

THEORY-PRACTICE TRANSITIONS AND DIS/POSITIONS IN SECONDARY MATHEMATICS TEACHER EDUCATION

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One challenge for mathematics teachers and teacher education programs lies in translating socio-cultural theories into pedagogical practices. The study described in this paper endeavours to address the challenges faced by secondary mathematics pre-service teachers as they negotiate the transitions between/within university curriculum courses and their classroom field experiences as interns. This paper presents several theory-practice transitions, including those of the researcher, as it seeks to dis/position the power and tradition at the centre of secondary mathematics teacher education.

INTRODUCTION

Mathematics education research documents a range of personal, political, and social factors that influence the development of mathematics teachers and their pedagogical identities (Goos, 2005; Kaartinen, 2003; Lerman, 2005; Walshaw, 2005). If these factors are viewed through socio-cultural and poststructural lenses, several possible dimensions of a mathematics teacher's pedagogical identity can be revealed. However, even in acknowledging the multiple dimensions of identity, these “collections of stories about persons” (Sfard & Prusak, 2005, p. 16) as mathematics teachers are still strongly influenced by the conservative power of school tradition and culture. According to several researchers (Jaworski & Gellert, 2003; Lerman, 2005), traditional textbook and teacher-directed approaches still dominate mathematics classroom practices because of a number of socio-cultural issues relating to institutional structures, the perceived nature of mathematics, acceptable styles of interaction, and personal epistemological beliefs. These issues are often neither trivial nor overt in the lives of pre-service teachers but, instead, embedded within personal and professional ideologies at work in the classroom.

According to Kaartinen (2003), one challenge for mathematics teachers and teacher education programs lies in translating socio-cultural theories into pedagogical practices such that a reformed participatory approach to learning mathematics is stressed. In other words, instead of emphasizing traditional modes of interaction between teacher, student, textbook, and standardized tests, a participatory approach emphasizes social interaction and discourse, student problem posing and solving, distributed expertise, and the recognition of collective meaning making. But why has it proven so difficult to realize such participatory approaches in mathematics classrooms (Nolan, 2007)? Perhaps the reason lies in how participatory approaches fly in the face of typical classroom and teacher concerns, such as covering large

amounts of curriculum and demanding that all students attain similar levels of ‘understanding’ and ‘expertise’ within the same pre-given timeframe.

The study described in this paper embodied the characteristics of participatory approaches in an attempt to address the challenges faced by secondary mathematics pre-service teachers as they negotiate the transitions between/within university curriculum courses and their classroom field experiences as interns. By viewing the mathematics classroom through socio-cultural and poststructural lenses, the study aimed to understand more about theory-practice transitions through a deliberate effort to ground theory in the practice of innovative instruction and assessment in mathematics classrooms.

THEORETICAL FRAMEWORK AND PURPOSE OF STUDY

While there are a range of theoretical landscapes for describing and understanding how/when/if learning occurs, socio-cultural views of learning are being drawn upon more and more by educators and researchers due to an increasing belief that learning embodies social, political, historical and personal dimensions. To explore learning through socio-cultural lenses means to open the nature(s) of learning to scrutiny by (1) viewing learning as situated with/in the social interactions of members of a social group (Bauersfeld, 1988), (2) understanding cognition to be both in the minds of individuals and distributed across communities of practice (Eames & Bell, 2005; Wenger, 1998), (3) exploring how particular practices of schooling are implicated in the constitution of teacher and student identities (Walshaw, 2005) and, (4) exploring how meaning is negotiated through the cultural tools (especially language) that operate within school discursive practices (Lerman, 1994). In addition, research with/in a poststructural framework can highlight the importance of a critical mathematics education (Skovsmose & Borba, 2004) by drawing attention to assumptions that remain unquestioned while highlighting possible alternative images of mathematics practices and discourses (Nolan, 2007).

