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Teaching Reflections of Secondary Mathematics Final-Year Student Teachers

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Abstract

Universities have the sole responsibility of producing teachers in most countries including South Africa. Part of teacher education involves school-based experiences where student teachers seek to integrate theory and practice. The purpose of this study was to explore how final-year secondary mathematics student teachers' reflect on their school-based experiences. The three-step guided reflection conceptual framework was used to frame this study. A case study design was adopted with the self-reflection report as the data source. The participants were 39 teacher candidates registered for a final-year school-based experiences course majoring in mathematics and another science subject. The results indicated that guided reflection was appropriate to unravel instructional challenges and successes that student teachers went through in the six-month period. Moreover, student teachers perceived school-based experiences as impactful on their future teaching career, as an opportunity to gain teaching experience and to put theory into practice under the guidance of experience mentors. However, student teachers significantly encountered negative attitudes towards mathematics which complicated their efforts of instruction in all the topics. With low motivation levels to study mathematics, all topics were difficult to the learners and student teachers had to come up with new instructional strategies.

Keywords: *Mathematics Instruction; Student Teachers; School-Based Experiences; Guided Reflection; Mentor; Initial Teacher Education; Narrative Inquiry*

Introduction

After all diploma-awarding colleges of education were closed between 1994 and 2000 in South Africa, universities have the sole responsibility of producing new teachers. Teacher education has been incorporated into universities according to international trends (Fengu, 2017). However, there was growing concern as to universities' capacity to produce teachers. University-trained teachers were reportedly "dumped in schools" without the know-how to handle practical classroom situations. "Teachers need rigorous training. Universities deal with theory. Teachers could continue to be involved there but for research and accreditation to maintain high standards. We need radical training of teachers to provide them with necessary skills" (Fengu, 2017: 1). Moreover, the technical report released by the Department of Education named the *Integrated Strategic Planning Framework for Teacher Education and Development in South Africa for 2011-2025* indicated some challenges experienced in teacher education after the shift from colleges of education to university teacher education. These are:

Lack of integration between initial and continued education; weak initial teacher education programmes delivered by some institutions; excessively theoretical initial teacher education programmes delivered by some universities; limited school-based practicums or internships; and that few initial teacher education programmes have been designed to go beyond skills training to developing competences and reflective practice (Department of Education, 2011, p. 99).

The reference above concerns an imbalance between theory and practice and the dearth of reflective practices in teacher education. To bring about the necessary links between theory and practice, teacher education uses its component of school-based teaching practice to achieve that. According to Leijen, et al., (2014), teacher reflection is an overarching activity for developing practical knowledge and linking it with educational theories in teacher education programmes. Furthermore, reflection is a critical skill and characteristic of an effective teacher in a teacher education programme (Alger, 2006).

Student teachers undertake mandatory school-based experiences (SBE) in schools as part of a teaching degree course. The duration and intensity of SBE depends on the institution and the degree qualification. Universities are therefore responsible for ensuring that their teacher education programmes are responsive to national priorities and meet professional needs (Department of Education, 2011). However, the initial teacher education in some institutions in South Africa lack integration of initial and continuing education, as well as of theory and practice. Student teachers also regard SBE as a formal requirement towards qualification as a teacher, without due regard to its essence. Thus, the contribution of this study was to expose student teachers to the concept of guided reflection, which is a process of self-inquiry and learning through reflection "in order to effectively realise one's vision of practice and self as a lived reality" (John, 2010: 34). This was intended to realise a collaboration of researchers, school mentors and the student teachers in order to understand the contextual nature of desirable practices and the possible factors that limit attaining these practices (John, 1997). The purpose of this study was to explore how final-year secondary mathematics student teachers' reflect on their SBE. The research for this study was "To what extent does education theory influence mathematics student teachers' experiences on school-based experience and how do their reflections impact the mathematics instruction?" Answering these questions will help to provide insight into how mathematics student teachers develop the synergy of professional knowledge and instructional skills while they are on SBE (Nyaumwe, 2004). The rationale for this study was to provide a context to explore the interaction between practice and theory for secondary mathematics instruction at a time when student teachers were engaged in SBE. Connecting practice and theory help to empower student teachers with the necessary skills of mathematics instruction context of South Africa.

