

Re-Envisioning Early Childhood Mathematics Education

Learning through Memory Drawing

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As a teacher educator of early childhood mathematics at a South African university, I am studying my lived experiences of my practice. I aim to support pre-service to view and experience the teaching and learning of mathematics in an integrated way. Nkopodi and Mosimege (2009) highlighted that it is crucial to expose learners to opportunities that associate mathematical concepts and principles with the application of what they encounter in everyday experience. My experience spans from teaching at primary schools both in rural and urban contexts, to teaching at a college of education and universities as a lecturer in rural and urban settings.

In South Africa, the Foundation Phase (FP) is the first phase of primary education, starting from Grade R to 3. The mathematics curriculum for this phase highlights the competencies that young learners need to acquire in each of the five mathematics content areas, namely numbers operations and relationships, patterns, functions and algebra, space and shape, and measurement and data handling (Department of Basic Education, 2011). The curriculum guidelines stipulate that teachers need to employ sociocultural and constructivist approaches in the development of mathematics concepts (Laridon et al., 2005). The curriculum for Foundation Phase requires learners to build awareness of the important role that Mathematics plays in real-life situations (Department of Basic Education, 2011).

Shulman defines different categories of teacher knowledge that teachers need to have, such as knowledge of content and pedagogy (Shulman, 1987). Pre-service teachers need to acquire “pedagogical content knowledge, content knowledge or subject matter knowledge” as well as mathematics-for-teaching which encompass both subject content knowledge (Pournara et al, 2015, p. 2). Furthermore, Pournara et al. (2015) asserted that teachers require more knowledge than sound content knowledge of Mathematics itself. For example, the use of concrete material when teaching Mathematics is vital. Moreover, when preparing pre-service teachers, there is a need for teacher educators to show how they can use different strategies and incorporate play into early childhood mathematics. Linder et al., (2011) support this view asserting that mathematics for young learners should be presented in a way that they could make meaningful connections through play and exploration.

In this self-study, I am working from a sociocultural theoretical perspective. Goos (2014) emphasizes the importance of cultural materials and people’s experience of sociocultural environments in making meaning. In creating positive and meaningful learning experiences, teacher educators need to be able to articulate their knowledge of teaching practice that is informed by theory and firmly grounded in particular contexts (Goos, 2014). They must exhibit expertise as well as uncertainty as they need to explore new methods in their teaching consistently. John-Steiner and Mahn (1996) expand on

Vygotsky's sociocultural perspective; which states that language and symbol systems facilitate the occurrence of human activities. These are better understood by scrutinising their historical development. According to Björklund and Ahlskog-Björkman (2017), teachers and teacher educators need to consider the cultural tools as fundamental to teaching and learning and shaping the cognitive processes. The sociocultural perspective also gives attention to social development, where learning takes place through cooperating with others (Samaras, 2002).

From a cultural perspective, Goodell (2011) maintains that teacher educators could afford pre-service teachers opportunities that include significant ongoing teaching experiences that are reinforced by structured opportunities. Pre-service teachers must then reflect on these experiences and learn from them as this allows them to construct knowledge about teaching. Gerdes (1998) presents how prospective teachers can develop mathematical ideas and practices in and about their own and their future learners' cultural environments. Therefore, in my module, I aim to incorporate activities about sociocultural contexts and create opportunities to link learners' school culture and their home culture.

Aims

Early learning experiences can influence teaching knowledge. To illustrate, when I was in primary school, I found Mathematics as the most challenging subject. The teachers compelled us to memorise times tables and beat us for getting the wrong answers. Nicol (2011) shares the same perspective stating that many pre-service teachers have experienced learning mathematics as a set of rules for simple problem solving and understand mathematics as describing strategies in solving such problems. In contrast, we can see the mathematics and the processes of learning mathematics as an integrated development of forming connections. Schuck and Pereira (2011) consider mathematics as related to tangible aspects and connected to our everyday lives. I aim to assist pre-service teachers to acquire the fundamental elements in early childhood mathematics teacher education.