In contrast to research that merely directs attention to the lack of innovative instruction and assessment approaches being used by secondary mathematics pre-service teachers (i.e. a description of *what is happening*), this critical study incorporated a more constructive and feedback-oriented approach to understanding the conditions necessary for pre-service teachers to try such innovative approaches (i.e. an exploration of *what is possible*). In order to better understand what is necessary for new approaches to gain access to, and hopefully change the face of, the mathematics classroom, this study exemplified a progressive intervention into what might otherwise function as traditional mathematics classroom situations.

DESCRIPTION OF STUDY

The aim of the study was to mentor pre-service secondary mathematics teachers as they negotiated transitions from the theories of a university curriculum course to the

practices of the classroom. The question posed in the study was: What happens in a secondary mathematics classroom when pre-service teachers who have been introduced to alternative and innovative instruction and assessment strategies in a university-based curriculum course attempt to realize the strategies in practice? Since this question was explored throughout the pre-service teachers' internship semester, the research study was really about viewing the mathematics classroom as a curriculum laboratory (Vithal, 2000) where these new ideas could be tried under the guidance of experienced cooperating teachers and a mentoring teacher educator.

The research study was designed as a case study to investigate the experiences of three pre-service teachers during their internship in secondary school mathematics classrooms. The study emerged out of a recognized disconnect between the theory of a university-based curriculum course on alternative instruction and assessment and the practical implementation of these ideas in mathematics classrooms. The university curriculum course focused on studying the theory and practice of alternative instruction and assessment strategies such as problem-based learning (PBL), technology-integrated pedagogy, portfolio assessment, journal writing, student interviews, and self-assessment. The strategies clearly represented a paradigm shift in mathematics teaching and learning for the pre-service teachers enrolled in the course. Their perceptions of what it means to know, to teach, and to learn mathematics did not readily enable (let alone encourage) them to integrate these new and different ideas into practice. In fact, as the instructor, I encountered substantial student resistance to the course based in their perceptions of the "reality" of mathematics classrooms, curricula, and students. From my perspective as both a teacher educator and researcher, I sought to design a means to assist pre-service teachers as they negotiated their way through the theory/practice transitions— ways to enable teachers to resist the strong current of tradition once inside the classroom walls. Desirable transitions between theory and practice demand fluid movements between university and school, including a more reflective and mutually supportive relationship between practicing teachers, teacher educators, and pre-service teachers.

THE RESEARCH "PLAN"

Acting in the capacity as both the researcher in this study and the instructor for the university curriculum course, I wanted to make a deliberate effort to re/position the course discussions, assignments, and learnings into secondary mathematics internship classrooms. My main criterion for selection of the case study pre-service teachers was that they were willing to make an effort to incorporate alternative instruction and assessment practices into their internship classroom. The methods chosen to gather data in the study were such that the pre-service teachers' beliefs, concerns, and practices could be brought to light. The "planned" methods included individual interviews with the three pre-service teachers (monthly), focus group discussions with the pre-service teachers and their cooperating teachers (monthly), and maintaining an ongoing reflective artefact in the form of a written journal or a

weblog. By audio-taping and then transcribing the interviews and discussions (and also by keeping a researcher's journal), I sought to identify the challenges or questions encountered by the interns, along with general thoughts and feelings regarding the research conversations. In addition to these formal methods for data collection, my commitment to an on-going mentorship approach meant that I planned to maintain regular contact with the interns throughout the semester through individual conversations (in person, via telephone, and e-mail).

After selecting the three case study pre-service teachers, my "plan" of research included the following sequence of events: (1) meet with each of the pre-service teachers individually to discuss the instructional and assessment strategies they preferred to try in their classroom, (2) work with each of them to create a tentative plan for implementing these strategies into their internship semester, (3) mentor the pre-service teachers along the way to help them with the implementation, and (4) interview them to understand the challenges and successes of the theory-practice transitions they were experiencing. As will be described in the next section of this paper, such research "plans" did not come to fruition for a variety of reasons.