At the moment, mathematics attainment in South Africa is low, and this is exacerbated by the number of schools which drop mathematics as a school subject (Umugiraneza, Bansilal & North, 2017). According to the Department of Basic Education, the main reason that schools drop mathematics is because of the shortage of teachers ("Here is why thousands of South African schools dropped maths as a subject", 2020). The institution where this study was conducted made strides to contribute to the production of future mathematics teachers in South Africa, in the myriad of 26 other institutions. Students at this institution register for a four-year Bachelor of Education (B.Ed.) qualification in diverse areas of specialisations like languages, humanities, commerce, natural sciences and others. All students learn general pedagogy courses in psychology, teaching and learning and school management, as well as methodology courses in their respective disciplines.

For the first two years of the degree program, the student teachers do not perform teaching duties during SBE but do a few weeks of observation at the schools of their choice. In Year 3 and 4, they embark on five weeks (for year 3) and six months (year 4) of SBE which involves teaching but under the mentorship of a qualified teacher. The school mentor is the owner of the class to be taught by the student teacher. The then phase of the B.Ed. degree programme confined student teachers to teach specifically

tenth and eleventh graders even though other grades may be taught as per school demands. University lecturers visit schools for assessment only once in the first five weeks, and the limit to only one visit is dictated by costs. The Institution is rural-based hence not affluent and the students opt to do SBE in their own rural areas. This entails university lecturers have to make the arduous school visits some of the rugged and remote areas. SBE for mathematics is intended to offer teaching experiences that present student teachers with the classroom complexities that require them to define problems, to construct meanings and to test theories (Baker & Shahid, 2003). One of the central learning outcomes for the mathematics SBE module was to reflect on the theoretical knowledge acquired and integrate it into the work environment. This was achievable through merging theory and work-place experience in learning to teach mathematics through collaborating with the school-based mentors.

Literature Review

Student teachers grow to become mathematics teachers by enacting methodology and educational theories through enculturation and participation in societal practices in school environments (Lave & Wenger, 1991). The nature of the school environment is important for the effective training of mathematics teachers. The Department of Education (2011) proposes establishing or identifying dedicated teaching schools to support teacher education. A study by Spangenberg (2017) examined mathematics student teachers' learning experiences at one such teaching school as advocated by the Department of Education. The participants were five students registered for a post-graduate diploma in Education engaging in teaching practice for the second and last time. The results indicate that most student teachers acted and reflected experiences where they perceived mathematics as theoretical, abstract and complicated which led them to believe mathematics teaching is rule-driven. Consequently, they were insensitive to the impact of their teaching on learners they taught.

In most teacher education programmes, the trend is that students spend long periods on school attachment, but the duration differs with institutions. The art of teaching can only be fully developed through experience in school practical sessions. Student teachers learn by attaching to experienced teachers and the school environment. Nyaumwe (2001) identified four models of teaching practice, which are apprenticeship, reflective-practice, the practical theorising and theory into practice. The model used at this institution is the apprenticeship, whereby student teachers do not have absolute responsibility to a class, but are attached to a mentor who coaches them to acquire teaching skills and competencies. Student teachers' perceptions to the mentoring model which they experienced was the focus of a study by Nyaumwe (2001). Nyaumwe explored student teachers perceptions of the guidance they receive from school-based mentors. Findings in Nyaumwe's study revealed that mentoring is an effective way of initiating student teachers into the teaching profession, and the collaboration enabled student teachers to develop insights into managing a class, and their reflective practices improved. However, some mentors were hesitant to have student teachers sit in their classes while they were teaching. With mentors not receiving any form of formal training to coach student teachers, the unexpected can happen (Nyaumwe, 2001).

Teacher reflection is defined as actively examining one's thoughts to improve one's teaching practice (Freese, 1999). Reflection through given terms of references transforms it into guided reflection. If handled well, reflection can be a catalyst that facilitates student teachers to synthesise new conceptions from the collision of theory and real-life classroom events (Baker & Shahid, 2003). Schon (1983) extended Dewey's concept of reflection by emphasising the time wherein reflection takes place. These were reflection-in-action, which occurs during the moment of teaching and reflection-on-action, which occurs before and after teaching. The reflection in this study was part of reflection-on-action, a critical deliberation on practice. Benefitting from reflection requires looking backward and forward to develop "new understandings, greater insights and/or greater responsibility for future actions" (Anderson, 2019, p.