Maasepp and Bobis (2015) showed how many pre-service teachers in Australia had developed negative beliefs about mathematics during their schooling, and this has attributed adversely to their learning and teaching of the subject. In my experience, it is similar in South Africa. Self-study research provides opportunities for teachers and teacher educators to examine their own beliefs and practice critically and positions them as inquirers and learners (Samaras, 2011). My experiences in teaching mathematics in primary school and teacher education prompted me to undertake this self-study project. In my view, the stilted and traditional methods that were often and are still used to teach mathematical concepts are not successful, and this makes it difficult for many young learners to grasp these concepts. Despite changes to the prescribed curriculum, teachers still teach mathematics as abstract concepts that are not related to the context of the real world. Hence, Akyeampong et al. (2011) contend that teachers of mathematics should create more opportunities in the classroom environment to develop practical knowledge of teaching early mathematics.

Before I embarked on this journey, I experienced challenges in teaching mathematics at a higher education institution. I realised that I needed to learn more, to enhance my pedagogical approach as a teacher educator to assist my pre-service teachers in gaining content knowledge as well as pedagogical content knowledge. To improve my practice in early childhood mathematics teacher education, I asked the following research question: *What can I learn from memory drawing to improve my practice of preparing pre-service teachers to teach mathematics to young learners?*

Methods

I chose a self-study approach to improve my practice by interrogating my learning and teaching of early childhood mathematics. According to LaBoskey (2004, p. 859), “self-study employs multiple, primarily qualitative methods” which afford us prospects of gaining various and extensive perspectives on the educational processes under study. This sentiment was earlier expressed by Schuck (2002), who stated that self-study researchers might use a variety of methods ensuring that the focus is to improve practice in teacher education. In this study, I used two self-study methods to respond to my research question. I used the *arts-based self-study* and *memory work self-study* methods.

Arts-Based Self-Study Method

Samaras and Freese (2006) state that the arts-based self-study method stimulates and prompts self-reflection, and conversation about enhancing one’s teaching employing the arts. I used the drawings that pre-service teachers and I drew as reflective prompts to look into the actions that influenced my educational experiences. Weber (2014) proclaimed that drawings compel us to take a step back and look at our practice from another standpoint as presented by the medium itself. As noted by Richards (2013), art has the potential to provide a situation for students to convey their feelings and ideas that may otherwise be difficult to express. Further, the conscious exploration of the self can heighten arts construction with its creative nature and emotional aspirations (Richards, 2013). Arts-based self-study methods help researchers to reflect on, investigate and engage in dialogue about improving their teaching (Samaras, 2011). The art-based self-study method allowed me to reflect on the learning of early mathematics so that I could think about ways of improving my practice.

Memory Work Self-Study Method

The memory work self-study method serves to expose how individuals construct their identities; what we recall and how we recall events in our lives to create the essence of who and what we are at present (O’Reilly-Scanlon, 2002). According to Pithouse-Morgan et al. (2019), memory drawing as a self-study method aims at exploring early memories of school, represented as drawings, that can aid teachers to attend to issues of practice related to educational and social concerns. Mitchell (2008) notes that drawing has been used with pre-service teachers in South Africa to study different phenomena. By engaging my pre-service teachers in memory recall activities, I was hoping to learn about their early learning experiences to improve my teacher education practice.

Participants

I was the primary participant in this self-study project. The secondary participants in the study were pre-service teachers enrolled for the early childhood mathematics module. Due to time constraints in the prescribed curriculum in the module that I taught in the first semester, I invited pre-service teachers for extra-curricular activities in the second semester. Twelve pre-service teachers volunteered to participate. The group involved ten females and two males, of which ten were Black, and two were Coloured students. The activities took place over eight weeks. I met with the pre-service teachers once a week for two hours. The memory drawing activity was one of the exercises in which we engaged. It is noteworthy that historically, the people of South Africa were categorised according to race, which meant that the different racial groups lived and schooled separately. The racial groups are Blacks, Coloureds, Indians and Whites. During apartheid, schools were segregated

and provided for disproportionately based on race Carrim (1998).

Data Sources

The pre-service teachers and I engaged in memory drawings to elicit our narratives of how we learned mathematics in our early years. We also wrote short paragraphs about these experiences and discussed how our early learning of mathematics enabled or disabled us to grasp the concepts. During this process, I tried to create an atmosphere where pre-service teachers could speak openly (Mitchell et al., 2019) to allow them to learn from each other. I audio-recorded and transcribed the conversations with pre-service teachers.

