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Knowing Mathematics to be a Teacher

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The limited mathematical knowledge of preservice primary teachers is an international concern. The areas of mathematical difficulties have been well documented, which has led to many universities instituting testing regimes to ensure that preservice teachers have appropriate knowledge of primary school mathematics. In our study, the preservice teachers identify some benefits for being tested, but these were often related to having sufficient knowledge so that they did not lose face in front of students. We suggest that this emphasis on performance could exacerbate preservice teachers' reliance on procedural rather than conceptual understanding. Thus, there needs to be consideration of the type of testing that is instituted so that it connects to preservice teachers' professional identities as teachers.

Primary-school preservice teachers' learning of mathematical content is complicated. As outlined in Figure 1 (from Ponte & Chapman, 2008), their understandings about mathematics and how to teach it are influenced by several factors. Using aspects from Figure 1, we discuss how preservice teachers' professional identities in relationship to mathematics were affected by:

- research on preservice teachers' lack of mathematical knowledge,
- organization of the educational system, as a response to this lack of knowledge, and
- the initial mathematics education course in their teacher education degree, specifically the requirement to pass a Basic Skills Test in mathematics.

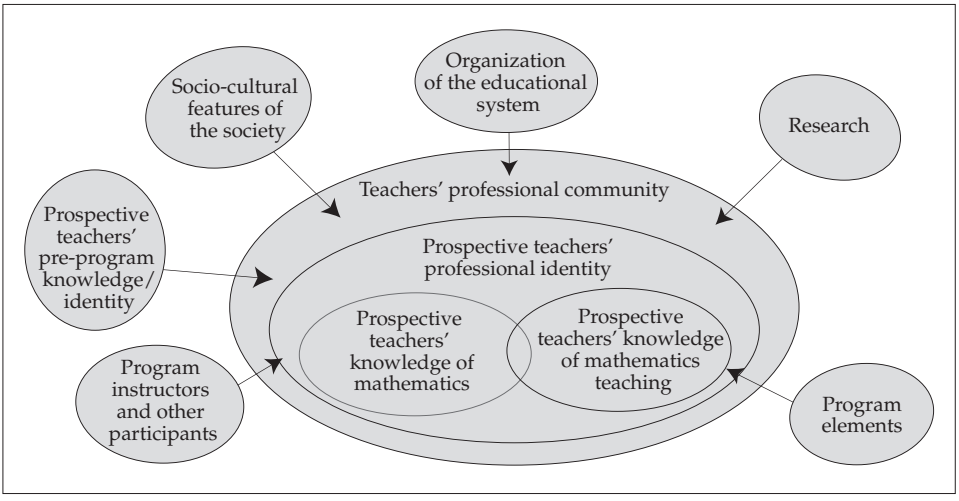

Figure 1. Landscape of preservice mathematics teacher education (from Ponte & Chapman, 2008, p. 224)

To do this exploration, we use data from one Australian university of preservice teachers' responses to being tested on their primary school mathematical knowledge. The tests seemed to position preservice teachers as users rather than as teachers of mathematics and thus conflicted with their professional identities as teachers.

Professional Identities as Teachers of Mathematics and Learning

The idea of professional identities has not been clearly defined, although many people have been using the notion in mathematics education research for some time (Bjuland, Cestari, & Borgersen, 2012). Ponte and Chapman (2008) suggested that professional identities must be considered in two ways: as something the individual develops alone and also as something that draws upon community perceptions of the profession. This has similarities with Gee's (2000) ideas about institutional and affinity identities. Gresalfi and Cobb (2011) described these in the following way:

> An institutional identity refers to instances in which someone is recognised as being a certain kind of person based on the ways in which a particular positional role (for example, principal or mathematics teacher) is defined and legitimised by authorities within an institution. In contrast, an affinity identity refers to instances in which someone is recognised as being a certain kind of person based on the ways in which he or she participates in a particular group (for example, a professional teaching community). (p. 274)

Preservice teachers, especially those at the beginning stages of their teacher education, do not view institutional and affinity identities from positions of being teachers. Preservice teachers' perceptions of what institutions, such as schools and Education Departments, consider to be a teacher's identity are drawn from when they were students, parents, or in other roles in schools. Not holding a position as a teacher in a school also means that they do not have affinity identities as teachers. Rather they would have identities from before they began their study, which Ponte and Chapman (2008) describe as their pre-program identity. All of these identities would include views about mathematics and how it should be taught. As their teacher education progresses and with experiences of teaching children in schools, it is likely that preservice teachers' affinity identities of being students at university, and learning about teaching, may change to one about being a teacher. Therefore, it may be quite late in their teacher education before their perceptions of institutional and affinity identities of teachers combine into their professional identities. In the meantime, the institutional identity is something to aspire to. Working with ideas about identities, Sfard and Prusak (2005) distinguished between:

> *Actual identity*, consisting of stories about the actual state of affairs, and *designated identity*, consisting of narratives presenting a state of affairs which, for one reason or another, is expected to be the case, if not now then in the future.

> … The scenarios that constitute designated identities are not necessarily desired but always are perceived as binding. One may expect to "become a certain type of person," that is, to have some stories applicable to oneself, for various reasons: because the person thinks that what these stories are telling is good for her, because these are the kinds of stories that seem appropriate for a person of her sociocultural origins, or just because they present the kind of future that she is designated to have according to others, in particular according to people in the position of authority and power. (p. 18)

In relationship to preservice teachers, when they begin their teaching degree, they may have actual identities as recently-finished high school students but designated identities of being primary school teachers. Their designated identity involves taking on the institutional role of a being a (mathematics) teacher.

