unfortunate reality of the traditional practice of teaching is that learners often do not understand what numbers and symbols represent, even though they perform the procedures as a continuous practice (Beisly et al. 2025; Peker and Ulu 2018).

The opposite of the traditional practice of mathematics instruction is the alternative practice of mathematics education, also known as the 'problem-solving practice' (Ernest 1989: 16). In contrast to the traditional practice of mathematics instruction, the alternative practice views mathematics as unfinished and open-ended, with a view to it being a dynamic process (Stipek et al. 2001). In alternative practices of teaching mathematics, the focus should be on self-regulation, engagement and attaining a sense of responsibility for work, teamwork and participation in classroom activities among learners (Jdaitawi 2020; Yilmaz 2017). In accordance with this view, Di Martino and Zan (2001) explain that when learners have positive experiences with mathematics early in their lives, a lifelong positive attitude towards mathematics is created. The most significant difference between the two practices of mathematics instruction is that, in the alternative practice, learners are encouraged to make use of inquiry to construct their understanding (Cohrssen et al. 2015) and the focus shifts from teacher-centred practices to learner-centred practices. Teachers assume the role of facilitators, assisting learners to activate prior knowledge and think critically and creatively to develop their own methods to solve problems (Beisly et al. 2025; Finlayson 2014). The role of the teacher as a facilitator includes asking appropriate questions to deepen and extend learners' mathematical understanding (Beisly et al. 2025). In the alternative practice, attention shifts from arriving at an answer as the product to understanding the process of mathematics word-problem-solving (Beisly et al. 2025). One such alternative practice of the instruction of mathematics word-problem-solving is the play-based teaching practice. Ndlovu and Mncube (2021) explain that a play-based practice promotes a special mode of thinking, a sense of possibility, ownership, control and competence in mathematics learners. Similarly, Ndlovu and Mncube (2021: 185) advocate that 'play-based learning sustains learner attention throughout the lesson and promotes problem-solving skills'. One advantage of integrating play as a teaching practice is that both teachers and learners can engage in creativity and activate critical thinking, while being in an environment that allows for flexible thinking and reasoning (Ndlovu and Mncube 2021).

Play as an instruction practice of mathematics word-problem-solving

The word sum wheel (Swanepoel 2022), depicted in Figure 5.1, emphasises the value of learning through play and makes reference to a variety of different manners in which teaching and learning mathematics word-problem-solving can be done by means of *play* as an umbrella term. The word sum wheel was collaboratively developed by the co-researchers[1] in

1 The co-researchers in the study were participating Grade 3 teachers. The terms 'co-researchers' and 'teachers' are used interchangeably depending on the context.

Swanepoel's (2022) research. The six steps in the word sum wheel are as follows: (1) read and look for clues; (2) constantly communicate (ask questions and reflect); (3) make time for play and creativity; (4) work out an open number sentence and operations; (5) work out the answers (calculations and sentence answer) and (6) double-check your answer (Swanepoel 2022). In the current paper, emphasis is placed on the aspect of play and the implementation of critical instructional practices that elicit joy and fun in mathematics word-problem-solving. In light of this study, emphasis is placed on *play*, which is the umbrella term used to encapsulate fun, creative and interactive practices of teaching mathematics word-problem-solving and changing the landscape of mathematics word-problem-solving instruction (Swanepoel 2022). Polya's (1945) four-step problem-solving process informed the word sum wheel.

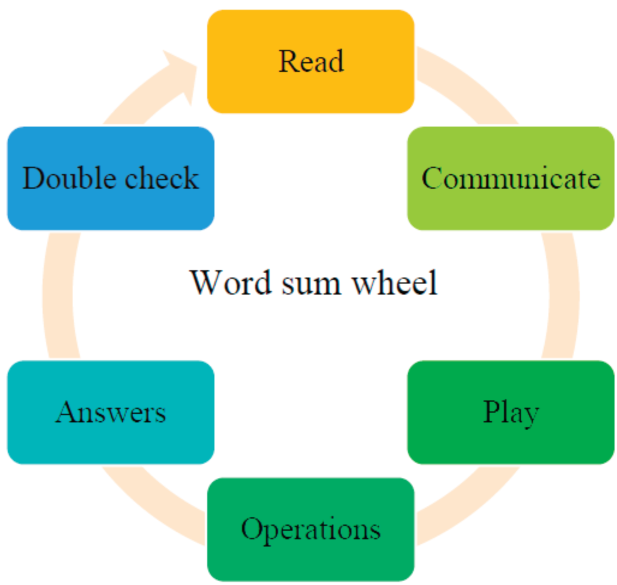

Figure 5.1: The word sum wheel
Source: Swanepoel (2022: 280)

