

Preservice Teacher Education in Mathematics: Thinking Innovatively About Innovation.

Mary Klein

James Cook University
<mary.klein@jcu.edu.au>

Australia's Teachers: Australia's Future (DEST, 2003) highlights the increasing demands on the education system to train, inspire and retain outstanding teachers of mathematics. Such teachers, it is stated adopt “innovative approaches” to teaching while developing in students “the capacity to be innovative” (p. 6). However, the document itself is far from innovative in its views of *how* this ideal is likely to be realised. In this paper I adopt a poststructuralist view that the prospective teacher’s capacity to act in innovative ways, though based on knowledge, skills and attitude, is (im)mobilised through how s/he is, and has been, positioned in teaching/learning interactions and relationships in teacher education and schools. Discursive relationships shape professional and mathematical identities and abilities though they are not mentioned in the DEST (2003) document.

Australia's Teachers: Australia's Future (DEST, 2003, p. 217) makes clear the educational climate or culture it is seeking in schools; it is one where students “learn how to learn, to develop thinking skills and other metacognitive strategies, to learn in teams, to cope with ambiguous situations and unpredictable problems, to communicate well in speech and not just in writing and to become creative, innovative and entrepreneurial”. While the document recognises that the changes in pedagogical practice such learning implies signify a transformation rather than an incremental change in teachers’ practice, it does not engage seriously enough with the question of how this change will be realised. Like many policy documents, *Australia's Teachers: Australia's Future* (2003) relies on dated notions of teachers and teaching to convey an unwarranted certainty that the desired changes are well within reach. Simultaneously, it places the onus for change squarely on the shoulders of teachers and teacher educators.

The document invokes humanist notions of rational autonomous teachers (teacher educators and preservice teachers) able to reflect on practice and implement innovative classroom cultures. It relies on the psychological individual, who “understands” new teaching practices and is socialised into novel educational cultures through participation in teacher education programs and schools (DEST, 2003, p. 131). As well, a-critical notions of the efficacy of collaboration, learning partnerships and time spent in schools oversimplify the often arduous and difficult journeys of preservice teachers struggling to establish themselves as competent and innovative teachers of mathematics in balkanised university and school classrooms. In this paper I argue that new conceptions of teachers, teaching and a revitalised teacher education are needed to ground mathematics education in and for the twenty-first century. As Luke, Luke and Mayer (2000, p. 11) state: “Remaking the teacher and the school and redesigning teacher education for new times go hand in hand”. Though remaking is necessary, it is not expected to be easily won because those on whose shoulders it ultimately rests have established themselves as legitimate policy makers and educational authorities within traditional educational structures, leaning more towards conservatism and conformity than informed generational change.

Notion of the Teacher as Instrument

Throughout *Australia's Teachers: Australia's Future* (2003) humanist, psychological notions of teachers and students prevail. St Pierre (2000, p. 500) states: "The individual of humanism is a conscious, knowing, autonomous, and ahistoric individual who is 'endowed with a will, a freedom, an intentionality which is then subsequently expressed in language, in action, in the public domain'. The humanist individual can observe and reflect rationally on the outside world, and has the power to bring about change. In the DEST (2003) document, it is taken for granted that teachers will understand and reflect rationally on the proposed changes and do their best to implement them. For example, teacher education must ensure "that all students [preservice teachers] improve their broad understanding of the forces of change in Australian society and the importance of science, mathematics and technology in underpinning the knowledge economy and society" (DEST, 2003, p. 145). It is assumed that understanding policy leads to compliant action, rendering invisible the numerous social, emotional and intellectual factors that intersect to affect teachers' practice. Indeed, in the above document the teacher is represented as almost robotic needing "a trained capacity to teach the science, mathematics and technology components of the primary school curriculum..." (DEST, 2003, p. 145). The word "train/ed/ing" pops up intermittently and the implications take mathematics teacher education back many years to when learning mathematics was about recall and procedure.

Unfortunately it does mathematics educators and the whole educational enterprise a great disservice to think of teachers in this way. Teachers will not be led by the nose in directions they have no desire to go; they have strong investments in teaching 'well', but this is as they have personally constructed it, after many years in the classroom as a student, student teacher and teacher. They do understand policy, but its implementation may be ignored or a pretence, depending on how well it meshes with what their own experiences have taught them about how children learn and their needs. Luke (2003) for example states:

Teachers are artists at resisting, undermining and ignoring policy. For their part, many policy makers know that teachers ignore central office, disregard curriculum reforms, and devote substantial work to getting around policy. (p. 59)

While many taking a humanist perspective could assert that teachers are just being obstinate, an alternative reading could be that asserted by Janks (2002, p. 32) that "identification holds reason hostage". Teachers, and preservice teachers, often *identify with* traditional ways of being a teacher of mathematics, unintentionally reinforced in teacher education, that militate against the implementation of policy and intellectually rich and innovative teaching/learning cultures in schools (Klein, 2002).