THE RESEARCH "REALITY"

The carefully outlined plan of research described in the previous section can be viewed through a socio-cultural lens itself. As it turned out, the research plan of exploring pre-service teachers' theory-practice transitions had to be modified quite dramatically because of social, political, and cultural factors that came into play while attempting to "realize my research agenda". It is at this point that this paper itself becomes one in transition— branching into two paths of discussion. One path remains focused on the theory-practice transitions of the three secondary mathematics interns, while another path moves the discussion in the direction of the theory-practice transitions experienced by the researcher. The intent of this paper is to briefly describe the topography of these two distinct paths, but each has also been written about in greater detail in separate papers (Nolan, *forthcoming 'a'*; Nolan, *forthcoming 'b'*).

THEORY-PRACTICE TRANSITIONS: FOCUS ON RESEARCHER

It is not unusual for a research process to change, regardless of how carefully the methods and methodologies are considered in advance and contextualized to the question at hand. I expect, however, that researchers seldom write about what they planned to do, but didn't. Writing reflexively about the changes and modifications to the research process is, I believe, more common in postmodern projects where one seeks to highlight the tentative and in-flux nature of research. There are two issues I wish to bring forth and briefly discuss with respect to researcher (and research process) theory-practice transitions (Nolan, *forthcoming 'a'*). It could be said that both of these issues emerged from a naïve notion of the in/visibility of the researcher.

In/visibility: An agenda in disguise

In the first few pages of their book, Brown & Jones (2001) caution postmodern researchers with an emancipatory quest that “[a]ny emancipatory perspective presupposes values which cannot be agreed upon universally or permanently. If we fight for something we are always working against someone else’s interests and there are difficulties in creating a robustly moral perspective that will be seen as better by everyone” (p. 4). My research agenda was naïvely presented from the perspective of a concerned teacher educator trying to learn from her students how to *do things better* in a mathematics curriculum and instruction course. In reality, however, I believe that underlying my research plan was a desire to learn from my students how I could *convince* them that alternative instruction and assessment (as described and modeled in my curriculum and instruction course) IS the way to *do things better*. In a sense, then, my research agenda was disguised as an open exploration of how to improve the teaching and learning of mathematics, while it was really quite closed after all. Brown et al. (2007) would basically agree with this self-critique of my research agenda since these authors “question the efficacy of a research agenda predicated on encouraging teachers to align themselves with a particular model or philosophy of practice” (p. 184) in the name of ‘improvement’. In other words, even though my agenda seemed focused on a goal of expanding their repertoire of instruction and assessment strategies, it seems as if what I *really* wanted (and expected) was for them to buy into the notion that my ideology is better than theirs! Ritchie and Wilson (2000) propose that change will not happen as long as we, as teacher educators, believe we can *do* or *give* something to our pre-service teachers that will ‘emancipate’ them from cultural narratives that tie them to traditional practices and views on knowledge (p. 180).

In/visibility: Stepping back

A second key theory-practice transition of the researcher and research process occurred during the first step of my four-step planned research process (outlined previously). Perhaps I waited too long to implement this first step because, by the time I met with each of the case study pre-service teachers to discuss the instructional and assessment strategies they wanted to implement in their classroom, they had already spent considerable time with their co-operating teachers “learning” about all of the limitations they would experience in the secondary mathematics classroom. They learned, among other things, that they would not be able to experiment much with alternative strategies because the curriculum was too full and time was too short. Hence, my first meeting with the pre-service teachers, with the co-operating teachers at their sides, was one of intense angst for me. I could say very little that would be taken seriously; I could feel their gaze saying to me that my ideas belonged in the ivory tower milieu, where theory resides on the surface and practice falls through the cracks.

