TENSIONS RELATED TO COURSE CONTENT IN TEACHING MATH FOR TEACHERS: THE CASE OF ALICE

Susan Oesterle

Simon Fraser University

Instructors of mathematics content courses for prospective elementary teachers are influenced by many (sometimes) competing factors as they strive to meet their goals for their students. This report will illustrate some of these tensions in order to contribute to a deeper understanding of how they shape instructor decisions related to course content. Interview data from one instructor will be analysed.

INTRODUCTION

Prospective elementary school teachers are often required to take a mathematics content course before or as part of their teacher preparation programs. The recent report of the National Mathematics Advisory Panel (2008) has recommended that these courses be specifically tailored to the needs of prospective teachers, and that they be taught by mathematics instructors in mathematics departments. Such courses are already offered at many institutions, and though their course titles vary, they will be referred to here as "Math for Teachers" (MFT) courses.

In a plenary address to the PME-NA, Ball (2002) commented that "we have not put in the foreground the "who" of teacher learning as often as we might". Following on this, not only is it important to understand the "who" of our prospective teachers, but also of their instructors, as the contexts of both groups mutually influence one another within the environment of an MFT course. This paper reports on a small portion of a larger project whose aim is to understand who these instructors are, specifically how they perceive and respond to their role(s). The focus here will be on one of these instructors and the tensions that she operates under as she tries to make decisions on content for her course.

FRAMING OF THE STUDY

There is a vast amount of literature which makes recommendations for the knowledge, beliefs and attitudes that teachers of elementary school mathematics should have (e.g. Ball, Lubienski, & Mewborn, 2004; Philipp, 2007). Although policy documents (e.g. Greenburg & Walsh, 2008) provide the clearest mandate for MFT courses, there is little advice or agreement on how to set priorities within the long lists of qualities they present. Furthermore, the extent to which MFT instructors have contact with this literature, either directly or indirectly, is unclear.

In fact, very little research has been done on post-secondary instructors in general, let alone instructors of MFT courses (Artigue, 2001). Because they teach at post-

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secondary institutions, MFT instructors usually enjoy considerable autonomy over their courses, and as a result, their specific content, aims, and approaches can vary significantly (Oesterle & Liljedahl, 2009). Understanding these instructors, their beliefs and motivations, is a crucial component in understanding the role they play in the activity of teacher preparation (Roth & Lee, 2007).

This report will offer a glimpse, via one case study, into some of the influences which contribute to one aspect of this activity: content decisions made by MFT instructors. These influences are framed as tensions. Berry (2007) observed that tensions:

> captured well the feelings of internal turmoil experienced by teacher educators as they found themselves pulled in different directions by competing pedagogical demands in their work and the difficulties they experienced as they learnt to recognize and manage these demands (Berry, 2007, p. 119).

METHODOLOGY

Data for the larger project was gathered through semi-formal interviews conducted with instructors of MFT courses at post-secondary institutions in British Columbia. Theoretical sampling was used to select instructors who represent a range of years of experience teaching the MFT course, and come from a wide variety of post-secondary institutions. Most of the participants were previously known to me on a professional basis, as I am also an MFT instructor. Member checking (Creswell, 2008) was employed to mitigate bias due to my own prior experiences.

In the interviews, participants were asked about their educational backgrounds, their preparation for teaching the MFT course, their aspirations for their students, and their approaches. They were also asked to reflect on how successful they were in achieving their goals. Audio-taped interviews were transcribed and coded using constant comparative analysis (Corbin & Strauss, 2008). Forty-eight focussed codes emerged from the preliminary analysis, which could be tentatively arranged under 8 (not disjoint) themes: instructor identity, tensions, resources, student knowledge, affect (beliefs and attitudes), orientation to mathematics, orientation to teaching, and classroom environment. Instances of tensions were identified through instructors' expressions of ambivalence or even guilt, and through apparent contradictions between reported intentions and described realities.

This report will draw on data from the interview with Alice (a pseudonym).