Notion of Teaching and Teacher Education as Instrumental

In *Australia's Teachers: Australia's Future* teaching is defined as "a complex, sophisticated task requiring a high level of skill and training" (DEST, 2003, p. 102). The overriding need "is for teacher education students to develop greater practical skills for the classroom environment (p. 131)...and, as an afterthought, it is stated "there must be more serious effort directed at ensuring teachers are properly prepared to teach Indigenous students" (DEST, 2003, p. 133). Teaching is seen as instrumental, as something done to students, and again it is assumed that there is a linear translation between skills taught, 'proper' preparation and classroom (social) practice. This discursive construction of teaching is convenient though dangerous; it is convenient for policy makers in making

change sound easily achievable and yet dangerous in that it trivialises the role of the teacher and the task facing teacher education and schools. First, it constructs the mathematics teacher as a technician and teacher technicians are meant to search for and find the ‘best’ techniques for teaching mathematics, ignoring the socially, ideologically and politically charged nature of these techniques. It is as if teaching could be equated to instructional practice, determined through research and transferred to the classroom. However, this raises the perplexing question of how it might be that teacher technicians could hope to foster innovative and entrepreneurial thought and action in those they teach; how could it be that while they themselves are compliant and accommodating to what others demand of them, that they could work with their students in ways that celebrate diversity, difference and generative participation? Teacher technicians (in schools and universities) and their instructional strategies are unlikely to make available to students the physical, emotional and intellectual spaces needed to fashion critically reflective mathematics teachers and citizens of a postmodern world.

A second problem is that it is teacher education that is charged with the task of ensuring that the stipulated outcomes are realised: “teacher education...is critical in any moves aimed at increasing the proportion of young people studying science, technology and mathematics and acquiring competence in other fields of high knowledge intensity and application” (DEST, p. 129). Teacher education is seen as an instrument or tool; to ensure “an appropriate knowledge, skills, values and attitude base” (p. 127) and to “convey good teaching practice” (p. 131). Again there is the assumption that the preservice teachers’ capacity for innovative practice follows easily from knowledge and skills developed in teacher education; for example, DEST (2003, p. 163) states: “Building the capacity of teachers to foster a culture of innovation and support students’ innovative learning capacities involves a range of knowledge, skills and attributes...”. However, there is now an extensive literature (O’Brien & Schillaci, 2002) that shows the over-simplification of this assumption; research demonstrates that learning to teach in ways that authorise student initiated inquiry and entrepreneurship is a much more confused and complex process. It is not easy for preservice teachers (nor teacher educators) to abandon the authoritative teacher-centred communication styles through which they have been constituted, and which, if taken to excess, build a culture of dependency and inhibit innovative participation on the learners’ part. In the following sections of this paper, from a poststructuralist perspective, I argue that new notions of teachers, teaching and teacher education are needed to ground pedagogical practice in teacher education in and for the new millennium.

The Professional Self: Contingent Upon Discourse

A difficult and contentious first challenge to be faced in teacher education is that preservice teachers (and teacher educators) have been constituted through relations of power in normalising practices (discursive practices) in school mathematics that essentialise and categorise according to humanist interpretations of ability and socio-cultural status. They have come to know that there are those who can do mathematics, and those who can’t, often categorized along gendered and cultured lines. For example, psychological discourses that inform classroom practice take for granted that there are motivated/unmotivated learners and management discourses speak of the well behaved/poorly behaved students. It is as if students have essential qualities that define them, that are unchangeable and indicative of their ‘proper’ positioning on the positive or negative side of the binary. This constituted *knowing* (Lather, 1991) about the nature of learners, and the interactional protocols appropriate to learners positioned on either side of

the binary, anonymously influence the preservice teachers' classroom practice. Ultimately, if learners are essentially good or bad, motivated or not, why would one change one's pedagogical practice to better accommodate their learning needs?

Normalising discourses (student/teacher; expert/novice) also frame preservice mathematics education and valorise 'experience' as if "learning to teach is a linear process in which a novice student becomes a teacher through the function of unproblematic experience" (Youngblood Jackson, 2001, p. 386). However, 'experience', whether on campus, or in schools, is never unproblematic and can have positive or negative effects on developing professional identities. To the extent that teacher education "remains a bastion of traditional pedagogical practices" (Luke et al., 2000, p. 10), old authority relations prevail. Preservice teachers depend on their lecturers, school-based teacher educators, booklets of readings and texts to make available to them the selective skills and knowledge said to be needed to make them recognisable as teachers of mathematics. In schools they are often expected (Youngblood Jackson, 2001) to 'model' themselves on the school based teacher educator, establishing themselves as apprentices to the knowledgeable and 'experienced' teachers. However, as Luke et al. (2000, p. 9) make clear, such practices "are geared not so much toward the creation of a 'generative' teacher for new ecologies and technologies, but more towards the representation and reproduction of particular historical models of 'good teaching', as culturally generalisable and as universally practical".