During this first meeting with interns and their co-operating teachers, I found myself being very cautious in how I introduced and described the goals of the research project. I prepared myself in advance of the meeting to tread softly and speak quietly about my goals, and to tone down my criticality. I was confident that implementing alternative instruction and assessment strategies would create opportunities for the currently unsuccessful mathematics student to experience and demonstrate mathematics knowledge in diversely legitimate ways. However, when speaking with cooperating teachers and interns, I wanted to be cautious in how I advocated for changes in mathematics teaching and learning. I felt that, ultimately, my open and critical expression of a desire to *change* practice reflects dissatisfaction with *current* practice. How was I to express such a dissatisfaction with current practice without alienating myself and the research project from the practicing teachers and interns? As part of the conversation, one cooperating teacher responded to my call for more student-centred problem solving by saying, “I tried teaching in more constructivist ways where the students try to solve the problems on their own, but the students said they preferred it if I just did an example first and then they could follow it to do more.” I felt strongly that this teacher was *explaining away* the obstacle of student resistance to alternative ways of learning mathematics by claiming that students do not, in fact, learn better through these more participatory approaches and that they prefer the way things are done now (Nolan, 2006). I wanted to express my conviction that students have learned to play the rules of the game over many years and so it is expected that they would resist changing the rules and/or the game without understanding why, but I remained silent. In remaining silent, I know that I took a step back from my research agenda.

THEORY-PRACTICE TRANSITIONS: FOCUS ON SECONDARY MATHEMATICS INTERNS

As discussed in Nolan (*forthcoming 'b'*), the data from two interviews and a focus group session with the case study pre-service teachers was initially read with the intent of understanding the dynamics of transforming university course curriculum theory into mathematics classroom practice and the role these transitions play in shaping one's identity as a mathematics teacher. In doing so, however, issues came to the fore that demanded attention and deconstruction.

Adopting Bourdieu's concept of “dispositional harmonization”, Noyes (2004) defines habitus as “a set of dispositions fashioned in the peculiar social milieu(s) in which they originated but that also, through the outworking of those dispositions, restructure the social space” (p. 246). I refer to the themes constructed out of the data as dis/positions because they have been fashioned out of the classroom culture and student experience but they are, in the words of Bourdieu, “a structuring structure” (Bourdieu, 1984, as cited in Noyes, 2004, p. 246); that is, they are not merely constituted, but they also have the potential to constitute. In other words, I believe that if the pre-service teachers could critically analyze and reflect on these

dis/positions then there would be potential to restructure the space from which they originated. The research “reality”, however, was such that this key step of critical reflection (over such a short period of time) did not occur and so the dis/positions continued to structure the milieu, functioning almost seamlessly as regulative discourses within secondary mathematics classrooms. As Lerman & Zevenbergen (2004) state:

... the regulative discourse, which remains invisible, manifests the criteria by which students are judged as complying or not with the cultural order... It is through the regulative discourse that the instructional discourse gains its internal logic—how the interactions and content are framed, sequenced, and delivered. For any curriculum, including mathematics, the regulative discourse contains ideological elements which are often unknown or unrecognized by the participants. (p. 33)

Through the analysis of interview and focus group transcript data, several dis/positions were identified as regulative discourses operating in the secondary mathematics classrooms of the interns involved in the study. The themes of these dis/positions are: *time* constraints, discomfort with *innovation*, the culture of *tests*, traditional classroom *structures*, student *discipline* and management, and the labelling of mathematics ‘*strength*’. It would be too daunting a task to describe these regulative discourses in this brief paper; they are de/constructed in considerable detail in Nolan (*forthcoming ‘b’*).