The umbrella term *play* encapsulates dramatisation, peer and group engagement, the introduction of manipulatives and the inclusion of the multiple intelligences (MI) theory. The first component of play allows learners to dramatise a word problem to their peers. Dramatisation aids in linking learners' personal background to the nature of the word problem (Swanepoel 2022). An example of dramatisation taken from Swanepoel (2022) is a teacher who gives the learners in their class a broomstick and a mop and allows the learners to run around. When time is taught, the learners decide among themselves who is the short hand and who is the long hand of the clock. This way, the learners depict the clock as best they can and learn about reading time in a playful manner. Another example is to allow learners to sing their timetables and assign actions to the words (Swanepoel 2022). In the study by Nair et al. (2017), once the learners became physically involved in the dramatisation of the word problem and took part in the integration of movement, they started to understand concepts on a concrete level.

Second, the inclusion of peer and group engagement, where teachers allow learners to turn to one another and teach the mathematics word problem to one another, can be used successfully (Double et al. 2020; Harmer 2007; Henriksen 2016; Matherson and Windle 2017; Nurlaili et al. 2015; Panadero and Alqassab 2019; Swanepoel 2022). Group engagement is also effective when learners are granted the opportunity to teach and learn in an unconventional manner (Stach and Veldsman 2021; Swanepoel 2022). By using peer and group engagement, learners are given the freedom to discover the meaning of the mathematics word problem and experiment with solutions to the problems while working in their groups (Swanepoel 2022). Part of the success of integrating the MI theory and creativity in a lesson is to expose learners to real-life experiences (Ariba and Luneta 2018) and let them experiment with three-dimensional objects rather than abstract prototypes (Swanepoel 2022).

Third, by integrating concrete manipulatives, learners are given the opportunity to concretely explore, acquire or investigate mathematical concepts or processes and perform problem-solving activities. Bartolini and Martignone (2020) explain that concrete manipulatives are physical artefacts that learners can handle concretely and offer a large and deep set of sensory experiences. Some learners need the reassurance that concrete manipulatives are provided to understand the essence of the mathematics word problem. Most learners enjoy being taught mathematics through interactive and participatory methodologies that include the use of manipulatives (Day and Hurrell 2017; Reimer and Moyer 2005; Stiegelmeier and Moore 2019). In addition, Maboya et al. (2020) align the use of manipulatives with play as an instruction practice for mathematics word-problem-solving by explaining that the beauty of manipulatives is the learner's ability to engage in hands-on learning in mathematics. Manipulatives do not have to be costly, but can include items such as maize, wheat, rice grains, bottle caps or stone pebbles (Maboya et al. 2020). Time should be allocated for learners to play actively with these concrete materials and manipulatives to experiment and discover how the mathematics register, numbers operation and relationships complement one another (Larsen-Freeman 2000; Millington 2011; Tirtayani et al. 2017).

Part of the success of integrating the MI theory and creativity in a lesson is to expose learners to real-life experiences (Swanepoel 2022). The inclusion and application of the MI theory make solving mathematics word problems fun for teachers and allow all learners to engage in teaching and learning in a *language* that learners understand (Larsen-Freeman 2000; Millington 2011; Tirtayani et al. 2017).

Methodology

This qualitative research was viewed through the constructivist paradigm, and PAR was employed as the research design. Data were generated through virtual collaborative workshops, which were transcribed for data analysis purposes. Teachers' reflection diaries and field notes and the researcher's research diary were also included as data generation instruments. Deductive data analysis was used to create four predetermined categories, after which inductive analysis was used to analyse the data. After reading through the data generated, inductive analysis was used to code key aspects of the data, which were grouped into predetermined categories. For the purposes of the current paper, attention is focused on one of the categories, namely critical instructional practices for mathematics word-problem-solving.

Grade 3 teachers from six different primary schools in Gauteng were included in the population sample. Sampling was done through purposive sampling. The sampling criteria included teachers who had been teaching a Grade 3 class and had been teaching Grade 3 learners consecutively for two or more years. The theoretical framework used to underpin the research was the continuous process of professional development (Swanepoel 2022), as seen in Figure 5.2, which incorporates Shulman's (1987) model of pedagogical reasoning and action (part 1), the CBMoTD (part 2) and the interrelated relationship between subject matter knowledge, pedagogical content knowledge, professional development and the understanding and instruction of mathematics word-problem-solving (part 3) (Swanepoel 2022).