2). Some researchers added reflection-for-action as a third reflection type (Wilson, 2008; Moore-Russo & Wilsey, 2014). This happens when student teachers connect present and past experiences with theory to develop personal practices to act in certain types of classroom situations (Buchbinder, Brisard, Butler & McCrone, 2021). The various types of reflections are normally used to monitor the effectiveness of student teachers' instructional decisions (Nyaumwe & Mtetwa, 2011).

Knowledge of mathematics content knowledge, teaching methods and learner psychology can increase as a result of reflection. Thus the challenge of preparing future mathematics teachers involve reflection, which is central for improving mathematics teaching (Artzt, 1999). Reflective practice is an important tool necessary for the continual teacher development (Kaasila & Lauriala, 2012). Reflection has been a part of teacher education in many studies as it builds towards becoming an effective teacher. Possessing the desire to reflect is highly likely to result in one doing reflection (Alger, 2006).

As much as teachers' reflections are important to portray the development and moulding of student teachers into professional teachers, the reflections need to be guided to reveal particular aspects of teaching. Inviting unstructured reflections from student teachers tend to draw out preposterous and superfluous points of view (Edens, 2000), for example, complaints the curriculum, inclement school environments, lack of resources, indisciplined learners (Baker & Shahid, 2003) among others. This study is on student teachers' reflections on mathematics instruction was premised on guided reflections. The model for Guided Reflection was used to structure this study.

The Guided Reflection Conceptual Model

The procedure of guided reflections conceptual framework is premised on two principles: (i) use teacher education to develop instructional practices that are required to enable student teachers to encapsulate into professional teachers and (ii) acquire the skills and knowledge student teachers require before they enter into the teaching profession. The model for guided reflection consists of three stages, namely:

Stage 1: Selecting Instances for Reflection

There is need to select the instance(s) of reflection beforehand. The instances of reflection were the mathematics lesson taught by student teachers in the entire six-month-long period of SBE.

Stage 2: Oral Reflection

After selecting the instance(s) of reflection, student teachers undergo oral reflection. The oral reflections of the instances were done in two parts. Firstly, it was informally done to the mentor throughout the SBE period. Secondly, it was done by the university lecturer once in the first five weeks of SBE and took the form of a post-observation discussion.

Stage 3: Written Reflection

Finally, students engage in written reflections, which can be before, during or after teaching. This took place at the end of the entire six-month SBE period. Student teachers at this stage reflect on the selected instances in individual self-reflective reports that revolve on given guiding questions. The following guiding questions were used in this study:

1. How was your SBE practical?
2. What were your successes in your teaching?
3. What were your challenges/difficulties in teaching your classes and the topics?
4. What have you learnt from the 2022 SBE practice?
5. What could you have done differently?

These were simply guiding questions and student teachers were free to expand the scope of their reflections. The guided reflection procedures were used in a study by Allas, Leijen and Toom (2016) in their quest to find useful pedagogical knowledge that has the potential to prepare student teachers for day-to-day teaching routine. Their results indicated that guided reflection procedures support the development of knowledge that can be easily transferred to other classroom situations, including post-qualifications. In another study, guided reflection procedure was used to support the development of practical teacher knowledge in the light of theoretical knowledge of student teachers during teaching practice (Leijen, et al., 2014). The findings revealed an acknowledgement of the value of guided reflection procedures and its correlation to the student teachers' prior pedagogical experiences gained in teacher education.

Methodology

The interpretivist research paradigm was used in this study, which acknowledges the subjective nature of human understanding which is required to explore student teachers' acquisition of instructional knowledge. This paradigm enables researchers to view reality through the experiences and perceptions of the participants. Under interpretivism, the research uses those experiences and perceptions to construct and interpret his understanding from gathered data. This study was interpretive because meanings from the student teachers' instructional reflections on SBE for mathematics were examined and inferred from the narratives (Ensor, 2000). A single case study research design was used in this investigation. Thirty-nine purposively-selected fourth-year students for 2022 took part in the study. The narrative inquiry methodology was used to collect and analyse data. A narrative inquiry allows for an exploration of the meanings that the participants derive from their experiences. The participants in this study shared their instructional experiences at the end of their SBE period in December 2022. Narrations are used in the process of self-construction and as the students told their stories, the researcher constructs meaning there out (Author, 2022). The use of narrative inquiry in this study was also informed by the paradigm within which this study is located. The participants were given a chance to 'interpret' their lived experiences, after which the researchers also interpreted them.