EDUCATIONAL SIGNIFICANCE OF STUDY AND FUTURE DIRECTIONS

As mentioned previously, this study arose out of a perceived necessity to design ways to assist pre-service teachers in negotiating the theory-practice transitions in becoming a secondary mathematics teacher. The design and purpose of the study corresponded well with, and responded directly to, ideas and recommendations emerging out of recent research on teacher education and induction:

- deconstruct the myths inherent in perceptions of mathematics and what it means to teach and learn it which are rooted in a belief that *learning* mathematics is about memorizing rules and procedures and so it follows that teaching mathematics is showing how to memorize and execute them effectively and efficiently. As Jaworski & Gellert (2003) remind us: “How mathematics itself is perceived... emerges as central to the way it is taught” (p. 845).
- study the induction and mentoring of novice teachers through educative mentoring by, and joint reflection between, exemplary support teachers, tutors, and teacher educators (Feiman-Nemser, 2001; Jaworski & Gellert, 2003)
- resist describing theory and practice in dichotomous language when it is more valuable to “consider theory and practice... as reflexively connected elements of knowledgeable activity” (Jaworski & Gellert, 2003, p. 832).

This was the theory and purpose of the study; the practice was, indeed, a different story. This paper can be said to be in transition because the study itself is in transition. In one extension of this research initiative, I propose to conduct case studies with pre-service teachers spanning a four-year time period. The study will focus not only on their internship semester (fourth year) but also on their pre-internship semester (third year) and their first two years of teaching. This extension to the study is anticipated to be of significance since recent studies (Muis, 2004) have drawn attention to the fact that few longitudinal studies have been conducted into the potential impact of teacher education on challenging and changing teachers' beliefs and practices regarding reformed practices in the teaching and learning of mathematics.

Additionally, in the spirit of a confession to designing the study as a “my-ideology-is-better-than-yours” approach, it is worth revisiting the nature of a study that jumps to practical solutions without sufficient theoretical explorations of the problem(s). In retrospect, it seems apparent that I designed the study to propose a clear and obvious solution (alternative instruction and assessment strategies) to what seemed to be a very clear and obvious problem: that the “exercise paradigm” (Skovsmose, 2008) currently visible in secondary mathematics classrooms is simply not working to engage students in the learning of mathematics. In other words, the goal of the study was surreptitiously embedded in a move to replace one ideology (viewed by this researcher as ‘the problem’) with another one (viewed as ‘the solution’)—where the ‘solution’ ideology is perhaps just as suspect in the long run as the current ‘problem’ ideology. Brown et al (2007) discuss Althusser’s conviction that believing there could be one ‘consensus’ ideology that works for everyone is the most mistaken ideology of all (p. 187). Hence, a very different extension of this research initiative—an appendage, so to speak— involves stepping back from classroom practice solutions to focus more on theory in/of mathematics teacher education and the study of teacher identity. *AFTERmath Education* (the new study underway) works to reveal and deconstruct the Aporias and Fissures in/for *Teacher Education Research and Mathematics Education*. This theoretical appendage to the body of classroom practice research holds promise for delving into mathematics teacher education from new perspectives— exploring the doubts and cracks in pre-service teachers’ images of what it means to know, to teach, and to learn mathematics, with a goal to understanding more about the cultural and discursive landscapes of schooling that currently work to maintain the power of dominant school traditions and regulative discourses in mathematics classrooms.

REFERENCES

- Bauersfeld, H. (1988). Interaction, construction, and knowledge—Alternative perspectives for mathematics education. In D. A. Grouws & T. J. Cooney (Eds.), *Perspectives on research on effective mathematics teaching: Research agenda for*