Sfard and Prusak (2005) stated that "learning is often the only hope for those who wish to close a critical gap between their actual and designated identities" (p. 19). Consequently, perceptions of the institutional identity of teachers will influence preservice teachers' learning. If mathematics must be learnt to become a primary school teacher, then preservice teachers will learn it but in a way which matches their perception of the institutional identity. The learning needed to pass a test of mathematical knowledge, essential for moving forward in their education, will be done from their perceptions about how this fits into fulfilling the institutional requirements to be primary school teacher and so gain the institutional identity. Nevertheless, the test itself, will contribute to the preservice teachers adjusting their perceptions of what the institutional identity of being a teacher involves as it tells the preservice teachers what knowledge is deemed to be important for being a teacher.

Radford (2008) considered learning to be "not just about knowing something but also about becoming someone" (Radford, 2008, p. 215). In this way, the object of learning, in this case the mathematics being tested, is not only within the awareness of the learner, but the learner him/herself is part of what is to be understood in the learning process. Consequently, "a person's becoming occurs through engagement in the ways of knowing, doing and valuing of a particular social group, for example, philosophers, mathematicians, lawyers, gang-members, etc" (Brown, 2009, p. 172). In making adjustments to their perceptions of themselves and also to the institutional identities of being a teacher, they make use of the collectively and culturally constituted forms of reflection (Radford, 2008) to think about the mathematics they need to learn and how it should be.

As preservice teachers meet, or do not meet, their expectations about what they need to learn, then their conceptions about themselves as teachers will be affected. The reflection that preservice teachers do while they learn mathematics in these circumstances will affect their perceptions of the kind of person that they are becoming (Radford, 2008). Therefore professional identities can be considered as intimately connected with learning and preservice teachers' knowledge about mathematics, or lack thereof, will affect and be affected by professional identities.

Research on Preservice Teachers' Knowledge of Mathematics

Although preservice teachers may not be aware of the research highlighting their possibly limited mathematical knowledge, it has led institutions to require that mathematical knowledge should be displayed before the institutional teacher identity is gained. Consequently, preservice teachers' displaying of mathematical knowledge becomes part of the process of achieving this institutional identity. In this section, we summarise this research before discussing institutional responses to this potential lack of knowledge that are relevant to this study.

In the last few decades, international concern has been raised about preservice teachers' lack of mathematics knowledge and poor attitudes to the subject (see Ponte & Chapman, 2008). In reviewing the research done in Australia, Tobias and Itter (2007) stated "it is reasonable to conclude that many preservice teachers may have peripheral beliefs, poor attitudes and feelings about learning mathematics" (p. 4). These concerns have led to the instigation of several research projects to identify the knowledge that preservice primary teachers lack, as well as different ways to assess and improve this knowledge base (Goulding, Rowland, & Barber, 2002).

Shulman (1986) described knowledge of the relationship between a content area and how to teach it as pedagogical content knowledge (PCK). Using these ideas, Kenny, Ball, and McDiarmid (1993) suggested that during the teaching act, teachers draw upon knowledge of: learners, learning, pedagogy, the teacher's role, curriculum, and subject matter. Other research suggested that having the mathematical content knowledge is of primary importance (Ma, 1999). Ponte and Chapman (2008) stated that "[w]hile having strong knowledge of mathematics does not guarantee that one will be an effective mathematics teacher, teachers who do not have such knowledge are likely to be limited in their ability to help students develop relational and conceptual understanding" (p. 226). Skemp (1976) described "relational understanding" of mathematics as "knowing what to do and why" (p. 21) and so is related to the conceptual underpinnings of mathematics. Goulding et al. (2002) suggested:

> Beliefs about the nature of mathematics may be tied up with SMK [subject matter knowledge] in the way in which teachers approach mathematical situations. If they believe that it is principally a subject of rules and routines which have to be remembered, then their own approach to unfamiliar problems will be constrained, and this may have an impact on their teaching. (p. 691)

Nevertheless, mathematical knowledge per se may not benefit preservice teachers gaining the institutional identities of mathematics teachers that teacher educators and school systems expect. If relational understanding is considered by institutions to be the type of mathematics that is most beneficial for the primary school students then this is what the preservice teachers also need (Ball, 1990). However, depending on their previous experiences with mathematics, it may not be what preservice teachers themselves consider as being necessary in order to become teachers.

Institutional Responses to Teachers' Lack of Knowledge

Research on preservice teachers' lack of mathematics knowledge has led to initiatives to ensure that preservice teacher gain institutional identities as teachers. In this section, we look specifically at what the New South Wales Institute of Teachers (NSWIT) and Charles Sturt University (CSU) determined to be the mathematics knowledge that preservice teachers needed.

Like other government organisations (see Office For Standards in Education [OFSTED], 1994), NSWIT considered that teachers needed strong mathematical knowledge and so, from their high school education, required preservice teachers to have:

> Higher School Certificate minimum Band 4 Standard English, or minimum Band 4 English as a Second Language, or minimum Band 4 Advanced English AND Higher School Certificate General Mathematics minimum Band 4, or completion of Mathematics (2 unit). (NSW Institute of Teachers, 2006)

NSW universities, such as CSU, have adopted selection criteria based on NSWIT requirements. If preservice teachers enrol without appropriate mathematics then they must complete an equivalent university mathematics subject. Nevertheless, Tobias and Itter (2007) in their investigation of primary-school preservice teachers' mathematical knowledge found "[t]his study confirms that we cannot presume that preservice teachers who have completed Year 12 studies in mathematics have sufficient mathematical content knowledge that will enable them to teach mathematics meaningfully" (p. 14).