Home-based SBE is the norm at the Institution where this study took place, thus student teachers select schools convenient to them. The mentor model commonly used nowadays saw student teachers allocated a grade 10 or 11 mathematics class that belonged to the mentor so that they jointly teach that class. The topics which they jointly teach were guided by the annual teaching plan for that period, July to December. Hence all student teachers taught more or less the same content. These were Geometry, mensuration, statistics and probability and financial mathematics for grade 10. The same four topics applied to grade 11 with the exception that they had trigonometry in place of financial mathematics. Student teachers reflected at the end of a six-month long SBE. SBE was the last exercise that concluded their four-year teaching degree, just before they qualify. As lecturers, the researchers explains the expectations of SBE before they started SBE. We visited student teachers for teaching practice assessment purposes only once. We went to class for classroom observation, followed by post-observation discussion to address concerns that were observed in the file and lesson observations. Finally, the student teachers wrote down their experiences pertaining to instruction as a guided reflection report. The only instrument of data collection considered in this study were the self-reflective reports. For the sake of confidentiality, the reports were classified as B1, B2, and so on up to B39 to correspond to each of the 39 student teachers. The interpretations were categorised using thematic analysis, which is explained in the next section.

Findings

The narrative analysis of the student teachers' narrations revealed two broad categories of reflections. The first alludes to SBE as an opportunity to learn to be a mathematics teacher and the second is about threats to mathematics instruction. These are explained in the next sub-sections.

Opportunity to Learn to Teach Mathematics

The SBE is an opportunity to put theory into practice in the process of learning to be a teacher. In teacher education, the student teachers acknowledged indeed they receive wholesome tuition in general pedagogies and methodologies in mathematics teaching. According to B38's perception "… studies prepare me well for the field of teaching because they tell us about the behaviour of learners and how to work with human subjects. Supported by the courses they did at campus, six participants concurred they were in a better position to teach their classes. It was time to "*put into action pedagogy and content knowledge*", according to B2. B20 further said he "*use what was learnt in Psychology, School management and Principles of Teaching and Learning to handle management issues*". Furthermore, the enacting of theoretical teacher knowledge was done under the supervision of experienced teachers, according to B9.

SBE is an opportunity to become a good teacher. B27 said that he learnt a lot from qualified teachers in the school who were producing good results, and he wanted to emulate them. In the mentor model, the first and foremost person wherefrom student teachers learn is the mentor. This involves developing pedagogical and subject matter knowledge, according to B28. Of importance, student teachers learn how to teach certain topics and create a conducive learning environment. B33 concurred and further said that by SBE "I try the art of teaching before actually getting into real teaching." Becoming a good teacher entails having the practical knowledge of instructional strategies. B1, B2 and B4 all suggested that they used different teaching strategies which had the advantage of stimulating learning and potentially accommodative to all learners. In line with the theory of instructional approaches taught to them in teacher education, the majority of student teachers appropriately leaned towards learner-centred approaches. B10 said he "used new learning strategies which encouraged learners to work as groups". This was supported by B12 who said he "*got advice from the lecturer during assessment on the use of learner-involvement that were discussion and Question-and-Answer methods*". To promote more learner-involvement in their teaching, B2 and B22 provided multiple practice activities which were to be done both individually and in groups. According to B2, giving plenty of activities raised learners' keenness for mathematics. However, after using cooperative learning, B26 reported a new challenge whereby "*learning can be noisy as learners engage in discussion and group exploration*". These findings emanate from trialling instructional methods in the real classroom and under the supervision of an experienced teacher.