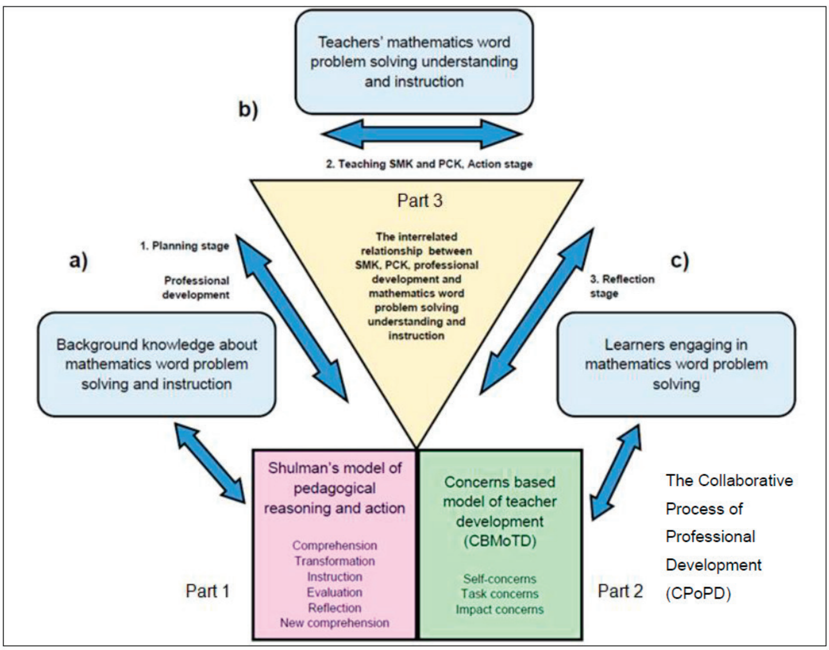

Figure 5.2: The Collaborative Process of Professional Development
Source: Swanepoel (2022: 29)

Ethical clearance was obtained from the University of Johannesburg (Sem

2-2019-030) and the Gauteng Department of Education. After providing consent, participants voluntarily participated in the research. The principles of anonymity, confidentiality, participants' rights and non-discriminatory and inclusive participation were upheld throughout the study. Member checking was done following the completion of the study.

Findings

Integration of mathematics word problems

Several teaching methods have been highlighted as important in effectively teaching mathematics word-problem-solving. The context or milieu of the mathematics word problem is essential. Throughout the teaching of mathematics word-problem-solving, the teacher should consistently integrate the instruction of word-problem-solving with other areas of the curriculum. The act of integration is what makes creativity possible. This is what Co-researcher EB3 did, and explained how they integrated daily activities with the instruction of mathematics word-problem-solving: 'I always try to relate it to real-life experience, whether it is banking or baking at such capacity and stuff like that. So, trying to relate it to real-life experience.'

However, in making the word problem relevant to the learners' context and background, the teacher should align the word problem with the background of the learners (Burt and Ridgard 2014; Ipatenco 2021; Joubert et al. 2019; Makoe 2014; Swanepoel 2016). Another suggestion for making mathematics word-problem-solving relevant to learners' context is to introduce texts, stories and themes that relate to the learners' interests (Swanepoel 2016, 2022).

Co-researcher EB1 explained that the best way to make mathematics word-problem-solving practical and relevant for a learner is to include 'things that he sees every day and you can really just bring those types of things into the class'. Similarly, learners can be accommodated in the class, and content can be made relevant to their lifeworld by 'taking the child's background into consideration and talk[ing] about current events' (Co-researcher ED2). Lastly, to involve learners and help them understand the background of the word problem, word problems should be linked to the learners' own circumstances (Co-researcher ED1).

Verbal answering technique used as an alternative approach to solving word problems

Verbal answering is a different stance on teaching mathematics word-problem-solving, as suggested by Co-researcher ED1. In the classroom, Co-researcher ED1 allows learners to provide verbal answers to mathematics word problems from time to time. Co-researcher EC1 explained that 'learners battle to read and write in Grade 3'. Although most learners can find the answer to the problem, they are challenged by having to write down the answer. However, when they are allowed to answer the word problem verbally, it takes away some of the anxiety of mathematics word-problem-solving.