At CSU, there was concern, shared with other regional universities, that preservice teachers may not have been taught by trained mathematics teachers because of the shortage in rural and regional Australia (Tobias & Itter, 2007). This could have an impact on preservice teachers' ability or willingness to teach mathematics. Consequently, when the new Bachelor of Education began in 2008, CSU required preservice teachers to have Higher School Certificate (HSC) Band 4 mathematics and to pass a Basic Skills Test (BST) in their first mathematics pedagogy subject.

The BST tested primary school mathematics topics, such as fractions, decimals, and place value (an example of a question is given in Figure 7). It was similar to those used in New South Wales schools from 1989 (Wasson, 2009). Mitchelmore and White (2003) suggested that the NSW Department of Education's Basic Skills Test "may be regarded as a most valid and reliable numeracy assessment instrument" (p. 515). The Basic Skills Test used at CSU was developed at one of its regional campuses in the early 1990s. We, as newly appointed staff members at CSU—arriving two weeks before the new course began in 2008—were provided with the BSTs to administer.

Preservice teachers had to pass 90% of a BST, although no marks were awarded to the final grade. As the test was similar to ones for primary school children, it seemed reasonable that preservice teachers had to achieve a 90% pass mark. They could do the test four times, but if they failed all attempts, they had to redo the subject. It was presumed that most preservice teachers would pass at

the first round and so only five one-hour tutorials were allocated to provide support. The majority of preservice teachers, however, did not pass the test first time. Despite this low success rate no extra time was provided at any of the campuses. The tutorials, given by Tamsin Meaney, went over the concepts behind the questions in the BST. They were well attended but many preservice teachers needed more help and so the preservice teachers were directed to web sites and to the university's Learning Support Services.

Each of the four tests had 30 short answer questions that were at a Year 6 level. The mathematical topics were similar from test to test and are indicated in Figure 2. Most topics were covered in one question, although some—like fractions—were covered in several questions. All of the tests were kept by the institution and were not returned to the preservice teachers. After each test, preservice teachers were informed whether they had passed. Preservice teachers who had not passed were provided with information about the mathematical topics that they had struggled with. It was anticipated that this would help preservice teachers focus on conceptual understandings. Comments to the lecturer, however, indicated that this was often resented by the preservice teachers who felt that knowing which answers they got wrong was the most important aspect of completing the test.

The nature of the BSTs and the preservice teachers' anecdotal comments about completing the test suggested that the BST was not contributing to preservice teachers gaining the mathematical knowledge required for an institutional identity as teachers of mathematics. As the semester progressed our unease increased about the effect that completing the tests were having and so we applied to CSU for research funding. We wanted to know both what mathematics the preservice teachers struggled with and also to find out how they viewed having to complete the test. The funding allowed us to do a literature review of the field and Ponte and Chapman's (2008) diagram (Figure 1) provided us with a framework for understanding the complexity within which the preservice teachers were operating.

Data Collection and Analysis

The data consisted of the test results from all four tests and transcripts from three focus group interviews with preservice teachers about completing the BSTs. Initially, 104 preservice teachers enrolled in the subject. However, not all of them sat all four BSTs. Some were away for one or more attempts and once they had passed the test, they did not have to sit again. Table 1 outlines the number of preservice teachers who completed each test. These tests were done in the normal lecture time for the course and were administered by Tamsin Meaney. The results from the tests are described in the next section.

Nine preservice teachers were interviewed in three separate focus group interviews, in the semester after grades had been awarded. Although two male preservice teachers had originally volunteered to participate, neither attended so all the interviewees were female. A research assistant with no previous contact with the preservice teachers was the interviewer. It was felt that preservice

teachers would be more open with a stranger than with the lecturer who had been responsible for giving them the BST. Some of the preservice teachers had passed the BST in the first round whilst others passed on the second, third or fourth rounds.

Table 1
Number of preservice teachers sitting each test

Basic Skills Test 1	93
Basic Skills Test 2	62
Basic Skills Test 3	45
Basic Skills Test 4	23

Analysis of the focus group interviews was done by looking for examples of Sfard and Prusak's (2005) actual and designated identities and how these were seen as connecting to institutional identities as teachers or affinity identities as students. This then allowed us to identify the role of knowing mathematics within these identities.

2008 Preservice Teachers' Results on the BST

As Table 1 illustrates, the number of preservice teachers who completed each test declined as more gained the 90 percent requirement. Although all preservice teachers had passed the test after the fourth round, the initial tests showed that many had started a Bachelor of Education with poor knowledge of primary school mathematics. Figure 2 shows that in the first test many preservice teachers struggled with mathematical topics that were also difficult for primary school students. This was similar to Tobias and Itter's (2007) study:

> Many preservice teachers experienced difficulties with items related to operations involving fractions and decimal fractions, division with two digit divisors, recalling and applying the order of operations convention, and applying formulae. (Tobias & Itter, 2007, p. 13)

Figures 2-4 show the number of preservice teachers in each test who gave wrong answers for specific mathematical topics in the first, second and third test. The fourth Basic Skills Test was passed by all preservice teachers.

