

Lived Experiences: Secondary Mathematics Pre-Service Teachers' Perspectives About Multiple Components of Their Teacher Education Program

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Received: 27 December 2019 Accepted: 31 October 2020
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Reform-based approaches to teaching mathematics are proven to be most effective for students' learning, yet many novice secondary mathematics teachers still use traditional approaches. One reason for this is that novice teachers tend to teach the way that they experienced mathematics as students themselves. There is thus an onus on teacher education programs to provide pre-service teachers (PSTs) with new, reform-based experiences with mathematics in order to positively influence their future teaching practice. Grounded in situated learning theory, this qualitative, exploratory case study examined PSTs' perceptions and experiences of reform-based approaches in three components of their teacher education program. PSTs shared during interviews that they experienced reform-based approaches in both "student" and "teacher" roles in different ways and to different extents. Findings also highlight the impact that teacher educators have on PSTs' learning. We conclude by proposing multiple considerations for how teacher education programs can provide opportunities for PSTs to experience reform-based approaches in situated ways.

Keywords teacher education programs • mathematics content courses • field experiences • mathematics teaching methods courses • reform-based approaches • situated learning

Introduction

Researchers and policymakers around the world continue to call for a shift away from traditional approaches to teaching mathematics (e.g., Board of Studies, NSW, 2012; Liu & Li, 2010; National Council of Teachers of Mathematics, 2000; Van den Heuvel-Panhuizen & Drijvers, 2014). Traditional approaches, characterised by teacher-centred learning through repetition and rote memorisation, limit students' mathematics understanding and attitudes towards mathematics (Schoenfeld, 2004). Instead, reform-based approaches characterised by student-centred and inquiry-based learning encourage students to problem solve, invent strategies, pose questions, and identify patterns (Hunter, et al., 2016). These approaches also increase students' autonomy and confidence as mathematics thinkers and doers (Boaler, 2002). Moreover, research also shows that students who learn through reform-based approaches retain mathematical knowledge longer than their traditionally taught peers (Boaler, 1998). Yet, despite the proven benefits of reform-based approaches, novice secondary school mathematics often use traditional approaches. One reason for this reliance on traditional teaching methods is that novice teachers tend to teach the way that they were taught (Ball, 1988) – typically for secondary school mathematics teachers, they only experienced traditional approaches to teaching mathematics (Lewis, 2014). Teacher education programs are thus faced with the challenge of creating lasting

effects of reform-based learning opportunities for secondary mathematics pre-service teachers (PSTs), if they are to positively influence their future practice. While research generally describes the learning opportunities in teacher education programs as positively supporting PSTs' development (Arnold et al., 2014; Yarmus & Begum, 2014), additional investigation is required for us to better understand how specific programmatic components – mathematics content courses, field experiences, and mathematics teaching methods courses – provide such learning opportunities for secondary mathematics PSTs.

In this paper, we place the secondary mathematics PSTs who live and experience these teacher education programs at the fore. In teacher education programs, PSTs are regularly asked to reflect on their experiences for the purposes of their own professional learning (Griffiths, 2000). Reflective practice requires PSTs to actively consider the interaction between their beliefs, actions, and outcomes to better understand the meaning and value of their experiences (Bullough & Gitlin, 2001). Engaging in reflective practice enables PSTs to make more informed and thoughtful decisions about their teaching (Farrell & Ives, 2015). The power of reflective practice is not only of benefit to the PSTs themselves. Indeed, research indicates that PSTs' perspectives are of notable importance for other stakeholders such as teacher educators and program administrators (Clift & Brady, 2005). Yet, first-hand accounts of PSTs' experiences in teacher education programs seem to be lacking in the extant literature (Savolainen et al., 2012). In response to this gap, this study centres PSTs' perspectives with the aim of understanding how an undergraduate-level teacher education program in Canada supports PSTs' development. More specifically, the research questions guiding this study were:

- 1) What are secondary mathematics PSTs' perceptions of the three subject-specific components of their teacher education program (as explored below)?
- 2) How do the components provide opportunities for the PSTs to experience reform-based approaches?

Components of a Secondary Mathematics Teacher Education Program

Whereas secondary mathematics PSTs take general education courses¹ (e.g., Assessment and Evaluation, Educational Psychology), there are only three components of their teacher education program that specifically address PSTs' subject of specialisation:

- 1) mathematics content courses,
- 2) field experiences, and
- 3) mathematics teaching methods courses.

Intended to complement one another, the components of teacher education programs generally have different foci (Baumert et al., 2017).