Mathematics is a computational subject that is activity-driven. The more activities learners are exposed to in class, the better their understanding of mathematics. Some of the instructional approaches mentioned earlier centred on upholding activities, for example, discussion and question-and-answer. This took lengthy periods of preparation, to which B11 and B30 corroborated that they never went to class unprepared. Part of the preparation involve creating activities to use in class. B2 supported this by saying that he "*researched for stimulating activities*" to support learning and teaching. B2 was conscious of activities that bring motivation to learners. B31 gave lots of work to keep the learners engaged and B38 strove to administer informal assessment tasks every day. B29 added the dimension of use of past-examination questions in classwork and homework instead of the usual textbook questions only. However, the desire by B21 to administer frequent formal tests to get learners to get used to the questioning techniques remained something he hoped to do in future. The present workloads and pacesetter demands for the South African education system may not allow frequent tests and subsequent marking.

Still on activities, B2 had to contend with fast learners who completed activities quicker than planned. The same predicament faced B36: "*while helping slow learners, the fast were interrupting and making noise*." Without immediate solutions to these dilemmas, some students like B24 wished to use "differentiated teaching to provide a range of activities and an extension activity for the fast-learners". Instead of differentiated teaching which is obviously time-consuming, B29 and B19 envisioned separating classes according to ability so that appropriate activities can be administered to respective classes. B11 posited that if fast- and slow-learners attend in the same class, a balance of tasks is required. Such a balance is not easy to strike; hence B11 observed that many teachers ignored the interests of slow learners in favour of fast learners.

In some instances, the decision to use a particular instructional method came about as a result of collaboration with the mentor. This was supported by B16 who said the mentor and him "*discuss topic before class, compare lesson plans, consider the strengths and weaknesses of learners and come up with a teaching method to use for that topic.*" B4 and B6 supported the point and further indicated that she had meetings with the mentor before and after class, whereupon content issues and learner discipline were discussed. Collaboration was a grand opportunity which student teachers faced during SBE, until B26 said "*with right mentorship I can achieve a lot.*"

Threats to Mathematics Instruction

In conjunction to opportunities for accelerated growth as teachers of mathematics, there were also threats to mathematics instruction that student teachers had to endure according to their reflections. The first threat which student teachers faced head-on involved the various content issues which they taught in class. All student teachers did not have problems of understanding the topics they were supposed to teach except three student teachers. Of the three student teachers, B18 admitted that financial mathematics was difficult for him, so he sought help from his mentor to manage to teach it. B10 stated he had challenges "*teaching probability because I had less content of it and had negative attitudes towards it*." Finally, B20 mentioned that there were some sections that she missed at a time when she was a learner herself but did not specify the content areas. However, she said she had to really put emphasis when teaching these topics so that her learners did not repeat the same experience she had. Generally, fourth-year students do not have content issues with grades 10 and 11 mathematics. Hence the rest of the student teachers concurred by saying that grade 10 and 11 levels of mathematics content was not challenging to them. All of them had passed through the same education system a few years back and had also tackled some of the topics at a higher level in content courses in teacher education. Moreover, B6 said "*no topic is difficult because of working together with mentor*." In fact it was the learners who encountered some challenges with the topics that were taught to the extent that it made it difficult for the student teacher to teach it. B14 said that there was "*no challenging topic but all topics were difficult to learners due to weak prior knowledge.*" Indeed B18, B12 and B9 reiterated that learners' prior knowledge to the topics which they taught was shaky, and the chief culprit was Covid-19 pandemic. In the years 2020 and 2021, normal schools operations were disrupted, which led to some concepts not being taught fully. Besides the hard lockdown which forced schools to close, learners were not attending classes every day. Thus student teachers like B18 had to re-teach the basics for their learners to understand the current topics. This was the case when learners in B18's class could not distinguish mutually exclusive and independent events, as well as misconstruing the concept of experimental probability.

The guided reflection attempted to circumvent from student teachers general reflections not specific to mathematics teaching like school policies, learner discipline, provision of resources and behaviour of mentors, yet some were included due to their relevancy to mathematics instruction. For example, lack of sufficient mathematics teachers meant that some grades were not taught the pre-requisite concepts at a time when they were expected. B14 realised that his grade 11 learners lacked the basics of laws of indices because the school had a shortage of mathematics teachers for grade 10 where the concepts were supposed to have been introduced. That particular school relied on student teachers only