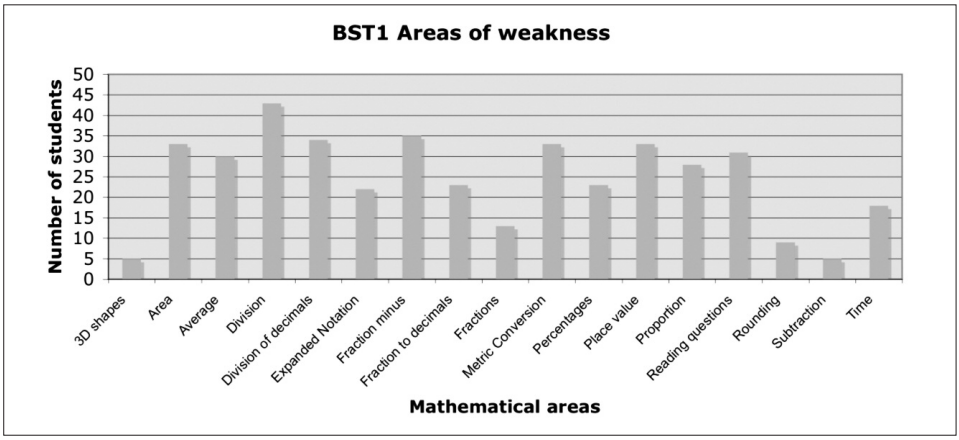

Figure 2. Results from Basic Skills Test 1

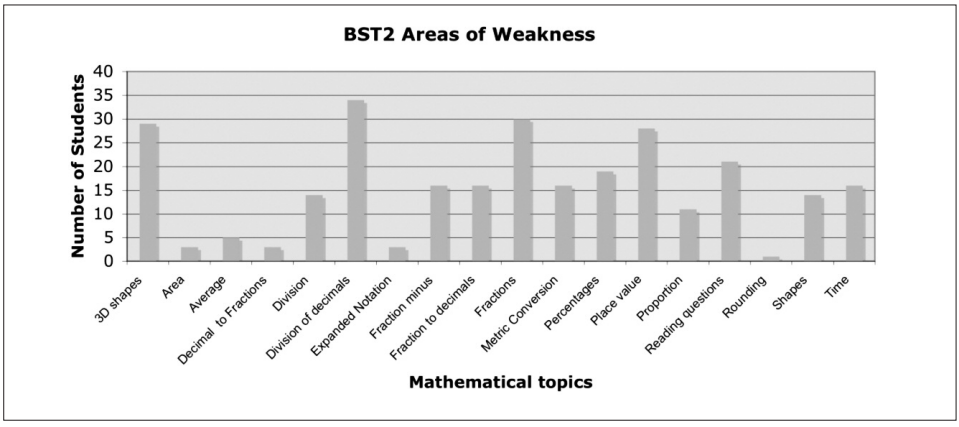

Figure 3. Results from Basic Skills Test 2

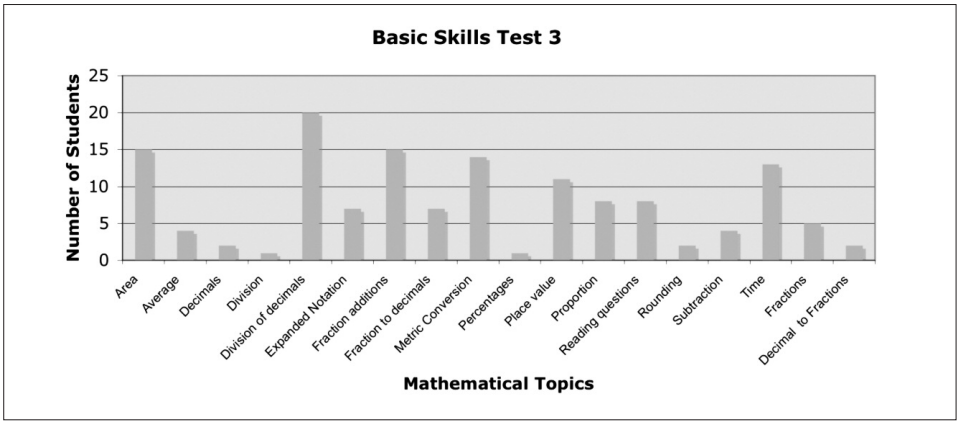

Figure 4. Results from Basic Skills Test 3

Errors for some questions, such as division questions that resulted in non-whole number answers, were overcome after a small amount of teaching. Figure 5 shows how the percentage of preservice teachers who were unable to do these questions steadily decreased over the four tests.

These questions required a short division and an answer to two decimal places. In Test 1, many preservice teachers placed the remainder into the first position after the decimal point. Once they understood how the place value system operated in relationship to decimal numbers, they were able to determine the decimal fraction part of the answer. In the third BST, only one preservice teacher gave an incorrect answer.

Other topics were harder for preservice teachers, even when they also required an understanding of place value. For example, many were unable to provide correct answers to questions involving division of decimal fractions. A typical question of this type was: A stack of 500 identical sheets of paper is 4.5 cm high. What is the thickness of one sheet of paper? It can be seen in Figure 6 that the percentage of preservice teachers who were not able to answer this question remained high for the first three tests. Twenty preservice teachers, out of the forty-five who sat the third test, were still unable to do this kind of question appropriately.

