Primary School Teachers' Experience of Mathematics Education

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Researchers and policy makers agree that all children can learn mathematics and that teachers play an important role in student learning. This phenomenological study interviewed 12 primary school teachers, providing insights into their experience and perspectives of mathematics education, highlighting the challenges and successes experienced by teachers. These insights provide a deeper understanding of the dynamics of the relationships and tensions between teachers, students and context, and promote conversations about what success in mathematics looks like and how it can be best supported. It is hoped that this could ultimately be of benefit for student outcomes.

The core subjects of literacy and mathematics are given much attention in the curriculum and in the press, due to their importance in later learning and life (Milton, Reeves, & Spencer, 2007). The Strategic Plan for Western Australian public schools 2016-2019 states that "for the next four years our focus is to bring the ambitious reform agenda currently in place to have a very direct and sustained impact on student learning" (DoE, 2015, p. 4). This agenda has "high expectations of success for every student in every school" (DoE, 2015, p. 5) and includes clear targets for increasing student achievement in mathematics.

Both national and international testing of students' mathematical skills and understandings are used in discussions about what is needed in mathematics classrooms in Australia. The Trends in International Mathematics and Science Study (TIMSS) is conducted every four years. In Australia, 30% of Year 4 students performed at or below the low international benchmark in the TIMSS in 2007, 2011 and 2015 (Thomson, Wernert, O'Grady, & Rodrigues, 2017). In comparing TIMSS and NAPLAN data, the intermediate international benchmark is equivalent to the level of proficiency for NAPLAN (Thomson et al., 2017). If the criterion for every child to succeed is for every child to reach a level of proficiency, and international assessments show significant levels of low achievement for Australian primary school students in mathematics, this situation requires attention. This paper reports on a phenomenological study that explores Western Australian primary school teachers' experience of and perspectives on mathematics education.

Background

In considering the historical context, a long-standing history of education reform becomes apparent, triggering changes in education that have impacted on what is expected of primary school mathematics teachers. Reform in this context can be regarded as changes that are made, or attempted, in order to improve education. Education reform has brought about changes in terms of who is educated in mainstream settings, it has reflected discoveries in how children learn, and can also mean changes in performance goals, professional standards, accountability procedures, curriculum or assessment. In terms of mathematics teaching, the work of Piaget and Vygotsky, in particular, triggered changes in teaching approaches, from a transmission of knowledge and procedures to a building of understanding and meaning (McDevitt & Ormrod, 2007). This required teachers to develop specific pedagogical content knowledge (PCK), a term coined by Shulman (1986). Beswick and

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Goos (2012) found that a teacher's PCK influences student learning but implied that PCK has proven difficult to conceptualise and measure, with more research into what 'underpins' it and "how its development … can be enhanced" (p. 86) required.

Measuring teacher preparedness, one research study involving Australian pre-service teachers found only 13.4% of participants to be completely confident to teach mathematics at the relevant year levels for their qualification (Beswick & Goos, 2012). It has been found that a teacher with high efficacy in mathematics will not necessarily have high self-efficacy beliefs with regard to teaching mathematics (Stevens, Aguirre-Munoz, Harris, Higgins, & Liu, 2013), and that teachers with more subject knowledge are not necessarily the most effective (Askew, Brown, Rhodes, William, & Johnson, 1997). These findings highlight the importance of Professional Learning (PL), especially during the early years of a teacher's career. Research into the PL of practising teachers has been described as a relatively new and "ill-defined" field (Even, 2014, p. 330), and research with PL as its focus has typically looked at "process and outcomes" with much less attention given to how PL providers investigate the needs of teachers to inform the planning of their programs (Beswick, 2014, p. 83). The literature also indicates that, in Australia, teachers often engage in short-term PL programs or research projects (Lerman, 2013), and that PL and collegial discussions often take place removed from any shared experiences in the classroom (Lewis, 2016).