Mathematics content courses serve a crucial purpose of educating secondary mathematics PSTs on subject-specific content knowledge for teaching. These courses range in a variety of fields such as algebra, geometry, and statistics. Mathematics content courses are designed to teach PSTs a breadth of mathematical content knowledge that is in many cases, more advanced than the secondary curricula they are required to teach. The higher level of mathematics often makes these courses a difficult undertaking for PSTs (Zazkis & Mamolo, 2011). Yet, study of advanced curricula supports PSTs in drawing interdisciplinary connections between various mathematical fields, which in turn, helps PSTs see the "big picture" of mathematics (Williams, 2001). Often taught by mathematicians, mathematics content courses traditionally use content-driven, lecture-

¹ In Canada, "courses" indicate a unit of study in a program. Often, courses are one semester long and are comprised of classes once a week for 13 weeks.

styled methods to teach their content to PSTs. Such teaching strategies have been shown to be ineffective and unfavourable for many, particularly for teacher education students (Nolan, 2012). In line with current research, there has been a shift in mathematics content courses towards incorporating more reform-based approaches, such as learner-focused, inquiry, and skills-based pedagogies to teaching mathematics (Ramdhany et al., 2018).

In order for PSTs to acquire authentic in-school teaching experiences, PSTs complete field experiences in host-schools (Borman et al., 2009). During field experiences, PSTs experience teaching within a classroom setting, which involves observation and delivery of practice instructional tasks (e.g., developing and carrying out lessons), as well as undertaking other teacher responsibilities (e.g., administrative tasks, extra-curricular activities) (Arnold et al., 2014; Begum & Yarmus, 2013). Given their *in-situ* and lived experience nature, field experiences allow PSTs to self-reflect, and try reform-based techniques and theory learned in coursework (Ralph et al., 2009). During field experiences, PSTs are paired with in-service teachers (cooperating teachers – CTs) who serve as models of professional practice. CTs also serve as mentors by supervising, guiding, and helping PSTs manage their workload in addition to facilitating PSTs' induction into the profession (Hobson et al., 2009). Research shows that PSTs value their CTs' feedback in both formal (e.g., written assessments of teaching performance) and informal (e.g., discussions between classes) contexts (Broad & Tessaro, 2009).

Research describes the purpose of teaching methods courses as providing an opportunity for PSTs to improve their pedagogical knowledge and to experience classroom teaching through both student and teacher lenses (Kiliç, 2011; Wilkins & Brand, 2004). The student lens allows PSTs to explore mathematics through reform-based approaches (Albayrak & Unal, 2011), while the teacher lens allows PSTs to cultivate positive dispositions towards mathematics, develop their mathematics pedagogy, and establish how mathematical knowledge is taught (Hodge, 2011; Wilkins & Brand, 2004). An important goal of teaching methods courses is to develop PSTs' pedagogical content knowledge (PCK) (Van Driel et al., 2002). PCK is the specific knowledge teachers require to connect pedagogy to the subject content and curricula within their practice (An et al., 2004). Indeed, PCK is important for those in the field of education as mathematics teachers require a different understanding of mathematics compared to those in STEM fields (e.g., engineers, architects) (Ball, et al., 2008; Hodge, 2011). Instructors of teaching methods courses may model the use of reform-based teaching approaches, to support PSTs' development of PCK (Van Velzen et al., 2012). This modeling of best practices requires instructors to use a "self-conscious narrative" to make explicit their instructional choices (Boyd, 2014). This narrative encourages PSTs to see reflective practice being modelled.

Situated Learning

Given the robust opportunities PSTs experience from reform-based approaches in their teacher education program that reflect future teaching contexts, the theoretical lens adopted for this study is situated learning. Situated learning theory assumes that: the understanding of a concept is constantly changing as social contexts evolve, action is grounded in a setting authentic to which it occurs, knowledge is difficult to transfer between disparate tasks, and learning through instruction is abstract and should take place in real social environments (Lave & Wenger, 1991). Regarding teacher education, this means that the PSTs' learning environments should imitate, and be contextualised within, the future climate in which they will teach (Korthagen, 2010).

Situated learning comes to fruition through the modeling of reform-based approaches by course instructors or CTs, or when PSTs have the chance to experiment with reform-based approaches for themselves (Borko et al., 2008). In the context of teacher education, situated

experiences for reform-based approaches may occur through: scaffolding advanced tasks, encouraging PSTs to apply their acquired knowledge to novel circumstances, varying and differing opportunities for practice, and providing opportunities for PSTs to collaborate with one another (McLellan, 1996). Additionally, reflective practice allows PSTs to make sense of their situated experiences and as described earlier in this paper, can be a powerful tool for PSTs' learning. Yet, as discussed above with particular regard to the mathematical content classes, opportunities for secondary mathematics PSTs to learn in a situated way throughout teacher education programs are not always available. By contrast, for university-based teaching methods and content courses, a challenge is to maximise PSTs' learning to teach mathematics through course instruction rather than practical, applied experience (Zeichner, 2010). Further, the instructional approach used by course instructors is important. Regardless of the course content (i.e., mathematics content or pedagogy) an instructional approach that mirrors that which PSTs are encouraged to use in their future practice, such as a reform-based approach, is of benefit. Pertaining to situated learning theory's claim that action is grounded in the authentic setting to which it occurs, field experiences arguably provide the best opportunity for situated learning to occur, given that they take place in classroom settings (Anderson, et al., 1996). Components of teacher education programs range in their affordances to provide opportunities for situated learning for secondary mathematics PSTs. While teacher education programs endeavour to create contexts that best support PSTs' development, much can be learned from the ways in which PSTs experience these programs. As such, our study focused on PSTs' perspectives of the components in their teacher education program.