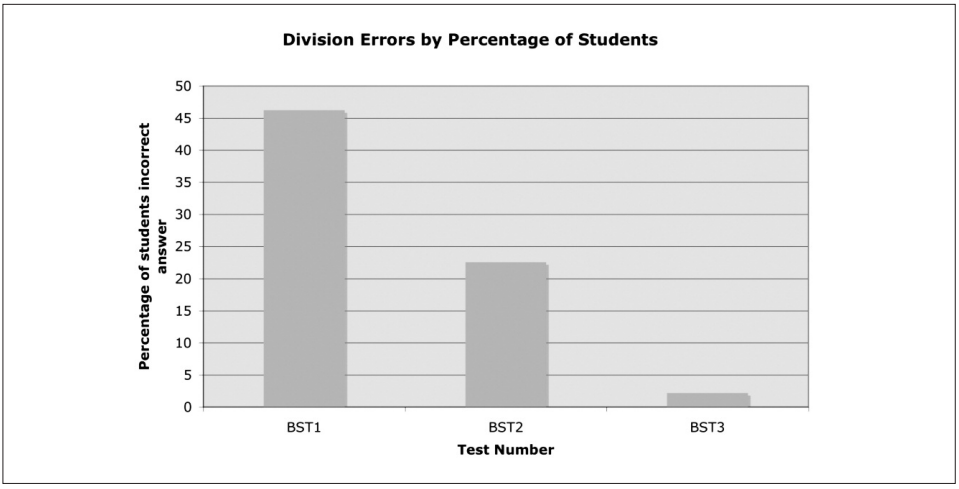

Figure 5. Percentage of preservice teachers providing incorrect answers to division questions across the three tests

Figure 7 provides examples of the difficulties that the preservice teachers had with place value. Similar misunderstandings about place value may have affected the solutions to the division problems discussed earlier.

Simply looking at the results from the BSTs would have shown that our preservice teachers had similar misunderstandings about mathematics to other preservice teachers around the world (Ponte & Chapman, 2008). A possible

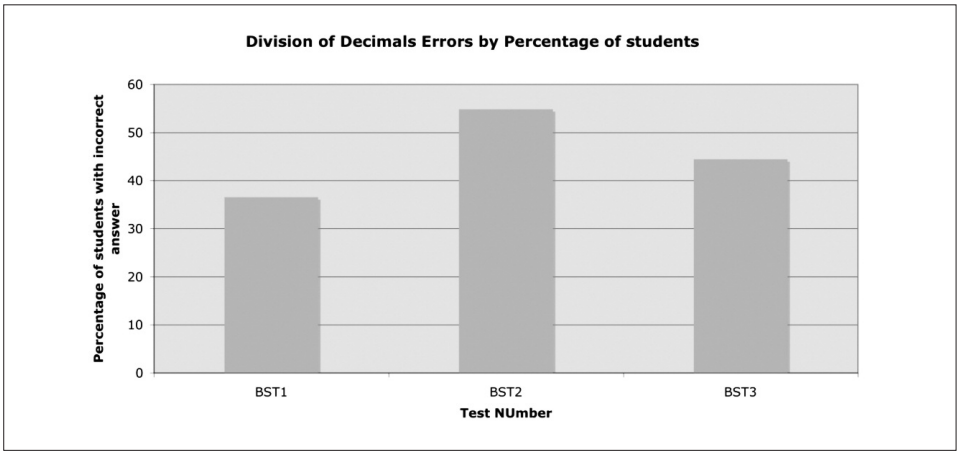

Figure 6. Percentage of preservice teachers providing incorrect answers to division of decimal questions across the three tests

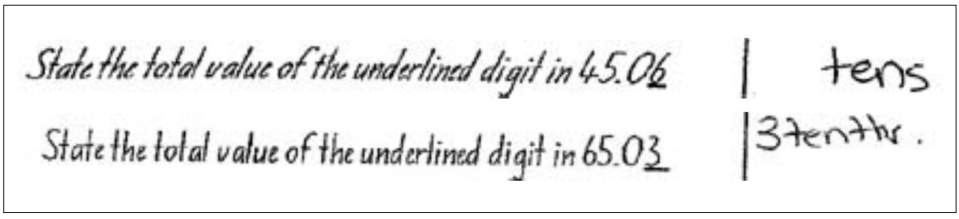

Figure 7. Two preservice teachers' responses to place value questions.

outcome of limiting our research to this could have meant that the tests themselves were deemed as adequate and therefore should not be changed. As described in the next section, however, information from the interviews suggested that this was not the case. The tests themselves were contributing to preservice teachers not taking on board the need to gain conceptual understandings of the mathematics that we were advocating, not just in the BST tutorials but also in the other activities that were part of their initial mathematics education subject.

Preservice Teachers' Views on Doing the BST

Preservice teachers' stories about the BST suggested that their focus was on showing what they knew (performance), and they rarely linked this to being competent in supporting primary school students. Many wanted to change their actual identities of not being good at mathematics to designated identities as being good at mathematics. This desire to change was connected to their long-term designated identities of being primary teachers of mathematics, but their perception of this institutional identity seemed to come from their affinity

identities as recently-completed school students. For them, a teacher professional identity involved being able to perform mathematics accurately in front of children, their parents, and the principal.