Ethics and Trustworthiness

Samaras (2011) asserts that in our relentless efforts to improve our professional practice in teacher education, it is necessary to ensure that we protect our students and colleagues. Addressing issues of ethics was crucial in this self-study research project, mainly because I was both a researcher and a teacher educator with an academic responsibility towards my pre-service teachers. They assisted me in working towards improving my practice. I have to be aware of the delicate position of these two roles to ensure that my positionality does not affect pre-service teachers. According to Samaras (2011), researching ethically improves the quality of research and contributes to its trustworthiness. I obtained ethical clearance to conduct this study through the appropriate channels from the institution. I explained to the pre-service teachers what my research entailed, and they consented willingly.

Critical Friends

During my self-study journey, I shared my work with my trusted colleagues and scholars from various platforms. The colleagues that served as critical friends were self-reflexive researchers from different disciplines at my institution and the university of technology as well as colleagues at national conferences. Schuck (2011) regards critical friends as colleagues who offer honest and valuable opinions about ways to improve our teaching. Self-study entails the formalisation and making the work public to other professionals for deliberation, examination, and judgment (LaBoskey, 2004). I audio recorded the discussions in my meeting with critical friends. During this interaction, I received positive and beneficial feedback that helped me in getting new ideas and illuminations about my research. As a result, I was able to interrogate my teacher education practice in depth. For example, a critical friend remarked my study was well-placed because of the stigma that is associated with mathematics currently. She indicated that because the pre-service teachers are in the Foundation Phase, it was crucial to deal with the negative learning experiences and gain suitable teaching methods so they could make mathematics fun. In the process of presenting my research, I established “new understandings about critical friendship, its benefits, and its challenges” (Schuck & Russell, 2005, p.107). The interaction with other people was an integral part of my learning.

Data Analysis

I analysed the data inductively using the learning zones and zone of possibility (Samaras 2011). Learning zones are “organic and diverse communities of expertise where learners co-mediate, negotiate, and socially construct an understanding of a shared task” (Samaras & Freese, 2006 p. 51). Zones of possibility happen where the teacher or mentor and students are learners open to

developing new knowledge through conversation (Samaras, 2011). I read and re-read the text data and colour coded the words and phrases of the paragraphs we had written, and the transcriptions of our conversations by marking them in different colours. I then constructed categories and read through the identified codes and created the themes that recur in the data. By adhering to this process, I identified issues and patterns that developed in response to my research questions.

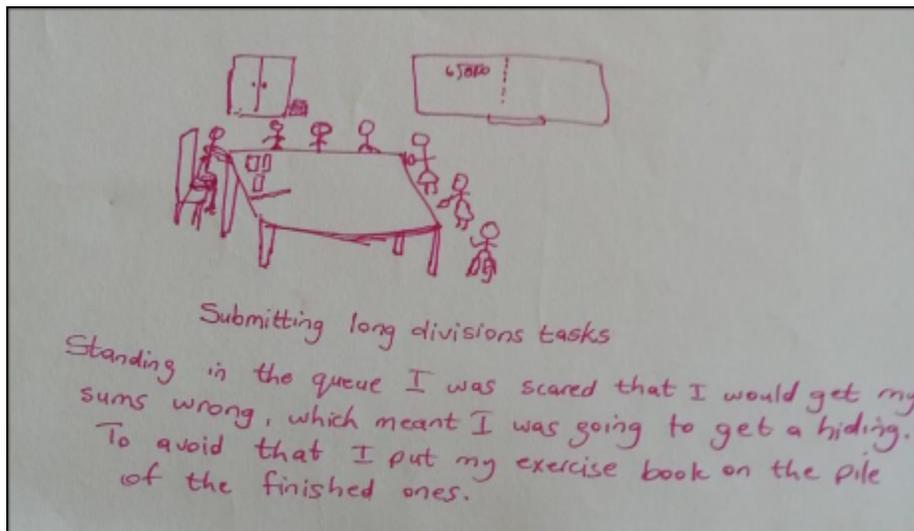
Outcomes

My Memory Drawing

In Figure 1 below, I present an image from memory to recall my childhood experiences concerning early mathematics learning.