Research Context

The study explored here took place within the context of a four-year undergraduate teacher education program at a Canadian university. PSTs enrolled in the program graduate with certification to teach in secondary schools (students ages 12 to 17) with one subject area of specialisation. Possible areas of specialisation include English Language Arts, Science, Social Studies, and Mathematics (the latter of which is the focus of this study).

The teacher education program is comprised of coursework and field experiences. For secondary mathematics PSTs, required courses are typically taken during autumn (September to December) and winter (January to April) semesters and include mathematics content courses, mathematics teaching methods courses, and general education courses (e.g., Assessment and Evaluation, Educational Psychology). PSTs may take mathematics content courses in the Spring/Summer semester. Typically, this occurs if PSTs need to re-take a course due to failure or to alleviate their course load during the year. Mathematics content courses are taken with undergraduate students in other programs of study (e.g., mathematics, sciences) with PSTs taking nine required courses (e.g., Calculus, Geometry, History and Philosophy of Mathematics, Linear Algebra, Probability, Statistics) and choosing eight elective courses to further contribute to their breadth and depth of content knowledge (e.g., Mathematical Logic, Number Theory). PSTs take two mathematics teaching methods courses, typically in the second and fourth year of their program. Finally, general education courses are taken by PSTs spread throughout the four years of their program. These courses are taken with other secondary PSTs (mathematics and otherwise) and, at times, with PSTs enrolled in the elementary teacher education program.

Secondary mathematics PSTs have one field experience per year in the program, of varied lengths of time, each with an increased level of responsibility. The first field experience (spanning two weeks in length) is purely observational and PSTs have the chance to observe different classes (mathematics and otherwise) in a local secondary school. The second field experience (also two

weeks in length) requires PSTs to co-teach a lesson with their cooperating teacher (CT). In subsequent experiences (two to three months in length), PSTs take on sole teaching responsibilities, upwards of 75% and 100% of their CT's teaching load in their third and fourth field experiences, respectively.

Methods

A qualitative approach was used to explore secondary mathematics PSTs' experiences in their teacher education program. This methodological approach was chosen to gain a deeper, authentic and descriptive perspective of the issues being explored (Creswell, 2013). More specifically, this study uses an exploratory case methodology (Yin, 2009), which promotes the development of a thick description of a complex phenomenon embedded in its real-life context. Indeed, this study uses the case of a Canadian undergraduate-level teacher education program to investigate and analyse the impact of three components of a teacher education program on PSTs. Participants for this study were all the secondary mathematics PSTs in one cohort of the program² ($n=7$).

Data were collected through one-on-one interviews to capture participants' perspectives in their own voice. Specifically, semi-structured interviews were used to allow for follow-up questions to address thoughts or ideas brought up by the participants during the interviews (Creswell, 2013). Participants were interviewed at the end of each of the autumn and winter semesters of their four-year program (there were no academic commitments in the summer semester). Thus, each participant was interviewed eight times. During interviews, PSTs were asked to reflect on their experiences in the components of their teacher education program that took place that semester. Specifically, PSTs were asked to reflect on challenges, successes, and moments from the component that affected their thinking about teaching mathematics and/or that they found helpful to them as developing teachers (e.g., Tell me about an experience in [the component] that contributed to your development as a teacher. How did it contribute? How did stakeholders (e.g., instructors, teacher educators, CTs, other PSTs) contribute to your experiences?). The first interview also focused on PSTs' educational background, motivation in becoming a mathematics teacher, and expectations and goals for the teacher education program (e.g., Why did you decide to become a mathematics teacher? What goals do you hope to achieve from studying in the program? How do you hope to achieve these goals?). The final interview at the end of the program also asked the PSTs to reflect on the teacher education program and their experiences throughout the program as a whole (e.g., What was the most meaningful component of your teacher education program and why? How have you changed from the beginning to the end of the program and what contributed to this change?).

Interviews were audio recorded and transcribed verbatim. Transcripts were then coded using NVivo software. Data were coded through the constant comparison analysis method (Miles & Huberman, 1994). While the use of the coding software necessitated the use of an initial coding scheme based on the literature, a "living" codebook was developed to allow for themes emerging from the data (Creswell, 2013). Data were first coded based on the component of the teacher education program (i.e., mathematics content courses, field experiences, and mathematics teaching methods courses) described by the participant. Broad categories of codes (e.g., general impressions, PSTs' learning) were then created by the research team after team members individually read a representative sample of transcript data. More specific sub-codes were then created based on emerging themes in the data (e.g., mentors, opportunities for practice, moments

² Mathematics is typically the smallest of the subject areas of specialisation in the program. Other subject areas (e.g., English Language Arts, Social Studies) may have cohorts upwards of 30 students.

of reform-based learning). New codes were proposed by individual research team members and added to the codebook upon discussion by the research team and codes were cross-checked by members of the research team for consistency and validity (Miles & Huberman, 1994).