Performing Mathematics to Gain Institutional Identities as Teachers

On the whole, the preservice teachers recognised that it was important that they knew mathematics.

> PST 4: When I said it was really stressful and that I didn't like the fact that we had to do a test, but thinking about it, it's probably the only way that I could think of assessing and making sure that everyone knew about it. (Interview 2)

> PST 7: I reckon it's just seeing what the students know. Like seeing where they are to, sort of, work on what they need to know for teaching and so that when they go out they have a background knowledge. Like, if they're put on the spot of how to teach long division then they've actually done it in a funny kind of way. (Interview 3)

The teachers in Gresalfi and Cobb's (2011) study showed how principals' expectations about their students doing well in standardised tests were part of the teachers' institutional identities. Successfully doing the mathematics in the BST indicated that the preservice teachers matched the institutional identity of a teacher of mathematics. The prevalence of uncertainty markers, such as "I think", suggested, however, that they were not completely sure about why they had to do the BSTs.

There was some discussion about the 90% pass mark, but it was recognised that someone else had decided what constituted sufficient mathematics to be a teacher. For some, the 90% pass mark was an appropriate level to show that they really knew the material.

> PST 1: I think getting the 90 percent, I think that's got to stay to make sure that they know the work not guessing it I guess.

> PST 2: Yeah, I think the level, the pass level needs to be that high. As far as the testing goes, I don't see it as a problem. (Interview 1)

On the other hand, some preservice teachers saw the need for a 90% pass mark as very stressful. In this case, their affinity identities of being recently-completed school students set the parameters of what they could achieve.

> PST 6: Too much pressure to be 90 percent pass.

> PST 9: 90 percent is too high because for some people, me, when I was at school, just last year I could barely get above 70 percent for all these things and then you come here and they're like you've got to get about 90 and it's just like it's pretty much impossible.

PST 8: I've never got 90 percent in anything.

PST 6: But then I think that comes back to the level they want people to have and that's their expectation that at that level of maths you need to be 90 percent. I can see where they come from to say, you have to get 90 percent to pass. Like that's the level they want you to have but a different way of going about it. (Interview 3)

For some preservice teachers, there was confusion about who determined the standards for the institutional identity for teachers of mathematics. They felt that having to do CSU's BST and complete the NSWIT's requirement for HSC Band 4 mathematics gave mixed messages.

PST 8: I want to know where this factors in to having a Band 4 in maths because I'm waiting to hear whether I need to do extra-

PST 6: So am I.

PST 8: And how does that figure then if I can pass a Basic Skills Test why do I need to be Band 4 maths? If I have to do it like I don't know where that figures into the whole scheme of things either so it wasn't our question. I don't understand why I have to go to summer school [to complete the HSC Band 4 requirement]. If I can get 90 percent in the Basic Skills Test and I've done maths on my HSC why do I need to summer school again to get Band 4 maths? (Interview 3)

For some, the institutional identity of being a teacher involved showing that you could do the mathematics and did not include necessarily supporting school students to understand mathematics. Sometimes, the need to do the mathematics was connected to being able to explain it to students, but more often it was connected to ensuring that they, as teachers, did not lose face.

PST 2: Yeah, I think so as well, because if you don't know the work and if you don't know how to do it yourself, you're not going to be able to teach it.

PST 1: And they're going to ask a hard question and you're just going to be, like, I don't know how to do it and that doesn't reflect very good on you and then it reflects badly on the school and then the parents will find out and then they'll tell people. (Interview 1)

This resulted in a performance-avoidance approach to their mathematics learning because they sought to "to prevent unfavourable judgments of their ability" (Perry, 2011, p. 3).

Only one preservice teacher seemed to suggest that she needed conceptual understandings to provide appropriate explanations to her future students.

PST 3: And the kids might need a longer explanation than what you're giving them to start off with. So you've got to know how to go into more depth but break it down even further so they can get it. (Interview 2)

Feelings about their actual identity as preservice teacher or about whether they would achieve their designated identities of being a teacher of mathematics evoked a range of affective responses. One preservice teacher saw the BST as contributing to her feeling comfortable about her mathematics knowledge.

> PST1: To ensure that we have maths knowledge so you feel confident and help us in other subjects I guess (Interview 1).

On the other hand, another preservice teacher who had had to sit the BST more than once felt that this experience contributed to making her uncomfortable about her mathematics knowledge.

> PST 9: But that Basic Skills Test pretty much demoralises people because it shows what you can't do. So if you keep going repeatedly failing most of the time, it just breaks you down because you think you can't do it. (Interview 3)

In this case, she did not consider she had a problem with mathematics until she did not pass the test. Thus the research on preservice teachers' lack of mathematical knowledge had an impact on her mathematics learning because it had resulted in the institutional response of instigating a BST. These sorts of comments match the anxiety mentioned by preservice teachers in other studies such as the one by McNamara, Roberts, Basit, and Brown (2002). However, some preservice teachers, often those who had passed in the first round, felt that having four opportunities to pass should reduce the anxiety.

> Interviewer: The anxiety component to the Basic Skills Test is mainly because of?
>
> PST 1: Fear that they will fail the subject.
>
> PST 2: Yeah that 90 percent rate, if you fail that and you're out after 4. … I think that's great that you get the 4 opportunities because some people as I say have that fear. I think it's preparation, you've got to be prepared. (Interview 1)

The preservice teachers identified the need to match the institutional identity of being a teacher or a preservice teacher as being the purpose of doing the BST. For them, the institutional identities were determined by expert members of the communities that they wished to join, teacher and teacher education communities. As preservice teachers, their role was to achieve these institutional identities. In order to match this institutional identity, many preservice teachers had to engage in learning.