Figure 1

An Image of Learners Submitting Long Division Tasks.



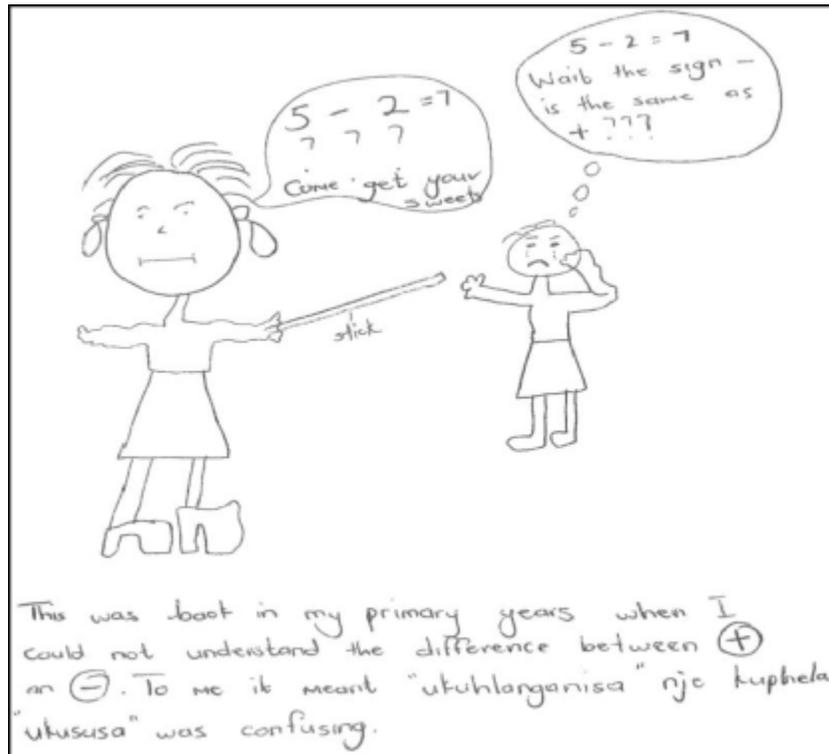
This memory drawing represented my struggles with the long division when I was in primary school. I was in Grade 3 when our teacher gave us some long division exercises. She sat in front of the class next to the cupboard. All learners had to queue to submit these exercises one by one. If you did not get the answers right, you got hiding with a cane. I was scared as I knew that I had not performed well. So, to escape the hiding, I decided to put my exercise book on the pile of the finished exercise books. Remembering this made me think of the methods we use to teach mathematical concepts for learners to grasp them quickly.

Pre-service teachers' memory drawings

The following images represent a selection of the memory drawings by pre-service teachers. The next image depicts a tearful learner with a teacher holding the stick.

Figure 2

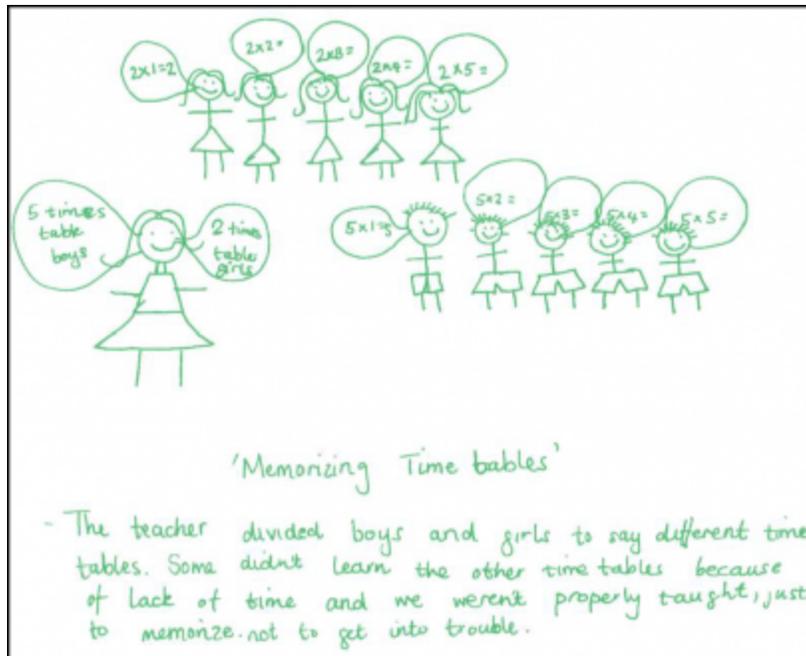
An Image of a Learner Getting a Hiding from the Teacher.