ALICE'S INTERVIEW

During Alice's interview she expresses feelings of ambivalence or regret several times, often while she is talking about issues involving course content. In order to set a context for the particular tensions that arise, I will begin with a summary of Alice's background and her goals for her students. This will be followed by a description of three episodes that occurred during her interview which shed light on some of the tensions she encounters.

Like most of the participants in the study, Alice has an advanced degree in mathematics, teaches in a mathematics department at a post-secondary institution, and has not participated in any formal education courses as part of her educational background. She was selected for this study because she is new to teaching the MFT course, having taught it only once, though she has been teaching mathematics for over 10 years.

Early in the interview, Alice was asked about the topics she teaches in her MFT course. In her list of topics she includes: problem-solving; arithmetic operations on whole numbers, integers, rationals and reals (including varieties of models); some geometry; and some probability and statistics. The topic list is very similar across different post-secondary institutions. In the context of the BC system, this is largely due to the need, for community colleges in particular, to offer MFT courses that will be transferable to the large universities that offer teacher training programs.

Further questioning revealed that Alice aspires to teach her students much more than simply how to do the mathematics subsumed under these topics. Her expressed goals in teaching the MFT course reflect a strong concern for addressing students' attitudes and beliefs. She explains:

> For me the main thing would be that they would, kind of, not be afraid of math, and like math, like think it's actually interesting, think it's fun... So I try to make it fun, and, playful, because many of them, I believe, are a bit hesitant about the whole math thing. And they postpone it as late as they can. So the goal was to make them feel a little bit improved on their confidence, for some of them...and for the others, to bring in some interesting, funny, questions. Like, little fun problems to solve, that they won't just have to teach the kids later on to add numbers over and over and over.

Her main concerns are combating her students' mathematics anxiety, building confidence and showing them that there is more to math than repetitive drill exercises. From her responses it is unclear what emphasis she places on improving her students' mathematical knowledge. For many of the other participants, goals for improving students' mathematical skills were explicitly mentioned in their goal descriptions. It is notable that this did not occur in Alice's interview.

Episode 1: Probability or Symmetry

This first episode begins early in the interview, when Alice is concluding her description of the course topics. She comments:

Alice:	Probability is there too. Statistics and probability. Statistics is basic. Probability branches...one could branch off. I guess I should not have.
Interviewer:	You shouldn't? You mean you did?
Alice:	I did. I did a little because I like it, and I shouldn't have. Next time maybe I'll play more with the symmetries and the tessellations...but as I look at elementary school curriculum, the probability is not there at all!

Alice couples her regret over having (possibly) done too much probability with the thought that she may not have spent enough time on symmetry. This competition between different topics for the limited time available in the course is a common tension experienced by many teachers in many courses. More interesting tensions become evident upon a closer examination of her reasons for both her regret, and for choosing to teach more probability and less symmetry in the first place.

Alice uses the elementary school curriculum as a reference to inform what her priorities should be. Indeed she goes on to explain that she has children in elementary school who have done work on symmetry, and in consequence:

> I figured maybe that [symmetry] was more important for me to cover than the actual probability which I enjoy much more than symmetries.

Her rationale for teaching probability is that she enjoys it. There may be an assumption here on her part that if she enjoys it, then her students will as well. Teaching probabilities could facilitate her goal of helping her students see mathematics as fun, but she is dismayed that it is not part of the elementary curriculum. There appears to be a tension here between what she wants to teach, and what she feels she should be teaching as indicated by the elementary curriculum.

One other factor emerges as she elaborates on not spending time on symmetry. She laments that "she cannot draw [the symmetries] clean and pretty" and as a result she feels uncomfortable demonstrating them. Instructor expertise (or in this case lack of it) contributes to the tensions in this instance. Her aversion to teaching symmetry is in conflict with her belief that she should be spending more time on it.

She resolves:

...probability for me was a much more fun topic, but next time I'll practice a little with my symmetries, and with my drawings... or use a computer.