Within mathematics education research, it has been shown that the beliefs and attitudes of teachers and students also play an important part. For example, a student's self-efficacy or anxiety can determine success more so than the mathematical tasks themselves (Kolacinski, 2003). However, while teachers' attitudes and beliefs have been shown to significantly impact the success of inclusive classrooms (Scherer, Beswick, DeBlois, Healy, & Opitz, 2016; Vaz et al., 2015), it is also the case that knowledge of appropriate solutions, rather than a negative attitude, can inhibit a teacher's ability to cater for the diverse range of needs in their classroom (Vaz et al., 2015). As teachers may hold beliefs that conform to the ideals of reform, while being unsure as to how they can apply them in their practice (Beswick, Watson, & Brown, 2006), what teachers report to believe in surveys does not always match what is observed in their practice. In addition, Beswick, Callingham, and Watson (2012) warned that "analysing and categorising (teacher's) knowledge, although useful in many respects, risks losing an appreciation of the complexity of the work of teaching mathematics" (p. 154).

In looking at the limitations of research, it seems apparent that beliefs, attitudes and knowledge need to be considered together. Researchers Skott, Van Zoest, and Gellert, when investigating trends in mathematics education, acknowledged the advances made in the fields of knowledge, beliefs and identity separately, but also highlighted the problem of studying them on their own by suggesting that this leads to "an incoherent view of the teacher and her or his role in instruction" (2013, p. 501). These findings highlight the importance of zooming in and out.

Stemming from the literature, it is important to support teachers in developing knowledge, skills and beliefs that will enhance their mathematics teaching. This cannot be achieved without insight into their lived experience. Within educational research, the gap in research appears to be in zooming out and looking at the overall experience, and from an insider's perspective.

Method

The methodology chosen for this study is phenomenology because it meets the objective of describing lived experience, focusing on the first-hand descriptions of participants. To explore this phenomenon, the main research question asked: How do primary school teachers perceive and experience mathematics education, as teachers and learners?

The participants in this study were 12 primary school teachers from a range of year levels, from Pre-Primary to Year 6, and with a range of teaching experience, from two years up to 30 years. The schools invited to participate had features in common - they were co-educational schools in the Perth metropolitan area, belonging to the Association of Independent Schools of Western Australia. Teachers were recruited for the study to the point at which new information did nothing to further the understanding of the phenomenon.

A process of *bracketing* was used, before and during the interviews and data analysis. This involved acknowledging personal perceptions and experiences, letting go of presuppositions, then revisiting the phenomena, freshly, from a viewpoint that has transcended personal opinions. The in-depth interviews were semi-structured and lasted approximately one hour each. The recorded interviews were transcribed and the steps of data analysis, adapted from Moustakas (1994), included: extracting horizon statements; reduction; establishing meaning from statements, creating themes; and integrating the textural descriptions and structural themes to develop the essence of the experience in a final narrative. The aim of the final narrative is to enable the reader to feel they have a better understanding of what it is like to be a teacher of primary school mathematics in Western Australia. Pseudonyms are used throughout.

Some Initial Findings

The participants in this study perceived mathematics as having various characteristics, such as being valuable for later learning and life, structured, abstract, and requiring specific terminology. Their personal connection to mathematics from past experiences, along with these characteristics, appeared to influence their current experience of mathematics education as primary school teachers. Teachers' beliefs, attitudes, emotions and motivation are affective factors. A strong theme emerging from the data was student affective factors:

> As soon as you put maths up on the board or you speak about maths, I think some kids start to worry, just with the idea of it… (they) just put up a bit of a mental block, and that's the biggest challenge for me, I think, how can I make this lesson where they get something out of it? (Adam)

In addition to student anxiety and confidence hindering a student's ability to engage in mathematics lessons, many participants perceived that a student's view of themselves as a learner of mathematics can affect them elsewhere in their learning and in their life:

> If a student labels themselves as being useless at maths it seems to permeate then into all of their learning. So, then they seem to think that they're just no good at learning anything. Whereas if a student sees that they're no good at writing it just seems to stay there with writing, it doesn't seem to have a spreading effect on their whole sense of themselves as a learner, and I don't know why it is that maths does that. (Claire)

Some participants spoke about the challenges of overcoming fixed views, "the older they are, the more ingrained that mindset has become" (Claire). Adam perceived a lack of student willingness to persevere, as is necessary in mathematics for problem solving, "a lot of students these days … want instant gratification and they're not willing to work towards something", elaborating that it "is not necessarily about getting it right or wrong but seeing the, seeing what you did to get it to that… kids just don't see that, they just want to get it finished" (Adam).