The pre-service teacher reported that when she was in Grade 1, she had problems differentiating between addition and subtraction. She indicated that everything meant "ukhlanganisa" (addition); "ukususa" (subtraction) was confusing. When she got the wrong answers, the teacher would then say, "Come get your sweets" - meaning getting hiding. This drawing (Figure 2) shows how we can be in touch with our inner child-life because that is how young children expressed themselves. Pithouse-Morgan et al. (2019) state that as adults, our drawings are childlike because we are not accomplished artists. Drawings remain particularly important for early childhood teachers in trying to explore childhood memories. The first four pictures (Figure 1- 4) show that there were no concrete objects or any type of resources in these classrooms.

Figure 3

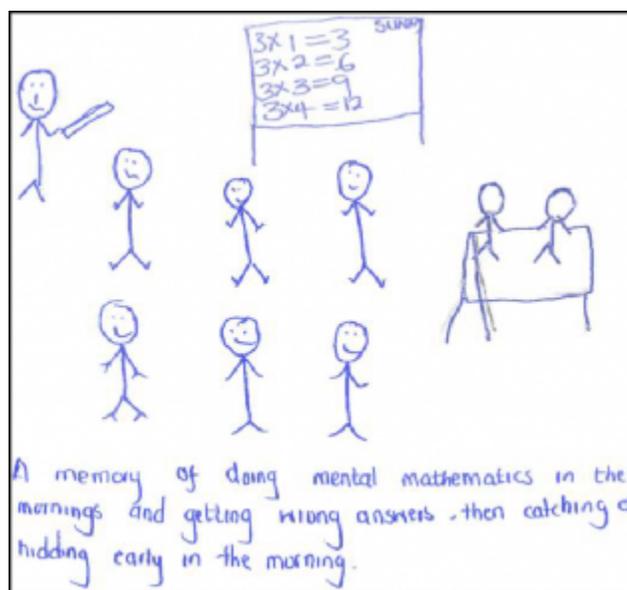
An Image of Boys and Girls Divided Memorising Different Time Tables.



The pre-service teacher who drew the picture in Figure 3, highlighted that the teacher divided them to recite times tables every morning. The image depicts the division of boys and girls as well as the times' tables they had to recite. The pre-service teacher indicated how they had to memorise so that they do not get into trouble. What comes through from these pictures is how fearful we were of our teachers when we were learning mathematics in the primary school. We tried, by all means, to avoid hiding.

Figure 4

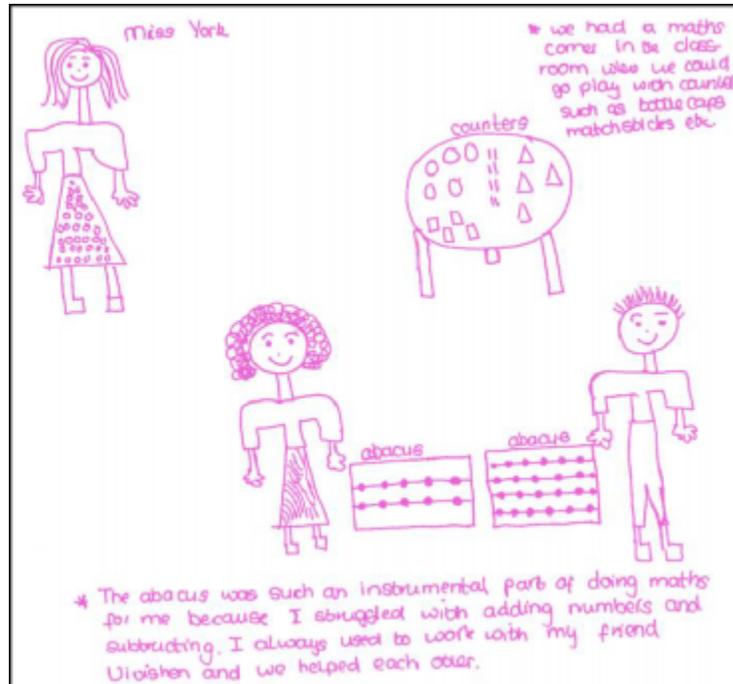
An Image of Learners in the Classroom Doing Mental Mathematics.