Findings

In this section, we present the PSTs' perspectives about each of the three subject-specific components of their teacher education program: mathematics content courses, field experiences, and mathematics teaching methods courses. All names are pseudonyms.

Mathematics Content Courses

Participants shared that the mathematics content courses acted as spaces to enhance their mathematics content knowledge. As Ruby shared,

[The content courses] are vital. They're important because we need to be masters in what we're teaching. We need to know it inside and out. We need to understand the core concepts, like, you can't go into a class and just know secondary school math.

PSTs described the mathematics content courses as having an impact on their future teaching in two ways. First, as a way to develop empathy for their future students and second, as lessons that they could learn from their course instructors.

Developing empathy for their future students

The PSTs described the mathematics content courses as being the most academically and emotionally challenging component of their program. Some/All PSTs spoke of failing and having to repeat content courses, and the stress that was induced by these courses. As described by Magda, "I'm not going to lie to you. It gets frustrating at times." For the PSTs experiencing this outcome, this difficulty was unfamiliar territory as usually they had excelled and enjoyed their elementary and secondary mathematics classes. Thus, the PSTs felt that these courses provided them with the opportunity to experience what some of their future students, specifically those who would struggle, would feel. As explained by Ruby,

I've experienced that [struggle] frequently in my university career. Like, yes, it's a different level [to my students], but the feelings are the exact same ... I understand feeling like, "I'm never going to understand this." So, it has helped me a lot in my teaching. I can spot when students are feeling really discouraged really quickly. Because like, that look, was like my look on my face when I was in those classes ... And, I can help them through it.

Domino described a similar belief saying, "[T]he feelings I'm feeling I can attribute that to students in secondary school who maybe are struggling as well. If you go through life just, like, excel and you don't get what it feels like to struggle." Although the content courses were challenging for the PSTs, they saw the value of this struggle to their future as teachers. More specifically, the PSTs described these experiences as allowing them to develop empathy for their future students. As Paula stated, "I can see a connection in the fact that I'm a student and I can understand how the students feel." Ruby agreed saying, "As much as you are a master in your domain ... I would say the empathy [is] more important than anything."

Learning from their instructors

The instructors of the content courses also had an impact on the PSTs. As Ruby shared, "I think you could learn a lot about ... the kind of teacher you want to become ... I learned a lot from the teachers and how they teach." Specifically, PSTs reflected on the teaching approach of their

instructors and as Paula said, "take something from them and know that I want to do this or I don't want to do this [in my own teaching]." Similarly, Domino stated, "I can see what certain [instructors] are doing, and what I want to take from that and apply to my teaching." PSTs concluded that they could learn from the instructors based on the teaching approaches they used, how they interacted with their students, and their assessment practices.

Most PSTs shared that what they learned from their instructors was "what not to do." Domino described her frustration of the assessment practices used by one of her instructors:

I understand that, like, for assessments you have to sort of like - you can't just keep it at the same level, you have to make it more difficult. But ... don't make your tests ridiculously harder. Because then the level of confidence of your students are just going to drop. They're not going to want to try. So yeah, make it harder, but make it a level that they can apply their knowledge to new ideas and new questions they maybe haven't seen before. As I was going through that exam I was like, "I'm never doing this. Like, this is not nice. It's not fair."

Many PSTs spoke of the traditional approach of teaching used by their mathematics course instructors. As told by Domino, "It's very lecture style. I think the thing I've learned is that I don't want to do that as a teacher." Similarly, Ruby said, "[The instructors] were very much like, 'I am the teacher and I am going to lecture to you' ... so I feel like they're kind of stuck in that time of just talking to people ... I learned that I never want to do that."

Although most participants stated that courses were typically taught using traditional approaches (e.g., lecture), some PSTs appreciated moments in which instructors used reform-based approaches. Domino recounted how one of her instructors used a practice-based approach that focused on high-leverage teaching practices (e.g., eliciting and responding to students' thinking, orienting students to each other's ideas) to encourage whole-class discussion:

I liked seeing the [instructor] use the practices and it's like you can still apply the practices no matter what you're teaching, and it was good to see how she changed the practices a little bit and applied them to a group of, like, a hundred 21-year-old students.

James described how one of his instructors scaffolded students' learning by having them make connections to previous learning saying,

He was sort of like - 'Have we seen something like this before? Oh yeah, what did we do then? Okay, can we, you know, take an educated guess about what the method might look like now?'