Breaking mathematics word problems into smaller sections

One mathematics word-problem-solving teaching method that was used by most of the participating teachers was the use of breaking mathematics content into smaller sections to aid with the instruction of word problems. Co-researcher AB1 commented that the teacher had 'to take it piece by piece, that the children really need to see it'. Co-researcher AD3 explained the rationale behind this teaching method as follows: 'With [the breaking up of the mathematics word problem] we realised that when we do that, they understand better what is required. So, they understand the concept behind the sum, it is not just limited to the numbers that are provided.'

Co-researcher EB2 explained that solving mathematics word problems could be made more playful by breaking the word problem into smaller sections so that everyone can understand it: 'I think if we take everything step by step and break the word problem in bite-sized chunks, we break the process of solving the word problem down and you actually make it fun and playful; then everybody can do maths.'

Using humour and dramatisation in the instruction of mathematics word-problem-solving

Another somewhat different teaching method used by Co-researcher AD1 is to introduce humour in the classroom. According to Co-researcher AD1, if learners are exposed to elements of humour, 'then they grasp something somewhat faster'. Co-researcher AD5 added that if the teacher makes mathematics word-problem-solving humorous, they can make the learners relax while they are solving the word problem. That way, without realising it, learners look for the clues and they do a word sum (Co-researcher AD5). The use of acting out or dramatising a word problem was an aspect that was highlighted by most of the co-researchers (AB2, AD4, AD5, AD6, EB1, EB2 and EB3). When learners dramatise a word problem, it allows them to reinforce and explain the vocabulary to one another in a playful manner, as Co-researcher AD6 explained. The act of visualising a word problem was also mentioned, with Co-researcher EB1 explaining it as follows: 'I would let them close their eyes and visualise what it is [...] Just so that the child gets a visual of what is asked of him or her.'

Co-researcher AB2 challenged themself in mathematics word problem solving and incorporated role play in teaching a word problem. They gave the following explanation:

> I put myself outside my comfort zone and we did role play in class [...]. I asked learners to count sweets with me in this see-through bag and see how many there are, and then they had to hand it out to their friend, but it was really role playing in the sense of them having to actually use emotions with it. The amazing thing is that role playing works. Learners enjoyed the lesson and could answer the questions which followed [...] although I had a couple who thought I was crazy.

The visualisation of a mathematics word problem is very important. Co-researcher AB2 explained it as follows: 'I also believe that the children need to understand this and it is a very big part for me that they should also imagine that they are in the story or they can see the story happen in front of them.'

Differentiation in mathematics word-problem-solving instruction

Emphasis was placed on differentiating teaching and learning methods in mathematics word-problem-solving instruction. In a classroom, the content must be differentiated in such a way that all the learners can grasp the information. Co-researcher EB3 explained that differentiated teaching and learning refers to 'learners [who] have different learning styles, so some may be visually inclined, auditory inclined, linguistically and kinaesthetically [inclined]'; therefore, it is important for the teacher to know how to adapt the learning content in such a way that all learners can learn and achieve success. The reality is that the teacher 'need[s] to know that children learn in different ways' (Co-researcher AB1).

The role of constant communication in mathematics word-problem-solving instruction

Continuous communication in mathematics word-problem-solving instruction is of crucial importance and entails constantly reflecting and asking questions to determine learners' progress. The main role of asking learners questions is to see whether they understand the work. If they do not understand it, the teacher must return to their previous knowledge and take and explain one aspect at a time (Co-researcher EB1). It is critically important to activate learners' prior knowledge, as their presence or lack of prior knowledge serves as a guiding light for what the teacher should teach the learners (Ahmadi et al. 2013; Jenkins and O'Connor 2002; Palincsar and Brown 1988). Co-researcher EB1 gave the following explanation:

> Learners' prior knowledge determines every lesson that you do. Because the minute you see that the children do not understand, there is no use going on and continuing to get to do this wonderful lesson if half your class is not going to understand what you are saying.

Asking questions during mathematics word-problem-solving is essential (Swanepoel 2016). Co-researcher AB1 explained that being able to ask questions is as good as being able to communicate, and that is the glue that keeps teaching and learning together. Similarly, Co-researcher EB2 explained that teachers are required to 'ask inter-leading questions, introduction questions [...] we ask questions to sort of figure out where [learners] are at, at that moment'. Furthermore, it remains the teachers' 'responsibility to probe [learners] and make them excited in that lesson' (Co-researcher EB2).