Catching a hiding early in the morning for getting wrong answers stood out for the pre-service teacher's image in Figure 4. Mathematics is a fearful subject, and it is even worse when associated with punishment (a stick) when you are still a young learner. Starting a day by getting a hiding was demotivating for young learners who are eager to learn. It is noteworthy to state that the stick features in most of the pictures.

Figure 5

An Image of Learners in the Classroom using the Abacus.



One pre-service teacher had a positive experience in learning mathematics. She indicated that the use of resources was instrumental in her learning of mathematics. They also worked together with other learners, helping each in the acquiring of mathematics concepts. The image in Figure 5 shows concrete objects in the classroom and no mention of the stick. The experience of this student indicates a positive and encouraging learning environment.

My Learning

I begin this section by providing examples of the codes and categories. Table 1 below illustrates the coded data.

In the following table, I represent the developed themes that recur in the data as well as my learnings.

Table 1

Codes and Categories

Coloured Codes

Categories

Weren't properly taught to memorise	
Getting wrong answers	
Mental mathematics	Get a hiding
Struggled with adding and subtracting numbers	Catching hiding early in the morning
Could not understand the difference between + and -	Come get your sweets (hiding)
Confusing	
Scared to ask the teacher	Always worked with my friend
Not to get into trouble	Helped each other
Sad whenever the lesson was about to start	Grouped for counting
Could go play with counters	

Table 2

Themes and my Learnings; Adapted from Samaras and Freese (2006)

Activities	Themes	Learnings
		Maths was abstract, paper-based, chalk and talk
	Mathematics is too abstract	A lot of rote learning Some sections that were found problematic - addition, subtraction and division
Memory drawings Discussions of memory drawings	Corporal punishment	Punished for making mistakes Teachers always using sticks in the classroom
	A safe learning environment	Starting a day with a hiding Learners always fearful An environment conducive to learning Fear must not be part of learning
	Co-learning	Learners helping each other Learning together Co-construction of knowledge

I used Samaras and Freese (2006) analysis framework, which I modified to capture the essence of what I was learning from the data. I developed the following four recurring themes from my analyses: Mathematics is too abstract; corporal punishment; a safe learning environment, and co-learning.

Mathematics is too Abstract

My experiences, as well as those of pre-service teachers, indicate that most of the teachers who taught us in primary school, employed teacher-centred approaches in teaching mathematics and did not use physical objects. Only one pre-service teacher acknowledged using an abacus for addition and subtraction. For both the pre-service teachers and I, mathematics was abstract and involved memorisation, rote learning and *talk* and *chalk*. I became more aware of an imperative need to disrupt the notion of mathematics as difficult and abstract. Björklund and Ahlskög-Bjorkman (2017)

argue that mathematics teachers should present it in a manner that allows for hands-on and prior experiences. I have thus made a conscientious effort to employ an integrated learning approach in the teaching and learning of mathematics for pre-service teachers to make it hands-on and understandable. I concur with Pereira (2011) who acknowledges that to surmount the damage brought about by numerous years of teaching would require more than mathematics courses. I aim to provide positive experiences for pre-service teachers and to consider teaching mathematics differently.

Corporal Punishment

Historically, corporal punishment was an integral part of South African education (Morrell, 2001). Teachers used corporal punishment as a form of maintaining discipline in the classrooms. Morrell (2001) notes that due to the criticism of its effects, the government of the day banned corporal punishment in 1996. The use of “the stick” for corporal was not part of the curriculum but to control learners in the classroom. I was astounded by the fact that most pre-service teachers experienced corporal punishment in their early learning of mathematics as I had many years before. I realised that not much has changed in the interim regardless of so many efforts to improve education.

I was surprised because I thought the pre-service teachers should have learned mathematics as set out in the contemporary curriculum. On the contrary, the pre-service teachers reported that their primary school teachers used traditional methods and encouraged rote learning. Such experiences resemble what Pereira (2005, p. 70) noted in the United States of America about how “unexciting,” or “uninspiring” the learning of mathematics was for his pre-service teachers when examining their personal experiences.