Closing the Gap between Actual and Designated Identities

Sfard and Prusak (2005) describe learning as a means to closing the gap between designated and actual identities. By publically identifying what they did not know, doing the BST made the preservice teachers reflect on the gap between their actual and designated identities and the reasons for this discrepancy.

Many preservice teachers blamed their high school mathematics experiences for their low ability to do primary school mathematics. Cooney (1999) pointed out that "often preservice teachers have a poor understanding of school mathematics [because they] last studied it as teenagers with all the immaturity that implies" (p. 165). Many preservice teachers at CSU, however, were only seventeen or eighteen when they took this test, implying that the issues faced at school may not be resolved when they reached university. It was a real struggle to re-learn the mathematics and they felt that they should have had more help.

The necessity for someone to teach them became even clearer in later research (Lange & Meaney, 2011). This need was connected to the fact that their previous experiences and the way the test was constructed meant that what they thought they needed was procedural rather than conceptual mathematics. As Perry (2011) noted "the hours of observations one accumulates as a student instil a view of teaching that is exceedingly difficult to change" (p. 3)

PST 4: Yeah, but I think that we should have probably gone over everything again in class. Like I personally didn't have too much problem with it. But I know there were quite a lot of people that they just don't remember that far back to primary school and they couldn't do a lot of the stuff because as you said we used calculators through high school.

PST 5: So we just forgot everything that we knew basically and some things were hard to learn by yourself. Like you look at it in a book but it's not the same as if someone is showing you or if a teacher teaches you. You might be able to remember how they taught you which would be better to teach the children. So I think they need to do more with teaching us how to do specific things, like she did a little bit but not much really. I got mine the second go, I think it was a bit stressing for some of us. Because some of our friends got it their third or fourth go and I know I was stressed for the second go because I didn't want to fail it again because then it would be even more stressing.

PST 3: I found it hard. I passed second time as well and I found it hard the second time to teach myself. I went online and I was going through it and stuff and some of the explanations were hard to understand to get the concept of how you got that and things like that. Because it just shows you the answer, it doesn't show you what you actually had to do so it was a bit confusing. (Interview 2)

These responses are similar to the preservice teachers in the study by Tobias and Itter (2007): "[p]erhaps, these students have a performance view instilled in their

prior learning experiences, where a 'learn and forget' attitude prevailed due to a lack of emphasis on understanding during the middle years of schooling" (p. 14). In these comments, the preservice teachers seemed to excuse themselves by suggesting that a "learn and forget" attitude was the norm.

PST 3: You're so used to using calculators because as soon as you hit high school you just use calculators and you just forget how to do the simple things in your mind.

PST 5: Even times tables.

PST 4: Same but in saying that though a lot of those questions were the basis of maths that you do in high school. So in some ways we probably should still know them, but in another light what happens, in high school just recently like for the mature age students and stuff (Interview 2)

These preservice teachers could see a clash between their affinity identity as a recent high school student and the institutional identity of being a teacher of mathematics, of which the first step was to gain the designated identity of being a successful student who passed the test. Regardless of why they felt that they had forgotten primary school mathematics, some preservice teachers found successful ways to study for the BST and passed on the first or second round.

PST 2: Yeah, I agree. If you look at that test, the amount of people who passed on the first round and had to keep going, obviously there was a need for it. It showed that there were a lot of people, either they weren't prepared or they just didn't have enough background. Before that test, I actually went on the website and I don't know if anyone else did and it had maths for teachers on the student learning [website] and a lot of people weren't aware of that site, it had practice questions and everything there.

Interviewer: That might be an option for people to prepare.

PST 2: It is if it was more advertised. You know how they've got the Interact [electronic forum] site and there's part of the student notices, or whatever, put a link in there. Instead of having it in student life, put the link into [internet resources for the subject] so they can click on it and they can see and it was great and I did that quite a few times and maybe because I'm older I also brought a year 7 text book with basic skills.

PST 1: I bought a maths dictionary (Interview 1)

These preservice teachers were able to close the gap between their actual and designated identities. For others, however, studying for the BST did not seem to be an appropriate way to gain the necessary mathematical knowledge. Sometimes, this inappropriateness was related to their views about the sort of mathematical knowledge needed in the classroom and how they perceived their designated identities as teachers.

PST 7: I personally am good at assignments and not tests because I don't remember anything. So I can only do it, if I know how to do it and for the Basic Skills Test I had a lot of trouble revising and things and because my dad's mathematical, he taught me different ways to do it and when you go out to teach the children, you can't use those ways. You've got to use the way it states.

PST 8: You actually had to study to the test, you had to actually just get through it. There was no learning how to teach it or anything. It was just basically pass it or you don't move on. (Interview 3)

Comments such as "I can only do it if I know how to do it" suggest that the preservice teacher (PST7) felt that knowing how to do the mathematics, procedural knowledge, was what was required to pass the test and to teach children. The mathematics that she had been taught by her father was unlikely to be the procedure that "it"—school/textbook/etc—anticipated that she would teach children. For her, the institutional identity of a teacher meant that very specific mathematical knowledge was needed and her father's ways of doing mathematics were not appropriate.