Co-researchers AD1, AD3 AD5, EB2 and EB3 agreed that the purpose of asking questions was to determine learners' level of comprehension of mathematics word-problem-solving so that the teacher can make adaptations to their style of teaching and ascertain how to support the learners best. Co-researcher AB2 expanded on this train of thought by adding: 'It also helps, it actually assists the teacher, because sometimes a child will give an answer, which actually leads to the next thing, and that encourages the other children to also think a little bit further.'

The learner's role in the process of asking questions is very important in guiding teachers. Co-researcher EB4 explained their view of the role of posing questions to learners and said that asking and answering questions should be a natural part of communication in mathematics word-problem-solving instruction. The stigma associated with learners asking questions should be removed. It should not only be the learners who do not understand who need to ask questions, but all learners should test their understanding by asking questions. The following explanation was given:

> I feel like the learners do have a role in mathematics word-problem-solving instruction. I tend to ask my children quite often throughout the day or throughout specific lessons if they are still with me. If they understand. If they do not understand, they need to put up their hand. And everyone always thinks I am a bit ridiculous when I say to them that I tell the children, you know, well not to stand up, but if they get everything wrong, they need to raise their hand and say: 'I need help.' (Co-researcher EB4).

The act of speaking *on* learners' level, as opposed to speaking *over* learners is another teaching method Co-researcher AD5 emphasised. Along the same line, Co-researcher AD6 clarified that 'one will absolutely have to convey those concepts at their level to them'. Co-researcher AD4 explained that teachers 'have to get back to [the learners'] level. As teachers, we want to think big, and that is when we begin to speak over learners'. Co-researcher AD5 gave a very practical example of what is done in their classroom. She explained that she talks to learners about a 'James Bond sum' or a sum where they must find clues like Scooby Doo. Co-researcher AD5 said:

> I do not like the word 'word sum'; it scares the children. I feel it is a problem they are giving you that you need to solve, almost like a detective case. I always tell them [...] I use a lot of stories and stuff. Almost like Scooby Doo has to look for the clues.

Teaching mathematics word-problem-solving using resources and interactive strategies

The use of resources in the classroom should also be considered to make the instruction of mathematics word-problem-solving practical, fun and relevant. Co-researcher AD3 explained that she enjoyed using resources such as large dice to teach. The participant said: 'I like using something like large dice that the words are written on, like altogether, divide, or what is the product, or what other word that we use; then I [toss] the dice [to] learners.'

Interactive teaching is a method that not all the participating teachers embraced with equal confidence. Co-researcher AB2, however, explained that interactive teaching served to ensure that learners understood the basics of the content. She added that teaching interactively also allowed learners to grasp concepts differently than just doing the calculations on paper. Co-researcher AD5 gave the following explanation of how she allowed her class to experience a word problem about time physically:

> I physically build a clock using sheets of paper that I put on the carpet from one to six [...] then the children are the hands. So, then I choose the second hand. Then as the minute arm goes around when five minutes have passed, then he jumps on five minutes and then the [unintelligible] stands and then the seconds hand runs. We physically do; we portray

how the clock moves. And then, eventually, I make it go a little bit faster. Then the hour one can give a step. So, we do it physically […] we run the clock on the carpet with the broomstick.

Discussion

The new landscape of the instruction of mathematics word-problem-solving

Practices for instructing mathematics word-problem-solving should be adapted (Fülöp 2021) by integrating the teaching methods highlighted above. It is crucial to create an environment where teaching mathematics word problems brings joy to teachers and learners (Ndlovu and Mncube 2021). A teacher cannot make the content relevant to the learners' background if they have little to no background knowledge of the learners (Swanepoel 2022). It is equally important for the teacher to unlock the context of word problems for learners and develop learners' vocabulary, so they can truly grasp the milieu of the word problem. Another foundational aspect critical to changing the landscape of instructing mathematics word-problem-solving is to allow learners to feel safe and secure. This is possible when the teacher speaks on the learners' level instead of over the learners (Swanepoel 2022). This critical instructional practice is often overlooked. However, inviting the learners to be part of the teaching and learning climate is important. Furthermore, this critical instructional practice allows learners to feel that they belong in the classroom and that their contributions to teaching and learning are important.