This pledge to practice more with symmetries before she teaches again, especially since she is still linking the topic of probability with symmetry, might be seen to be a move within the tension towards making a greater effort to spend more time on a topic that she sees as a significant component of the elementary curriculum, despite her inclinations or her aversion.

However, at a much later point in the interview, when asked whether probability and statistics would still be part of the course if she taught it again, Alice responds:

> Probability...I [have] more mixed feelings [compared to Statistics], even though I like probability, but I guess...the quantity and quality balance in there is hard to make, so maybe...[long thoughtful pause]…. I would still do it!

The tensions remain. Although she has determined to teach more about symmetries, there is no indication that she will give up on the topic she loves to teach, despite her acknowledgement of the "quantity and quality balance" dilemma.

Episode 2: Fractions or Tessellations

The second episode arises when Alice is asked whether she does anything with her students specifically because they will be teachers of mathematics one day. In response she describes having a discussion with her students about the elementary school curriculum and its neglect of the important topic of fractions:

> In the curriculum these days, from what I observe with my kids, is that fractions are covered at the end of a school year. For some weird reason, fractions are in June or May. And then…they don't always make it…. Fractions are VERY important! It almost signals to me why we have such a horrible situation with fractions. Everybody's so scared of the fractions, they push them towards the end. So I gave them a big speech that they promise to me, once they get into the workforce, they will fight to move fractions earlier.

The "horrible situation" she refers to is the lack of skill in working with fractions that she encounters regularly as a teacher of post-secondary mathematics. It is unclear who the "they" are who are so afraid of the fractions that "they push them towards the end", but it could be either the teachers themselves or the elementary curriculum designers. From Alice's perspective, not only are fractions neglected, but time is spent on less worthwhile topics:

> … it's frustrating, you know, for there are no fractions.… There are tessellations, they're done for a month, but fractions are done for a few weeks in June. And so I tried to relate … what I think is more important…

She goes on to muse:

> I don't know why I keep talking about tessellations. I guess because it was new to me—tessellations were completely new to me, and, so, they're lovely, but then again, how much of curriculum should be devoted to tessellations....Could [they] be maybe combined with art classes?

Alice experiences no difficulties in deciding the relative merits of fractions vs. tessellations. Her past experience as a college mathematics instructor informs her knowledge that most students exhibit poor understanding of fractions, and that this creates difficulties for them. At the same time the fact that tessellations are new to Alice may support her view that they are less important: if she has managed well without them then perhaps the students will not have a great need of them.

The tension arising here is between what she believes students need to know based on her own experience and what she perceives to be inappropriately emphasised in the elementary curriculum. This is in contrast to the first episode in which her understanding of the elementary curriculum seems to inform her priorities.

Not surprisingly, much later in the interview, when asked what she would do differently if she teaches the course again, Alice replies: "I would probably do less tessellations." However, this quickly gives way to an expression of guilt:

> I feel bad about it, because geometry is being so abandoned, but then again, it's a cycle, a vicious cycle. If I teach less, then they will not want to teach it...

Her regret in this case does not seem to be about tessellations in particular, but rather about her perception that geometry is not being given its due. At the same time it reveals the import she attaches to her content choices. What she chooses to teach or not teach sends a message to her students about the relative importance of mathematical topics, and will in turn have an impact on their future practice as teachers. This concern contributes to the tensions around her content decisions.

Episode 3: Knowledge or Attitudes

In a more philosophical discussion near the end of the interview Alice replies to a question about whether her students have sufficient mathematics knowledge to be teachers. Her reply reveals some uncertainties:

> That's a very good question. That, that's a very deep question. Because we don't teach so much math in that class, you know. We don't drill them on whether they can do those fractions. Mmm, so we kind of believe they have the elementary math [...] but how much above it they should be...You see they always say that you should be significantly above what you want to teach, because then you have the big picture, you see the troubles and all that. I don't know that much about that. [...] Many of them are [ready to teach] and many at least will not be afraid to go for it. But I still think there are people who will be afraid....I still think I let people go in there being afraid.