There was also a discussion about whether studying for the test meant the preservice teachers just had to memorise knowledge and procedures. They felt that this kind of learning was unlikely to be valuable when they were teaching, possibly because it too would soon be forgotten. For these preservice teachers, the designated identity of being a teacher was a strong focus for their learning but they were uncertain how to learn by themselves. Perhaps as a university student, a preservice teacher's identity was too similar to their recently-familiar high school student identity who just needed to pass.

PST 8: Also with being four tests, by the time you got to the fourth one, a lot of it you could do from memory, because the last three combined the fourth one. So you really didn't have to think you just had to regurgitate it.

PST 7: But they all had mainly the same structure so you knew what was going to happen. It was going to be something on surface area or something on division and time. You just knew what was going to be there, so you basically just had to revise everything from the first test.

PST 6: People were basically just learning enough to pass it and again I think it's important to break it all down into how you work it out, how you would go about teaching it. For me I just had to go and learn the basic concepts, like all the place value of this and I had to learn all those terms again they were …

PST 8: That was that thing where it's the net of something …

PST 6: Yeah, I had to look that up.

PST 7: I remembered that.

> PST 6: Just the mathematical terms that weren't quite as solid as maybe they should have been in your head to know what you were trying to get. So again, I think it's more important to break it down and teach it so you understand it and how you would go about teaching it to somebody else and then maybe see with a test. Then you see the knowledge that you've gained at the end of the course or something. (Interview 3)

These preservice teachers felt that the BST made them learn. At times, they had actively searched for information on nets, place value, or specific mathematical terms. Others felt that all they had really learnt was the format of the questions in the test: "it was going to be something on surface area or something on division and time". However, PST 6 did not feel that she gained the knowledge needed for the professional identity of a teacher of mathematics.

As noted at the end of the last dialogue, there was also some discussion about when the test should occur. This was tied into whether or not the preservice teachers were taught the material or were expected to relearn it themselves.

> PST 2: I think they need a test like that … but perhaps before they do it there's more instruction like you say. They have a booklet you either work through your own self-paced booklet and that's up to you, then you're responsible for your own learning. But you have a self-created booklet with example questions, maybe that might be in the test, may not be and then put the test on.
>
> PST 1: But then there's also going to be those people that already know a lot of stuff that's going to be in there. Like they already have a good background of maths that might…
>
> PST 2: But if it's a self-paced module they can finish it quickly and then forget about it. Other people can work through for the first few weeks. (Interview 1)

In this dialogue, there is no di scussion about professional identities as future teachers of mathematics and it seems that knowledge is something that can be forgotten once learnt. Instead the designated identity of being someone who successfully passed the test is assumed to provide the motivation to learn the necessary mathematics. Perry (2011) described this kind of motivation as a performance approach where learners want to learn so that they gain favourable judgements about what they can do. The preservice teachers' perceptions of their actual and designated identities revolved around their need to pass the test and their professional identity as teachers became invisible. Although some preservice teachers complained about the lack of connection between teaching mathematics and their desired professional identities, it was hard for many to see beyond the immediacy of passing the test.

In the interviews, many preservice teachers focused on the performance of doing mathematics. This is perhaps unsurprising given that they had to get 90% of the questions correct. The preservice teachers were in their first semester of

doing a Bachelor of Education. With a restricted view of what being a teacher meant, many may have found it difficult to imagine situations where they would need the mathematical knowledge to support students. If preservice teachers are to imagine a different rationale for learning primary school mathematics then the test and other structures around it need to change.

Conclusion

Preservice teachers' perceptions of teachers of primary school mathematics, combined with their previous identities as school students meant that that they had a restricted view of how mathematics understandings connected to institutional identities of teachers. Although, most recognised that their mathematical knowledge might be lacking, many were stressed by having to achieve a 90% pass rate.

As well, the questions in the test resulted in the preservice teachers reinforcing their views that what was important in mathematics was knowing the rules. It is unlikely that the requirement to have HSC Band 4 mathematics will disrupt this belief and this may have lasting implications for the preservice teachers' teaching. Expecting subsequent mathematics pedagogy subjects to change their understandings about the mathematics that they need for teaching may be unrealistic (Perry, 2011). Tobias and Itter (2007) suggested that "needless to say that unless preservice teachers possess sound fundamental understandings and desires to learn mathematics then they will hold a pervasive performance view rather than a desire to conceptually understand the subject" (p. 6-7). Performing mathematics in front of a class was perceived by some the reason why they needed to pass the test.

Often in teacher education, we instigate initiatives with the best of intentions. If we had looked only at the preservice teachers' poor results in the BST, we would have been convinced about the necessity of providing such a test. Yet, interviewing preservice teachers provided valuable insights into how these intentions were thwarted by the circumstances in which the tests were carried out. The views of preservice teachers have been crucial in exploring alternatives to the BST. As noted in later research (Lange & Meaney, 2011), we have made several changes both to the test and also to the support that we provide.

To do this, we have taken on Gresalfi and Cobb's (2011) advice that teachers—including, in our case, preservice teachers—need to "personally engage in forms of mathematical activity that differ from those that they experienced as students and also requires that they reconceptualise what it means to do mathematics" (p. 272). Creating an environment in which affinity identities that value conceptual mathematical understandings are forged, within their mathematics education courses, may contribute to them changing their perceptions of their designated institutional teacher identities.

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