who, in most cases are available on specific time periods. B27 also said his learners had challenges in the topics of "*trigonometry, statistics and probability due to lack of teaching resources.*" When such a thing happens, student teachers re-teach the concepts, spend more time and give more examples on the affected topics. B16 re-taught the topic of probability, and B12 chose to spend more time on affected topics. Some mathematics topics like trigonometry and probability commence in grade 10. In this regard, the learners in B23's class got lost in the introduction phase, and repeated attempts at re-introductions stretched for many days. In the end, the mentor was approached to assist with a better introduction of the topic, and there was an improvement. More experiences on the new topics by B39 also revealed that "*probability was not grasped, and that made me think I was the problem.*" Finally, learners had some challenges in financial mathematics due the terminologies thereof, which required good English command to interpret, according to B10 and B36. B11 also faced a situation where the school lacked mathematics textbooks for learner use, hence "*with no textbooks, Euclidian geometry was cumbersome to teach since I had to draw the diagrams on the chalkboard*."

Certain topics in both grades 10 and 11 were regarded as difficult by learners due to attitude issues. B1 discovered that learners had conceptual problems on mensuration topic because they hated it. B16 also commented that "*analytical geometry and financial mathematics were difficult to teach due to negative attitudes as learners perceived these as difficult*." Once learners develop an attitude that mathematics is difficult, it becomes a mammoth task for teacher to teach those topics. B29 had such an experience in one of his class: "*the attitude that mathematics is difficult made it difficult for me to teach and it took long to address individual concerns yet there are other topics to go to.*" In B11's class, learners had the stereotype that mathematics is difficult hence they did not participate fully. And B26 noticed that "*when faced with difficult problems, learners relapsed into a state of complacency that mathematics is difficult*." Some of the sources of negative attitudes towards mathematics do not involve the student teachers. B27 indicated that the grade 11 learners she was teaching had no grade 10 teacher and "*had developed negative attitudes towards mathematics which took me a month to change*."

The existence of Mathematical Literacy, a watered-down version of Mathematics in grades 10 to 12 in South Africa negatively affects learners' attitudes towards mathematics (Mkhize, 2019). Whenever grades 10 and 11 learners perceive mathematics to be difficult, they have an alternative of Mathematical Literacy. According to B4, "*most learners did not take mathematics serious as they prefer mathematical literacy.*" In the school where B14 was at, mathematical literacy was not offered but this did not help the situation. 14 said the learners registered "*zero interest in mathematics because there is no option of mathematical literacy*." According to B17, learner-attitudes are so influential that passing or failing mathematics depends on them.

Associated with learner-attitudes towards mathematics, student teachers also reported about lack of motivation to study mathematics as one of the challenges they had to endure. Motivated learners like mathematics and are a marvel to teach, according to B5. Faced with unmotivated learners, student teachers had to find ways to redress the situation. Student teachers like B23 had to design interesting lessons to rekindle learners' mathematics interest. B8 tried to vary teaching approaches by dividing the class into groups of ten each and appoint the top-performing learners to be group leaders. On the other hand, B10 encouraged healthy competition in class. B24 sums it up by saying that "*lack of prior knowledge and motivation and negative attitudes made it difficult for me to teach mathematics*." The discussion which follows in the next section qualifies some of the participants in the light of the literature. Among things that student teachers could have done differently, some mentioned using ICT tools to make mathematics teaching and learning more relevant and fun (B12). In that regard, B31, B24, B19 and B21 intended to use GeoGebra software in geometry where sketching and visualisation play key roles. However, most schools, being rural-based, had no complementary resources for teacher use like the projector or a computer laboratory.

Discussion

Guided reflection provides evidence and more data-based accounts of the impact classroom mathematics instruction in a bid to establish a connection between practice and theory for student teachers (Orland-Barak & Yinon, 2007). Literature reports that the initial teacher education does not adequately prepare teachers to relate classroom practical situations and the theories taught in the initial teacher education institutions (Allas, Leijen & Toom, 2016; Altan & Sağlamel, 2015). Consequently, beginner teachers encounter difficulties when dealing with some classroom situations, especially those concerning instruction (Meijer, 2010). The guiding prompts in this study directed student teachers towards mathematics instructional experiences. Baker and Shahid (2003) support the significance of teaching experiences that confront student teachers with the complexities of classroom events rather than untenable school policies or learner-indiscipline. The prompts led to structured narrations which circumvented general school comments, which, in most cases, students have no control over. Aptly put, "Guided reflection on their classroom experience has helped to stimulate and refine their thinking about instructional issues" (Baker & Shahid, 2003: 4). Reflective practice does not come naturally to many student teachers, but they need prompts to negotiate the reflection process appropriately in an ever-changing world.