- mathematics education* (Vol.1, pp.27-46). Reston, VA: NCTM and Lawrence Erlbaum Associates.
- Brown, T. & Jones, L. (2001). *Action research and postmodernism: Congruence and critique*. Great Britain: Open University Press.
- Brown, T., Hanley, U., Darby, S. & Calder, N. (2007). Teachers' conceptions of learning philosophies: Discussing context and contextualising discussion. *Journal of Mathematics Teacher Education*, 10, 183-200.
- Eames, C. & Bell, B. (2005). Using sociocultural views of learning to investigate the enculturation of students into the scientific community through work placements. *Canadian Journal of Science, Mathematics and Technology Education*, 5(1), 153-169.
- Feiman-Neismer, S. (2001). Helping novices learn to teach: Lessons from an exemplary support teacher. *Journal of Teacher Education*, 52(1), 17-30.
- Goos, M. (2005). A sociocultural analysis of the development of pre-service and beginning teachers' pedagogical identities as users of technology. *Journal of Mathematics Teacher Education*, 8, 35-59.
- Jaworski, B. & Gellert, U. (2003). Educating new mathematics teachers: Integrating theory and practice, and the roles of practicing teachers. In A. Bishop, M.A. Clements, C. Keitel, J. Kilpatrick, & F. K. S. Leung (Eds.), *Second International Handbook of Mathematics Education (Part Two)* (pp. 829-875). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Kaartinen, S. (2003). Learning to participate—participating to learn in science and mathematics classrooms. Unpublished doctoral dissertation, University of Oulu, Oulu, Finland.
- Lerman, S. (2005). *Learning as developing identity in the mathematics classroom*. Plenary lecture at the 27th Annual Meeting of the Canadian Mathematics Education Study Group (CMESG), Ottawa, ON, 27-31 May 2005.
- Lerman, S. (1994). Changing focus in the mathematics classroom. In S. Lerman (Ed.), *Cultural perspectives on the mathematics classroom* (pp. 191-213). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Lerman, S. & Zevenbergen, R. (2004). The socio-political context of the mathematics classroom: Using Bernstein's theoretical framework to understand classroom communication. In P. Valero & R. Zevenbergen (Eds.), *Researching the socio-political dimensions of mathematics education: Issues of power in theory and methodology* (pp. 27-42). The Netherlands: Kluwer Academic Publishers Group.
- Muis, K.R. (2004). Personal epistemology and mathematics: A critical review and synthesis of research. *Review of Educational Research*, 74(3), 317-377.

- Nolan, K. (2007). *How should I know? Preservice teachers' images of knowing (by heart) in mathematics and science*. The Netherlands: SensePublishers.
- Nolan, K. (2006). Math teaching becomes you: The challenges of placing identity formation at the centre of mathematics pre-service teacher education. In *Proceedings of the 30th Annual Meeting of the Psychology of Mathematics Education (PME-30) Group*, Prague, CZ, 16-21 July 2006.
- Nolan, K. (forthcoming 'a'). Inside voices: A mathematics teacher educator's journey into the unsaid and the undone.
- Nolan, K. (forthcoming 'b'). "For the sake of time" and other stories to teach by: Dis/positioning regulative discourses in secondary mathematics teacher education.
- Noyes, A. (2004). (Re)producing mathematics educators: A sociological perspective. *Teaching Education*, 15(3), 243-256.
- Ritchie, J.S. & Wilson, D.E. (2000). *Teacher narrative as critical inquiry: Rewriting the script*. New York: Teachers College Press.
- Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher*, 34(4), 14-22.
- Skovsmose, O. (2008). Mathematics education in a knowledge market: Developing functional and critical competencies. In E. de Freitas & K. Nolan (Eds.), *Opening the research text: Critical insights and in(ter)ventions into mathematics education* (pp. 159-174). New York: Springer.
- Skovsmose, O. & Borba, M. (2004). Research methodology and critical mathematics education. In P. Valero & R. Zevenbergen (Eds.), *Researching the socio-political dimensions of mathematics education: Issues of power in theory and methodology* (207-226). Boston, MA: Kluwer Academic Publishers.
- Vithal, R. (2000). Re-searching mathematics education from a critical perspective. Paper presented at the Biennial International Conference on Mathematics Education and Society, Montechoro, Portugal, 26-31 March, 2000.
- Walshaw, M. (2005). Pre-service mathematics teaching in the context of schools: An exploration into the constitution of identity. *Journal of Mathematics Teacher Education*, 7, 63-86.
- Wenger, E (1998). *Communities of practice: learning, meaning, and identity*. New York: Cambridge University Press.