The drawings helped me to gain a better understanding of my negative experiences and pre-service teachers’ insights into their encounters with mathematics so that I can try hard to provide positive ones. These reflections were pivotal, as Korthagen (2017) points out that reflection in teacher education is the essential foundation of teacher learning. I decided to consider pre-service teachers’ thinking and feelings in the teaching of early mathematics by employing an integrated learning approach. In applying this approach, I present mathematics concepts by combining other subject areas. I also consider pre-service teachers’ prior knowledge and experiences. I hope that they could emulate this with their learners one day.

A Safe Learning Environment

As I prepare pre-service teachers to teach mathematics to young learners, I must emphasise the significance of creating a learning environment where learners feel secure. Maasepp and Bobis (2015) highlight that creating a safe and conducive learning environment may lead to increased understanding of mathematics concepts. Schuck and Pereira (2011) believe that teacher educators should consider both the affective and the cognitive sides of learning and teaching mathematics because they are intricately linked. The authors note that most mathematics educators, including themselves, learned only the cognitive aspect at school (Schuck & Pereira, 2011). Hence, Allender and Allender (2006) ask for teachers to become more humanistic by making compromises that will favour the needs of students. I endeavour to take cognisance of a humanistic aspect of education as I strive to improve my practice.

Co-Learning

I was inspired to learn that one of the pre-service teachers in this study encountered positive experience in the learning of mathematics. She reported learning together with a friend and helping each other. Samaras (2002) notes that the Vygotskian perspective allows pre-service teachers opportunities to develop their understanding by interacting with others. The memory work activity afforded us to learn from each other. As I moved forward with my work as a teacher educator, I acknowledge what I had learned and that I was still learning from working with pre-service teachers. I embrace learning as a two-way process and hope to engage my pre-service teachers more intensely in the process of co-learning. My goal is to set high expectations for them and myself. I also learned from critical friends who provided me with support and ideas of how I could improve my practice.

Conclusion

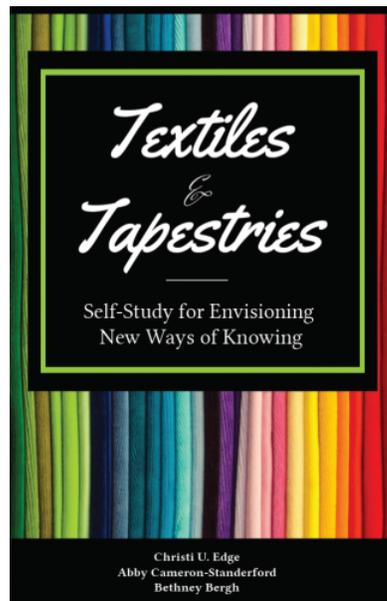
Memory drawings assisted me in learning about how I can improve my practice of preparing pre-service teachers to teach mathematics to young learners. The drawings and the discussions I had with pre-service teachers helped me to reflect on how I was taught and learned mathematics so that I can think about more effective practices that will be beneficial for my pre-service teachers. I better understood my struggles and those of my pre-service teachers.

It is vital for me as a teacher educator to understand that focusing solely on the cognitive development of pre-service teachers is insufficient. In my determination to provide experiences of learning and teaching mathematics, I need to be conscientiously aware of my objectives so that I do not revert to the improper ways of teachers who taught us. A sociocultural theoretical perspective afforded me a chance to venture into self-study methods that sought to evoke pre-service teachers' memories and assisted in eliciting their views and attitudes towards mathematics. I hope to make them think about the cultural background of their prospective learners so that they gain positive experiences in mathematics. My goal is to incorporate pre-service teachers' daily life as part of mathematics activities as well as their sociocultural backgrounds. I hope to build on this self-study by offering pre-service teachers opportunities to reconsider their early learning of mathematics of the past and re-envision memories of the future. I hope that others intending to improve their pedagogy through self-study may utilise arts-based methods, memory drawings and integration to help pre-service teachers interrogate their own schooling experiences in a particular discipline and that those understandings can impact improved pedagogy.

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