The guided reflection in this study produced to two main categories of student teachers' narrations of instructional experiences. These were opportunities to learn to be a teacher and threats to mathematics instruction. The identified opportunities to learn to teach mathematics are as follows: (i) collaborate with the mentor and peers, (ii) flex instructional strategies skills and (iii) connect theory and practice. Those student teachers who successfully accomplished the opportunities confirmed they were on the road to becoming good teachers of mathematics. Under the care and guidance of a mathematics mentor, student teachers managed to learn a lot about the intricacies of mathematics instruction. Student teachers are not alone out there when they encounter instructional challenges or sometimes a corroboration of the actions to take in given circumstances. Student teachers felt more confident working in a collaborative environment, where they support one another and share responsibilities (Almusharraf, 2020). There was also interaction with student teachers from other universities, as practicum times for many universities in South Africa coincide. Collaboration can provide rich opportunities to understand and recognise tacit knowledge and give student teachers further exploration to learn about teaching (Freeman & Richards, 1996). However, this is only successful if the mentor exists and is aware of the duties he or she must play in grooming the student teacher (Nyaumwe & Mthethwa, 2011). Some student teachers in this study found themselves alone in the class due to shortage of qualified mathematics teachers. Being alone, they had to sink or swim (Nyaumwe, 2001).

Reflections by the student teachers in this study, as in the study by Nyaumwe and Mthethwa (2011) were done at the end of the last semester of a four-year teaching programme. They happened at a time after all the theories of teacher education were taught and during the longest continuous SBE period. As good as end-reflections gave wholesome experiences of instructional practices, Mahasneh (2020) argues that they lack the reflective opportunities through all the stages of the degree programme. Some experiences could have been reflected upon earlier, creating provisions for growth and improvements. Nevertheless, the underlying purpose for this summative reflection is for student teachers to build personal resources of instructional experiences that they could draw upon in their future careers as qualified teachers. Most importantly, student teachers regarded SBE as adequate to prepare them for a job as a mathematics teacher, and they confirmed they could confidently walk into any mathematics classroom in the following year (Mahasneh, 2020). The aforementioned empowers student teachers to take ownership of their career development and to build the confidence needed to take risks and make bold decisions. Students enrol for SBE courses in public schools to apply the pedagogical practices they received in the methodology courses and theories of education. However, in most cases, the application is

ineffective because there are gaps between practice and theory. To bridge the gaps, student teachers should examine their teaching behaviours through reflective practice (Almusharraf, 2020).

The factors that militated student teachers' teaching of mathematics in this study were: student teachers' own content challenges; learners' inadequate basic knowledge of the content being taught; lack of resources; adverse learner attitudes which make teaching mathematics difficult; lack of motivation to learn mathematics; and the alternative subject to mathematics. A serious challenge which student teachers encounter in teaching mathematics rests with learners who have content gaps in the basic knowledge needed to make the current concepts understandable. It is not always possible for teachers to re-teach the basic knowledge because they need to keep pace with the annual teaching plan. In some cases, learners might not have been taught certain concepts because of shortage of mathematics teachers. This is common in rural schools which are normally shunned by qualified teachers. As a result, learners had difficulties making sense of what the student teacher is putting forth. That made it quite difficult for student teachers to deliver and it happened in many topics.