She goes on to comment that those who are still afraid will likely avoid the mathematics as much as possible in their future classrooms, though they may be "wonderful at some other subjects". She laments the fact that there are not specialist mathematics teachers at the elementary school level.

A careful parsing of this passage reveals some of the different forces contributing to the tensions that Alice operates under. As she thinks out loud, her pronoun use changes from "we" to "they" to "I". "We" likely represents her institution as she describes what doesn't happen in the course: there is not much math and no skill drill. As well she seems to explain why mathematics skills are not emphasised: "we kind of believe they have the elementary math". The hedging with "kind of believe" may indicate that she is in fact aware that many of her students do not have those presumed skills. This is also suggested by other comments in her interview. In the phrase "they always say..." , the "they" seems to point to education experts, or at least to those who have an informed opinion. She understands why having a higher level of mathematics knowledge might be advantageous for a teacher, but she switches to the pronoun "I", and quickly disassociates herself from the "they", asserting that she doesn't know that much about these matters. We see in this episode references to her institution, expectations regarding students' prior knowledge, education lore, and her own feelings of inadequacy with respect to educational issues, all of which inform and influence her content decisions.

Furthermore, although she appreciates the importance of the question, in the end Alice does not decide whether her students are prepared mathematically. She instead shifts to consider whether her students "at least" will not be afraid of the

mathematics, even if their content knowledge is not strong. Throughout Alice's interview, affective concerns are paramount and they emerge here again. She expresses some satisfaction that many will have overcome their fears, although after a pause she observes, regretfully, that this goal isn't always successful either.

DISCUSSION

Although tensions are often described in terms of two opposing forces, those experienced by instructors in MFT courses cannot be described so simply. In this context there is a plurality of influences which sometimes compete and sometimes combine in various ways to affect instructors' choices.

Episodes 1 and 2 show Alice making choices about particular topics. The elementary school curriculum as she experiences it via her own school-aged children is an important consideration, but it is sometimes in conflict with her personal inclinations and/or aversions (episode 1), or with her knowledge and experience as a mathematics instructor (episode 2). The tensions created are amplified by the necessity to make either/or decisions given the limited time she has with students in the course.

Episode 3 alludes to tensions that operate at a more theoretical level, revolving around fundamental questions about what role the MFT course should play in the development of elementary teachers. How important are goals for improving mathematical proficiency relative to goals for building positive student affect? For some participants in the study, affective aims are sabotaged by an emphasis on building mathematical proficiency, while for others the mathematics proficiency is a necessary step towards improving students' attitudes to mathematics. Alice chooses to emphasise affective goals, while at the same time acknowledging that others (education experts?) may not concur. In her particular case, she deals with this tension by deferring authority for deciding these priorities to others at her institution, and suggesting that deficiencies may need to be addressed at the systemic level (i.e. with specialist teachers.)

We see here tensions that operate among goals (e.g. mathematics proficiency, attitudes) and points of authority (e.g. the instructor herself, the elementary curriculum, her institution). Alice operates within the tensions without coming to any definitive resolution, though she must and does make choices within her practice.

Conclusion

The tensions described here with reference to Alice's transcript represent only a glimpse into a few of the many influences that affect decisions of MFT instructors. Students' prior knowledge and expectations, along with other peer and institutional factors are among those significant influences that could not be addressed within the space restrictions of this report. Moreover, these tensions do not only arise in the context of content decisions, but also in choices around methodology.

Although the tensions experienced by Alice will not be identical to those experienced by others, a consideration of her situation can improve our understanding of the

possible tensions that instructors of MFT courses may encounter, helping us better comprehend the context that they both shape and are shaped by. Bringing these tensions to light may allow them to become "the primary driving forces that bring about change and development" (Roth & Lee, 2007) within the practice of preparing elementary school mathematics teachers.

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