From this experience, James shared that he was able to glean an effective, and student-centred way to support students in developing proofs. Similarly, Ruby recounts one instructor's approach as:

He'll talk about one topic ... and just to have you really understand it and he'll approach it from so many different angles. He'll talk about religion, he'll talk about history, he'll talk about the philosophers behind it and it's just, it's very kind of unifying It just sticks with you. I think he's pretty great.

In describing this instructor's approach of connecting mathematics topics to other subject areas, Ruby noted the value of a multidisciplinary approach to learning. Even though the context of the mathematics content courses was different to their future teaching context, seeing reform-based teaching approaches applied in a different context gave the PSTs an alternative perspective about how these approaches could be enacted.

Field Experiences

Overwhelmingly, the participants described field experiences as the component of their program that had the most positive impact on their development as PSTs. As Domino said of the field

experiences, "You actually learn how to teach." PSTs described how the field experiences provided them with the opportunity to try to implement reform-based approaches in an authentic secondary classroom setting. Ruby spoke about applying the teaching method of "orienting students to each other's ideas" as a student-centred practice,

I redirected so many discussions between [the students]. It's fun being able to test those [high-leverage practices] out and seeing what works and what didn't work for my classroom.

While CTs contributed to PSTs' development as teachers, being immersed in a secondary school context seemed to have provided the most opportunities for PSTs' learning.

Learning from their CTs

PSTs indicated the significant role that their CTs had on their experience during field experiences. First, the PSTs reflected on the importance of getting feedback from their CTs. For Domino, she valued the fact that she "was able to implement" the feedback. Ruby appreciated getting feedback from more experienced educators. In her words:

[The CT is] there to tell you, 'Hey why don't you try this approach'. I haven't done this before, so it's great to have someone there that's like, 'I've done this, I've been in your place, I'm willing to [im]part any wisdom I may have.'

PSTs stated that the feedback they received from their CTs contributed to their learning. PSTs also described how observing their CTs in action supported their learning. Magda shared, "I got to see how [my CT] used videos off of YouTube and different songs to help review what they had talked about in class." As the PSTs had multiple field experiences as part of their teacher education program, they also had the opportunity to work with different teachers. PSTs appreciated learning from their different CTs and compared and contrasted the variety of teachers that they had across their field experiences. As Domino said, "you can have two teachers teach the same content in two completely different ways."

An immersive experience

PSTs described many other insights they gained from being immersed in the secondary school environment. In general, the PSTs said that the field experiences provided them with a "more realistic" perspective about life as a teacher. For some PSTs, encountering different types of students was enriching. For example, Domino described the impact of being in a school context that was different from the context where she grew up. As she explained,

Knowing the class culture and the classroom and who are your students, I think that's really important and that's something I learned because I'm from [a suburb] and so I'm a little sheltered. And that was the shock for me, seeing kids from an underprivileged area.

Paula described her experience being in one particular class with students with exceptionalities, difficult home circumstances, and learning difficulties,

I think it was really that there are a lot of different students you're [going to] have. [My CT] adapted her teaching styles based on the level of the class. ... I also learnt things about the students' personal lives and it made me think, there are a lot of factors to these students that sometimes you have to get involved as their teacher. It kind of gave me a different perspective on everything.

For many PSTs, the field experiences demonstrated the variety of students that they may work with in the future and as such, that their teaching practice would need to be equally as varied to support the needs of all students. As Magda summarised, "Not everything works with everybody!"

The PSTs' lived experiences in schools also allowed them to develop a more comprehensive understanding of the roles and responsibilities of a teacher. Many PSTs shared that prior to the

field experiences, they had a relatively narrow perspective of the role of a teacher. More specifically, it seemed that the PSTs had previously only thought of teachers' responsibilities within the classroom. The PSTs described how being in a school setting, taking on the responsibilities of a teacher, and working alongside other teachers was enriching. As Ruby articulated, "[It is] the reality of the job. There are so many things that you don't consider." Similarly, James said, "[All the] day to day ... what happens outside the classroom."

PSTs described interactions with various teachers at their host-schools and noted the benefits of having a positive relationship with colleagues. As Ruby shared,

It was always so great to be able to go into the math staffroom and be able to say, "Hey, try this." Or I would go in and someone else would talk about something and I would be like, "Oh I like what you did here."

Yet, PSTs also recognised that the busy pace of teaching may prevent such fruitful discussions or collaborations. As Ruby continued, "[Teachers] are very busy and it might not be because they don't want to, it's just because they're busy. And I was like, 'I'm too busy. Wow, I totally get it now.'"

PSTs gave specific examples of different ways that they got involved with school life during their field experiences. Some shared experiences of getting involved in extracurricular clubs and sports teams. Others reflected on their experiences on field trips. Magda described a fundraising event at the school,

There was a concert that [the students] put together to raise money for the school. The [student teachers] just went and had fun. We were clapping for them, we were dancing in the audience. I had a couple of students in the music program [who] were performing, so they were really excited that I came ... so that was really cool. They feel supported outside of [the math classroom] and something different too, so it's like being there put a smile on their face. You don't know the impact until you do it.