The use of humour is another critical instructional practice in teaching mathematics word-problem-solving (Van Dooren et al. 2019). While the use of humour is vital to speak a language that learners understand, it is also important to make use of differentiated teaching and learning methods in teaching mathematics word-problem-solving. Differentiated teaching and learning methods allow learners to be accommodated according to their strengths. This is one of the first ways in which learners feel welcomed and are given permission for their voices to be heard. Differentiated teaching and learning extend to several ways in which learners are accommodated in the classroom. One example is to allow learners to answer mathematics word problems verbally instead of having to write the answer down. This accommodation is an excellent asset to learners who are unsure about how to process their thoughts on paper (Swanepoel 2022). Another way of accommodating learners is through integrating the MI theory in the instruction of mathematics word-problem-solving. Gardner and Hatch (1989) define intelligence as the capacity to solve problems or fashion products that are valued in one or more cultural setting. The MI theory is important because it provides a platform for all to achieve. The MI theory is focused on the individual strengths of each individual (Swanepoel 2022).

The role of participatory action research in changing the landscape of mathematics word-problem-solving practices

PAR was selected as the research design for this qualitative study owing to its ability to introduce change and allow the participating teachers, as co-researchers, to stand together and find a collaborative solution to a challenge (see Somerville 2014). Considering the current study, PAR cannot be discussed without aligning it with teachers' professionalism.

In the intervention phase of the research, there was a continuous cycle of planning, action and reflection. The implementation of PAR led to the teachers' successful professional development. It provided a platform where they socially contributed to one another's learning and understanding of critical practices for the instruction of mathematics word-problem-solving. The teachers were able to establish a community of practice. The collaborative workshops informed the development of critical instructional practices for mathematics word-problem-solving. The collaborative workshops served as a platform for teachers to raise their concerns about instructional practices of mathematics word-problem-solving and share ideas, experiences and suggestions with one another to remedy these matters. Each collaborative workshop was based on the three phases of PAR, namely preparation, action and reflection. The first workshop dealt with the CBMoTD, and the second workshop critically viewed the MI theory and creative teaching methods. The third workshop paid attention to Shulman's (1987) model of pedagogical reasoning and action, while the fourth addressed subject matter knowledge and pedagogical content knowledge. The fifth workshop covered reading comprehension strategies, techniques, the mathematics register and critical thinking, and the last workshop addressed mathematics modelling and mathematics proficiencies.

When assessing the role of the teacher through the lens of PAR, one of the roles the teacher takes on during the instruction of mathematics word-problem-solving is that of an agent of change (Bourn 2016; Van der Heijden et al. 2015; White et al. 2021). Good education is largely determined by the quality of the teacher (Depaepe et al. 2020) and the ability of the teacher to set an example (Skemp 1993). The emphasis of PAR and professional development remains the collaborative nature of participants who work together to solve a matter at hand.

Conclusion

Mathematics word-problem-solving no longer needs to be a feared area of mathematics instruction. This research indicated how accessible and understandable mathematics word-problem-solving can be made for both learners and teachers. The focus of this chapter was to highlight how participatory action research was used to change the landscape of mathematics word-problem-solving from a product-orientated approach to a process-orientated approach. The answer to the research question 'How can Grade 3 teachers' mathematics word-problem-solving instruction be enhanced through a professional development initiative?' is that mathematics word-problem-solving should be meaningful to the teacher and the learner—it must be enjoyable for all.

Through the incorporation of alternative teaching methods, such as the integration of word problems into the curriculum and real-life experiences, verbal answering techniques, and breaking mathematics word problems into smaller sections, mathematics word problems can be explored in a different manner to ensure that the essence of the mathematics word problem is understood. Emphasis is placed on the constant integration of creativity and critical thinking as necessary components for successful teaching and learning. Through the introduction of humour and dramatisation in the instruction of mathematics word-problem-solving, the word problems become less daunting to teach for teachers and easier to understand for the learners. While incorporating alternative approaches to teaching mathematics word-problem-solving, the word problems are presented on the learners' level of understanding. They can solve the word problems while focusing on the process of the enquiry, rather than the final product. Adhering to the alternative approach to the instruction of mathematics word-problem-solving allows for differentiation. Lastly, the role of constant communication is highlighted as a critical aspect required for the successful answering of a mathematics word problem. This approach also includes the teachers' ability to speak to learners on their level, and not over them.

The new landscape in teaching mathematics word-problem-solving was made possible through PAR. The word sum wheel is the collaborative product of the participants in the research, which highlights the essential role of play in mathematics word-problem-solving. The collaborative process of professional development reinforces the notion of how important it is for teachers to continually evolve in their practice and ensure that they do not stagnate in their approach to teaching. Instead, teachers should continually find ways to approach mathematics word-problem-solving through alternative teaching methods that challenge the traditional teaching approaches and require teachers to think out of the box while having fun.

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