To overcome these affective factors, all of the participants described strategies they employed in their teaching to either overcome anxiety, build student confidence, engage students and/or turn around student attitudes. For example, they planned work to clearly link concrete, representational and abstract, focused on critical thinking skills 'what can you see' because that is non-threatening, integrated mathematics to make it more real for students,

valued mistakes, provided open-ended tasks, choice and student ownership, and tried to keep it fun.

Another theme emerging from the data, regarding students, was the wide range of student abilities, "right now I've got one student who is working at probably at Year 10 level, and then I've got some kids who can't count on from 5 to 10" (Adam). The participants expressed their experience of this in different ways but, in common with each other, indicated that it made meeting individual needs challenging, "I think that it's probably one of the hardest subjects to teach, because there's such of a range of abilities" (Paul). Many of the participants spoke about using assessment to identify student needs. The wide range of abilities impacted how they planned and organised their mathematics lessons, and many participants described different teaching strategies that enabled them to work with individuals or small groups as needed. At both schools, students who needed extra support or extension left the classroom to work individually or in a small group with a specialist support teacher or Education Assistant (EA). Paul indicated that his students had a range of needs, even though he taught students who had been streamed for mathematics, and he explained his preference for mixed ability grouping:

> Unfortunately, because they're in the bottom group, there's not a lot of that independent sort of stuff that they can do with each other … there aren't other kids that can carry them along, and I have to carry them along, effectively, and that's frustrating. (Paul)

Claire described the impact of conflicting research in deciding the best strategy to meet student needs:

> I've found … 'they should not be taken out of the regular classroom' but then you look at the gifted and talented body of literature … they say 'no, gifted kids need something quite different' … other research that I've read around grouping of students for maths is that it appears that the best way is to keep them in a heterogeneous setting but where the range isn't too extreme … it's been a bit scary to be, I suppose courageous to go down that path, because, um, because there is some conflicting research. (Claire)

Decisions about streaming and the provision of EA time or support groups are made at a school level. The data revealed how school expectations impacted a teacher's experience of mathematics education and the teaching approaches they adopted, "at my previous school it was more of a textbook base … quite boring … sort of rote learning … whereas here I tend to find that, um, it's more about the process rather than a filled-out textbook" (Adam). Stacey elaborated on the impact different school focus' had on her experience:

> The school's got a focus on visible learning, and a focus on enquiry … that's had an impact, just on the planning documents we use, the resources we have in our classrooms, the way we put up displays, and so all of those things sort of trickle down into my practice … definitely different school to school … in my last school it was explicit education was the big focus and that took away from hands-on at times, um, it was a pre-primary class and I had a lot of PowerPoint presentations to introduce topics … and that took away from my own pedagogy of 'maths should be hands-on in the early years and written after you understand it physically' … I think every school approaches maths in a really different way, and accepts different things, and it, yeah, definitely will have an impact on the way I teach. (Stacey)

When participants spoke about challenges, being time-poor was the most prominent theme, with grading, PCK and teacher experience also spoken about. The experience of feeling time-poor was portrayed by Paul:

> I will teach one concept, for like two weeks, and then I leave it … not because I want to necessarily, but because I have to move on because there is a gigantic curriculum that I cannot possibly cover, because there's all these interruptions, and it's a really busy school … if I don't move along, um, like some sort of maniac, and sometimes I do feel like that I'm just racing through it. Teach, teach, teach, revise, revise, revise, practice, practice, practice, 'alright guys, we're moving onto something else' …

> you talk about it for a week or two, you leave it, and there's no chance to practice it again unfortunately. (Paul)