Evident in Magda's sentiments, many PSTs had not considered the impact that they had on their students outside of the mathematics classroom. From the field experiences, the PSTs realised that developing relationships and supporting students was equally important both inside and outside the mathematics classroom.

Many PSTs had the opportunity to participate in parent-teacher interviews. PSTs described how this experience demonstrated to them the importance and value of communicating with parents. Specifically, PSTs spoke of using conversations with parents as a way to better understand their students. For example, Ruby shared:

I literally had a parent saying, "Well, I am an engineer and my husband's a doctor, so we have very high expectations for our son." And I'm [thinking], well that's great, but also this kid has really high anxiety and now I know why. So, balancing, keeping the student's mental health a priority but knowing what they are dealing with at home.

PSTs also spoke of at first, being reluctant to attend the parent-teacher interviews. Initially, the PSTs thought that the parents would be accusatory of the teachers. Yet, all PSTs described the experience as positive. As Domino said,

It was so much fun, because I liked seeing how [the parents] were very supportive of us, and how they wanted their child to do well, and they didn't blame us at all if they weren't doing well. ... I didn't just sit there and say nothing. I interacted, I gave my opinion I really enjoyed it, I thought it was a good way for me to see how [to] interact with parents.

Similarly, Zorra described how she had been nervous about attending the parent-teacher interviews but found that her misconceptions were just that. In her words: "I realised the parents

who come to parents' night, aren't just the ones whose kids are having trouble. It's also the ones whose kids are doing well."

In general, PSTs described how the immersive experience in a secondary school during field experiences provided an authentic experience about the realities of being a teacher. PSTs explained that what the PSTs learned from these lived experiences are, as Magda described, "things you are not really taught, you have to experience it."

Mathematics Teaching Methods Courses

Experiencing reform-based approaches with secondary level mathematics content in mathematics teaching methods courses was, for many participants, their first time with these approaches. PSTs shared that this lack of personal experience as students with reform-based approaches made them appreciate the methods course. For example, the PSTs had the opportunity to play a variety of mathematics games. The games were student-centred activities that allowed students to explore mathematics concepts in a fun way. Magda shared that she had not had personal experience with mathematics games previous to the course and that she would like to incorporate them into her teaching. She explained,

I never had them in classes ... I want to apply them [in my teaching]. It's a lot of fun and really cool to get [students] moving and doing something with math that's not just paper and pencil.

Jack added to this by describing the implications of experiencing these approaches as students saying, "This was beneficial because we are naturally unlikely to try out material, we are unfamiliar with." Other PSTs had similar beliefs. As James said,

If I had read about [an approach] and never done it, I would have never done this or any of those [approaches] ... and that's what contributed to the willingness to try different things. I wouldn't have been willingly because I wouldn't have even known that this was even attempted, or this is something that you could or should be doing in a math classroom.

PSTs shared that they experienced reform-based approaches in different ways by engaging in activities as mathematics learners, observing the course instructor modeling the approaches, experimenting with the approaches in a relatively low-stakes environment, and by reflecting on their experiences as future teachers.

Engaging in course activities as mathematics learners

PSTs described course activities as focusing on secondary-level mathematics content in which they engaged in their learning as secondary-level mathematics students would. PSTs described the substantial impact that these lived experiences had on their thinking as future teachers. For example, Paula explained how the opportunity to work in groups showed her the potential benefits of cooperative learning,

I saw that there are different ways to approach teaching math ... Working in groups, trying to figure things out as students explaining things to each other in different ways kind of made me realise that maybe working together is a good thing. Not just sitting there listening to the teacher talk. So that kind of made me change my perspective on teaching.

Similarly, James described an instance in a class where the PSTs engaged in a variety of online games:

[I had] no idea. And I love that, because you know, students probably feel like this most of the time, and it's pretty frustrating. Like, it's not frustrating - because I'm not frustrated; I just think it's hilarious, right? So other students might have that reaction. I just started pressing stuff. And I'm like, this is exactly what my students would be doing, like, if this is the situation, and I'm just pressing stuff and I'm trying to figure something out.

PSTs shared that experiencing the reform-based approaches as “students” provided them with insights about how their future students may experience similar approaches.

Learning from their instructor

PSTs appreciated seeing their instructor model reform-based approaches. As the PSTs had not experienced these approaches prior, seeing how a mathematics teacher could use them in their practice was valuable. For example, Ruby described her developing understanding of how to facilitate a discussion in a mathematics context as a direct result of having the opportunity to observe the instructor do so: “All of my teachers were lecturers mostly and I wouldn’t have known to redirect conversations and like, have the students have a conversation about math.” The PSTs appreciated the lived experiences of engaging with these reform-based approaches and seeing the instructor model the approaches. These experiences allowed the PSTs to imagine applying them into their own future teaching practice.