The learner-attainment of mathematics in South Africa has been incessantly low. Learners get alienated from mathematics at a very early age, when they are made to believe that mathematics is about pre-packaged facts to memorise and rules to follow (Govender, 2023). It was a mammoth task for student teachers to teach to learners who had negative attitudes towards mathematics in general. The presence of mathematical literacy, a separate high school subject alternative to mathematics, is indicative that learners have attitude issues with mathematics. In the 2022 national examination, 269,734 learners sat for mathematics, in comparison to 450,005 who chose mathematical literacy (Govender, 2023). In other words, learners are about twice more likely to do mathematical literacy than mathematics. In some rare schools where mathematical literacy is offered, learners displayed resentment for the deprivation by showing complete loss of interest in mathematics. The preference for a lesser mathematics subject implies that learners in South Africa are not motivated to do mathematics. Learners perceive doing mathematics is a coercion to do a subject that they might never pass. They claim mathematics is abstract, with no direct relevance to life beyond school. Nevertheless, what they fail to realise is that mathematics is significant in developing learners' problem-solving, critical-thinking and reasoning skills as needed in many occupations. Getting learners to have sound passes in mathematics is a likely way to motivate them to take mathematics seriously. With low motivation levels of motivation to study mathematics, all topics were difficult for the learners, and student teachers were compelled to come up with fitting instructional strategies to counteract this. Faced with unmotivated learners, student teachers are expected to reflect on their teaching and, depending on the outcomes, suggest alternative instructional approaches (Abidin, Budayasa & Khabibah, 2021). Shulman (1986, p.9) posit that "there are no single most powerful forms of representation, the teacher must have at hand a veritable armamentarium of alternative forms of representation."

At the moment this is not the case as there is a crisis in mathematics education in South Africa and the root cause is inadequate teaching. Instilling reflective practices in student teachers during training helps to redress the issue of inadequate teaching as they commence their teaching careers. As they grow in theoretical understanding and skill of teaching, student teachers would make the process of reflection a part of their professional repertoire (Baker & Shahid, 2003). The conscious reflections can be shared and used as points of references (Buchbinder, Brisard, Butler & McCrone, 2021) for making decisions for student teachers' teaching strategies (Ward & McCotter, 2004). Teacher reflection unravels opportunities for deepening instruction and leads to an understanding of threats to instruction.

In the student teachers' narrations of threats to mathematics teaching, some went so far as to decide and enact counter measures to deal with the identified threats to mathematics teaching. Student teachers also gave their envisioned practices as something that they could have done differently if they were to re-do the SBE exercise. During reflections, student teachers take inventory of what happened in

class, why it happened that way and what could be done differently in order to improve learner understanding and instructional competence (Galvez-Martin, 2003). Identifying the envisioned practice entails the ability to provide alternatives for improvement in the subsequent period (Abidin, Budayasa & Khabibah, 2021). There is need for student teachers to possess diverse ways to represent content so as to make it meaningful to their learners (Umugiraneza, Bansilal & North, 2017). This aligns with John Dewey's description of reflection as giving something serious consideration, which enables one to act in an intentional and deliberate manner (Dewey, 1933). After the conscious reflection of one's experiences, one intentionally seeks to improve by portraying the intended course of action. Some student teachers took the problem-based approach to instruction whereby they administered plenty of activities during and after class. Others used group work in a way to maximise learner-involvement in learning. Establishing relationships between topics was done by one student teacher, whereby he connected the behaviour of number patterns to functions. Finally, to have more contact time with their classes, some student teachers were obliged to conduct extra classes after working hours.

Conclusion and Implications

Guided reflection on student teachers is useful for self-inquiry during teacher education, which leads them to an envisioned practice in order to overcome threats to mathematics instruction during teacher education and after graduating. Reflective practice is also useful for mathematics teachers to enhance their continual professional teacher development (Aldahmash, Alshalhoub & Naji, 2021). We maintain that assisting student teachers to develop reflective practices is one of the objectives of teacher education programmes the world over (Moore-Russo & Wilsey, 2014). The current reflection will shape the future practice of student teachers as qualified mathematics teachers. The contribution of this study was to expose student teachers to the concept of guided reflection, which is a process of self-inquiry and learning through reflection "in order to effectively realise one's vision of practice and self as a lived reality" (John, 2010: 7). The implication of this study is that if learners are unmotivated and harbour negative attitudes towards mathematics, student teachers need to strategise their teaching approaches and evaluate them. By so doing, student teachers would use SBE as an opportunity to learn to teach and navigate the challenges to mathematics teaching to develop new understandings for future actions (Killion & Todnem, 1991).

Student teachers in this study only reflected after the longest continuous SBE period in the last semester of a four-year degree. This study recommends increasing the frequency of the guided reflections so that there is growth and depth of practice after each cycle of reflection during the same SBE period. Also, the reflection should start in year one during observation-only SBE so that there is incremental instructional knowledge where student teachers are appropriately supported through the process. The suggestion for further study is exploring in-service mathematics teachers' reflective practices as part of continuing teacher development.

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