With regard to teaching mathematics concepts, Paul observed that "most of it is linked in… however, some of these kids actually do not see it as that connected thing and so they still need to actually be taught these separate things, which means it's huge … there's just not enough time". Many participants spoke about integrating mathematics across the curriculum as a strategy to cover the content. However, barriers to integrating mathematics across the curriculum were identified by some participants: (a) "We have our maths timetabled for a certain period … that's quite set because some students come out for … extension … it sort of isolates maths as just maths rather than throughout the curriculum" (Adam); (b) "It's not as integrated as other learning areas are, just because it's got quite strict rules and you do need to explicitly go through some of those skills" (Stacey); (c) If students are streamed for mathematics, their teachers could not integrate mathematics across the curriculum because they did not see many of their mathematics students in other lessons. Sam, Rachael and Stacey, who taught Year 2, pre-primary and Year 1 respectively, found the curriculum was manageable, although Sam spoke about integrating mathematics with other subjects to make it manageable, "we, as primary teachers, are really clever and we can integrate things and I think gee, we're lucky to have that ability" (Sam). Rachael thought "the curriculum down here is very small, you know so I don't feel that pressure", but also commented, "when you get to Year 2, I think the maths focus is very big there". The remaining participants all indicated that being time-poor prevented them from teaching mathematics in the way they would like to. These comments generally related to perceptions that the curriculum, from Year 2 to Year 6, is crowded.

In terms of challenges, the compulsory grading of students on a five-point scale was described by some of the participants as counter-productive to their efforts in addressing affective factors in mathematics:

> The grading A to E … for a lot of students who've had a journey in school of failing maths, have had D, D, D, D, D, D, D, well, they are pretty much being told that they haven't progressed … we have to find ways … at saying … 'I can see that you've improved' but, on paper and especially for parents, often it's just not fine-grained enough ... it looks the same, and that's devastating. (Claire)

Adam described how the need to provide grades for primary school students can impact his choice of teaching approaches:

> Game-based play is great, but at the end of the day we still need to have a grade for maths and the only way to have that grade is to have some evidence, and anecdotal evidence is good, and teacher judgement is good, but it doesn't always fly with some parents … you get a lot of parents who, you know, expect a finished worksheet. (Adam)

In addition to grades on reports and marked work, a student's success in mathematics is often judged by parents, and the media, in accordance with NAPLAN results. Paul elaborated on the impact he perceived a focus on testing has:

> We sometimes think and place too much ideas about getting them up towards a particular score in a test, um, and that, that I think changes the way we teach as well. It changes the way that teachers approach the subject, and I think that that diminishes how much you can actually, um, you know, make your students enthusiastic about mathematics … going to then just teach mathematics in that sort of rote way I feel. (Paul)

Many of the participants described the NAPLAN data as unreliable, for example:

> There seems to be a huge emphasis on NAPLAN, and I just feel we're teaching children, and if they're tired or hungry or unwell, they're not going to perform. So, there's a lot of pressure, in the primary years, to get the best results possible, but children are children, so if they are not 110% in the zone, of course it's going to impact data. (Sam)

Some participants also perceived pressure, on students and teachers, due to NAPLAN, "I've never actually felt the pressure of teaching NAPLAN, um, but I do feel the implied pressure … that I'm going to be held accountable for their results next year" (Paul).

PCK was described by the participants as having developed over time, through experience, professional development, collaboration with colleagues and reflective practice. The participants' experiences varied, but all indicated a level of unpreparedness when they first started teaching. Stacey elaborated:

> In the seven years I've been teaching I feel like I'm a lot better at teaching maths. Um, just because I a) have the time to go confirm things, or I'm like 'oh yes, I told my class this last year'… I'm comfortable with that maths (year one), and I think there would be huge anxiety if you dropped me up into year six class teaching maths, compared to another subject. (Stacey)

Paul and Stacey both described the experience of running out of ideas to address student needs:

> There'll be just be occasions when they just, just don't want to do it anymore, and, and then, they'll just tell you they don't understand it, and it's very frustrating because you know, you have, you have changed, chopped and changed your methods about how to teach this and it's just not working anymore, and yeah, they feel a sense of helplessness and so do I. (Paul)

Stacey perceived a need to wait in some instances, a perception that was shared by other participants, "if they can't write numbers in pre-primary, I know they will write their numbers by the end of Year 1 or Year 2… I don't think we should actually force" (Rachael). In describing challenges and success in mathematics, none of the participants believed that it is realistic to enable every child to achieve a set level of attainment. The participants perceived success in mathematics education most commonly as positive changes in student feelings and attitudes towards mathematics, student growth, and students being prepared for later learning and life:

> If you're going to do maths you need to enjoy it … that's been something that's sort of impacted on the level of success that I personally judge myself on is that I want, I don't want kids to be scared of maths. (Stacey)

> We have a focus in our school of everyone is capable of improving and it's where you start from, that's your learning journey. So, we're not trying to make everybody the same, because that's just not realistic. (Claire)

With respect to their aims in mathematics, Sam valued her students' abilities in reasoning, "I believe it's one skill to have that automatic recall, but … a good mathematician can articulate the steps in that thinking process" (Sam). Stacey aims for her students to have "day-to-day maths knowledge" as she believes that some maths skills are "not just a skill for a career, they're a skill for life" (Stacey).

Summary and Conclusion

The most prominent challenges for teachers of Year 2 to Year 6 appear to be: overcoming student affective factors; catering to the wide range of student abilities; and meeting the expectations of the curriculum within the time available. The participants' perceptions of the importance to address student affective factors align with research, which suggests that the self-efficacy beliefs of students are the "strongest predictor" of attainment in mathematics (COAG, 2008, p. 50). The challenge teachers face catering to individual needs in mathematics could relate to assertions that mathematics learning difficulties are challenging to diagnose (Kucian & von Aster, 2015) and interventions are complex (MPR, 2009), so there is not one single educative approach that will be effective in all cases (Gifford & Rockliffe, 2012; Sherman, Richardson, & Yard, 2009). One strategy to address individual needs, used in both schools in this study, was to have students leave the classroom to access

support, which correlates with past research that found interventions in mathematics commonly involve leaving the classroom to work with a support teacher (MPR, 2009). One participant expressed concerns over the negative effects this strategy can have on students, and her views resonate with previous research suggesting that leaving the classroom can be a "stigmatising experience" (McLeskey & Waldron, 2007, p. 165). The common experience of being time-poor, due to a crowded curriculum, is a concern that has also been raised in previous research by Hurst (2015).

Being time-poor, along with the organisation and expectations of the school, appeared to be the most significant barriers to the participants' abilities to teach in line with their own values and pedagogical beliefs. To elaborate, the findings suggest that schools have a strong influence over a teacher's experience of mathematics education, as participants found different schools to vary in many ways, such as the resources available, the level of collegial support and PL opportunities, the students, and the school's focus and expectations. Several participants recounted teaching mathematics using approaches that did not align with their own pedagogical beliefs and preferences in order to meet school expectations. The fact that teachers encounter vast differences between schools resonates with research that asserts there is a "huge variation and no common agreement as to what constitutes *quality instruction* in mathematics" (Mason, 2016, p. 222).

The findings also reveal that current testing and grading requirements do not align with teachers' aims and perceptions of success in mathematics, which leads to a conversation that needs to be had on what success in mathematics looks like, how it can be better communicated, and how it can be best supported.

The limitations of the study are acknowledged. For instance, only a small number of teachers took part in the study, and interpretation has natural limitations. Nevertheless, the research gives a voice for primary school teachers, providing insight into their experience of mathematics education from their perspective. Through this approach, the research aimed to generate new understandings. The purpose of the study is the potential research impact, from the exchange of knowledge between teachers and researchers, and back to the education community, and in providing pathways for change. It is hoped that gaining insights into teachers' experiences will provide a deeper understanding of their role and may open dialogue for teaching practices, which could ultimately be of benefit for student outcomes.

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