Low-stakes opportunities to experiment as a teacher

In addition to experiencing reform-based approaches as mathematics students, the PSTs also experimented with the approaches in teaching rehearsals. In these rehearsals, the PSTs had the opportunity to implement reform-based approaches as they enacted a secondary school-level mathematics lesson on their peers, who played the role of secondary school students. These rehearsals were relatively low-stakes opportunities for PSTs to experiment with reform-based approaches as teachers as they were not graded on their ability to implement the approaches and, as they were teaching to their peers (rather than true secondary school students), any deficits with regards to their teaching would not have implications for their “students” learning. As Zorra shared,

Doing the rehearsal ... gives us an idea of what it’s like to teach. As much at least we’re teaching to our peers who have the math knowledge, treating them as they were secondary school students helps. And it gives an opportunity for those who have never taught before. ... It’s better than not having anything at all.

Although PSTs shared that they had to give presentations in other courses, they said that the rehearsals were the only chance they had to “teach”, and for many, their first instance of “teaching” in a context outside of one-on-one tutoring.

PSTs explained that having an opportunity to practice teaching prior to entering a classroom was an effective way to improve their practice. As Magda said, “If you actually get to practice it before applying it in a real-live scenario and then you just get so much better.” PSTs elaborated on how the rehearsals allowed them to refine their practice. For some PSTs, the rehearsals gave them insight into the complexities of teaching. For example, James said of his rehearsal,

I found that striking a balance between the lesson being driven by the questions of the students as opposed to keeping with [my plan]. I became a lot more cognitive that oftentimes you need to have another plan in mind and [be flexible].

Similarly, Paula described an instance from her rehearsal that had an impact on how she plans to prepare for teaching:

[In my rehearsal] there was a question that I wasn’t prepared for. And I realised, “Wow this could actually happen in a classroom.” So, you definitely have to know everything and if you don’t, you need to have a way to deal with it.

Others shared that the rehearsals allowed them to find their teacher identity, or as Ruby said of the experience, it allowed the PSTs to “find our voices.” She continued by expressing her gratitude of having this experience towards the beginning of her teacher education program

saying, "I'm happy we had the opportunity to do that so that I was able to [develop my teaching] earlier on."

Reflecting on their experiences

PSTs commented on the impact that having discussions about their experiences in the course had on their development as teachers. The PSTs shared that in these discussions, they were able to reflect on their experiences as mathematics students, their observations of the instructor, or trying out reform-based approaches in rehearsals. For example, James spoke of the value of the discussions that took place after engaging in activities as a student. He said it was important to "reorient yourself to what's going on in the students' minds ... whatever you're doing ... [it's important to] put a student hat on", and that the discussions were a space to highlight this value. PSTs also appreciated the opportunity to get different perspectives through the discussions. As Domino said,

I really enjoyed getting different things from different perspectives. I may disagree and I'm [going to] introduce in a different way, and seeing all of my peers, how they teach and experiencing that ... and seeing, 'Okay, you teach this way, I would do [it] this way as well but I'd change it a little bit and make it more of my own.'

The discussions were a chance for the PSTs to consolidate their experiences and consider their intentions for the classroom.

In general, the participants shared that they appreciated the variety of approaches that they experienced in the methods course. As Magda said of the course, "You learn so many different things, so many different techniques." Further, the PSTs felt they were gathering "a lot of tools" that could be used in their future teaching. Domino concluded, "I liked anytime where we were able to experience different math activities ... like interacting with math through games and seeing like, 'Okay ... I can use this.'"

Conclusion

This study explored secondary mathematics PSTs' perceptions and experiences of reformed-based approaches in three subject-specific components of their teacher education program: mathematics content courses, field experiences, and mathematics teaching methods courses. Through the lens of situated learning theory (Lave & Wenger, 1991), it was found that each component resulted in PSTs authentically experiencing both student and teacher perspectives, which could potentially be imitated or reflected in their future practice.

Findings suggest that the mathematics content courses provided PSTs primarily with authentic experiences as a "mathematics student", allowing PSTs to empathise with their future students. PSTs described this component of their teacher education program as emotionally and academically challenging, a previously established trend in mathematics teacher education programs (Williams, 2001; Zazkis & Mamolo, 2011). PSTs shared that these challenges allowed them to relate to their future students who may find mathematics courses to be a struggle. Through their lived experiences, PSTs could imagine how their future students may feel in a mathematics learning context and reflect on how the actions of an educator (their instructors) may affect students' learning (Bloomfield, 2010). For example, if instructors used approaches that the PSTs did not find effective as learners themselves (Nolan, 2012), the PSTs tended to critique these approaches and consequently noted that they would not use these approaches in their own teaching practice.

In the case of their field experiences, PSTs described how they were most often in the role of “mathematics teacher”, which also had PSTs consider how the actions of an educator (in this case, the PSTs themselves) affect students’ learning. During field experiences, students’ reactions provided immediate feedback to PSTs’ teaching practice, where the PSTs could then continually practice and refine their teaching. As has already been described in the literature (e.g., Broad & Tessaro, 2009; Hobson et al., 2009), being observed by and gaining additional feedback from a CT gave the PSTs an authentic professional perspective that they appreciated. Lastly, being in the host-schools for an extended period of time also provided PSTs with a lens into the full scope of life as a teacher, including working with a wide range of students and in different school contexts. PSTs also experienced out-of-class responsibilities that they had previously not considered including fundraisers, field trips, and parent teacher interviews further highlighting the complexities of teaching (Arnold et al., 2014; Begum & Yarmus, 2013).

Finally, PSTs described experiences in the mathematics teaching methods courses to provide experiences as both “mathematics student” and “mathematics teacher” (Kiliç, 2011; Wilkins & Brand, 2004). In these courses, positive learning experiences were directly attributed to their instructors’ use and modelling of reform-based approaches which led to PSTs feeling inspired to use these approaches in their future teaching. Specifically, after experiencing reform-based approaches for the first time as students, the PSTs felt more confident to implement them in their teaching rehearsals.

PSTs described their course instructors and CTs as having an impact on their learning and development as future teachers. As such, these individuals are in the role of “teacher educator” whether explicitly (as in the case of teaching methods course instructors and CTs) or implicitly (content course instructors) as PSTs viewed these individuals as models for their future practice. The instructional approach used by these individuals seemed to be important to the PSTs regardless of the course content (i.e. mathematics content or pedagogy) and the use of reform-based approaches (or not) was of particular interest.

There are several implications for practices that result from our study. First, findings suggest that teacher education programs should increase the authenticity of PSTs’ experiences within their program. In the mathematics teaching methods courses, while the teaching rehearsals did not fully mirror PSTs’ future teaching context, these and other similar “approximations of practice” (Grossman et al., 2009; Lampert et al., 2013) can still provide PSTs with opportunities to learn in a situated way via social contexts alongside peers and their instructors with many similarities to their future teaching (Korthagen, 2010; Lave & Wenger, 1991). Furthermore, given the reality that coursework often comprises the majority of teacher education programs, it is important to consider how we might create additional authentic learning opportunities for PSTs to think and act like teachers in these university-based spaces. Indeed, these approximations of practice may serve as an intermediate step for PSTs’ development as our participants shared that the teaching rehearsals allowed them a chance to practice teaching to their peers and further increase their confidence prior to entering a real classroom for their field experiences.

Second, we recommend that course instructors and CTs to be particularly reflective and responsive to their role and impact as teacher educators. It was likely not the intention of the mathematics content courses to have PSTs struggle in their own learning and feel discouraged as a result of their instructors’ traditional teaching approaches. While teaching methods course instructors and CTs may be able to draw from their own personal backgrounds in education, research indicates that these personal experiences do not always translate into their role as teacher educators (Korthagen et al., 2005). For mathematics content course instructors who typically are trained as mathematicians, undoubtedly many would not have reflected upon their role as teacher educators. Additionally, this may be particularly complex in mathematics content courses

where instructors are often teaching to a diverse group of students that include not only future teachers, but future engineers and mathematicians alike.

Finally, we encourage teacher education programs to provide ample opportunities for PSTs to reflect on all experiences and components of their teacher education program. By participating in this study, interviews provided PSTs with specific opportunities to reflect on their experiences in their teacher education program. We suggest that this process may have also contributed to their learning. For example, in reflecting on their negative experiences in the mathematics content courses the PSTs developed empathy for the challenges that students may face in mathematics classes. Research indicates that reflection allows PSTs to better understand their own capabilities and perspectives, thereby encouraging personal growth and development that can facilitate meaningful pedagogical moves in the classroom (Houston & Warner, 2000). Further, as described by McLellan (1996), situated learning theory advocates for reflective practice. Acknowledging that reflection is a common practice in many contexts in teacher education such as teaching methods courses and field experiences (Griffiths, 2000), we do not assume that our interviews were PSTs' only occasion for reflection in their teacher education program. We do, however, encourage teacher education programs to consider the breadth of the contexts in which PSTs engage in reflective practice.

With the best of intentions, teacher education programs have been developed to support PSTs' learning and prepare them for their future careers. Teacher education programs are multifaceted with different components that typically focus on different, yet complementary, areas for learning. This study is significant as findings describe the varied ways in which three components (content courses, field experiences, and teaching methods courses) provided ways for PSTs to learn in a situated manner. Yet, there is still more work to be done. The scope of this study was limited in that it did not measure the degree of PSTs' learning nor the change in their mathematical and pedagogical knowledge. Further research is thus needed to explore the effects of situated learning experiences in teacher education programs on PSTs' teaching practice both throughout the teaching program, as well as once in the field. It is through continuing to hear from the PSTs themselves that we can understand the impact that our actions and decisions (as teacher educators and program administrators) have on our next generation of teachers.

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