A poststructuralist epistemological position recognises how preservice teachers, as they construct mathematical knowledge, are simultaneously constituted through how they are positioned in the intersecting discourses of teacher education. Although these 'discourses', as a noun, centre on new types of learning, new partnerships and collaborations and innovative practice in schools, the discursive 'practices' of teacher education can act conservatively in funnelling thought and action towards what is constructed as 'best practice'. Walkerdine (1990, cited in St Pierre, 2000, p. 503) explains that "inherent in the discursive positionings are different positions of power. Individuals, constituted as subjects and objects within a particular framework, are produced by that process into relations of power. An individual can become powerful or powerless depending on the terms in which her/his subjectivity is constituted". Preservice teachers, who throughout their time in teacher education are consistently positioned on the 'novice' side of the expert/novice binary, probably do not have the opportunity to recognise themselves as competent and generative teachers of mathematics, they begin teaching on shaky ground, and often leave the profession soon after. Novice teachers can only 'be' in the classroom as the intersecting discourses of their lives, including teacher education, have made possible; they are not the sole architects of their professional identities which are more so the effects of cultural practice and positioning within discourse.

Encouraging Preservice Teachers to Think and Act 'Outside the Square'

Humanist discourses currently framing practice in teacher education and the production of documents such as *Australia's Teachers: Australia's Future* (2003) conveniently accept that "agency is, by definition, a feature of each sane, adult human being" (Davies, 1991, p. 42). There is an assumption that preservice teachers, given a comprehensive knowledge base, will establish themselves as knowable, recognisable teachers of mathematics who 'speak for themselves' and accept responsibility for their actions (adapted from Davies, 1991). It is imagined that as long as they are 'given' the necessary knowledge and skills they will confidently establish a learning culture of "continuous innovation" (DEST, 2003). However, poststructuralist theories are much more circumspect. Transformative

practices towards more inquiry oriented and investigative cultures of learning, both in teacher education and schools, need to be ‘lived’ to ground new practice. Pedagogical practice in mathematics education needs to make available to students more than the intellectual and pedagogical knowledge and skills of teaching; it must include spaces and support for them to develop the authority/agency to find themselves able to interact with learners, teaching colleagues and members of the community in more flexible, generative and inclusive ways. A large amount of work has to be expended in teacher education on this front, as authority/agency to teach or interact with students in innovative ways depends on:

- The discursive constitution of the preservice teacher as author of his/her own multiple meanings and desires regarding the teaching of mathematics (though only as these have been taken up as one’s own, within the discursive practices of school and university, and community based events).
- The discursive constitution of the prospective teacher of mathematics as having presence (rather than absence) as a novice teaching professional, that is as having access to a subject position in which s/he has the right to speak and be heard.
- The discursive constitution of the preservice teacher as having a sense of her/himself as one who can go beyond the given meanings in any one discourse and forge something new, through ...imagining not what *is*, but what might be.

(The above writing on agency is informed by, and adapted from, Davies, 1991).

Professional Identity: an Invention

The discursive practices of teacher education could be renewed to situate the teacher in process in learning situations where s/he is able to achieve authorship or authority in knowledge construction. The preservice teacher could be positioned as one who may or may not know curriculum content and pedagogical strategies, but who can find out; as one who is different from every other teacher, who has special (constituted) qualities and abilities that are dynamic and changing from day to day. Often competent in digital literacies and multiliteracies, preservice teachers will flourish in discursive contexts that encourage them to chart their learning-to-teach-mathematics journey in novel ways, for example, in e-portfolios constructed throughout their program of study. In celebrating the different learning paths, the wrong turns and unexpected delights, “prospective teachers learn that a teacher’s identity is an invention, a constant social negotiation among discourses” (Phelan, 1996, p. 344).

The second issue related to agency for preservice teachers, second bullet point above, has to do with power; it questions the power of traditional teacher education programs to strip students of the right to speak and be heard on matters pertaining to their own education (of course students do speak when given the opportunity, though they are rarely heard due to the inflexible, pre-determined structures of teacher education). Since levels and quality of participation are constitutive of developing professional identities, it is important that a culture of inquiry, dialogue and potential frames teacher education, rather than the transmission of knowledge and deficit talk. As an understatement, DEST (2003, p. 131) suggests “A key challenge for teacher education is to change students’ understanding of new approaches to teaching when they have themselves been taught in schools by more traditional methods (chalk and talk, rote learning, transmission approaches)”. However, it is not a matter of changing understanding (alone), but rather of engaging preservice teachers in a learning culture where rigorous and relevant learning happens, where who they are and what they can contribute is valued and where teacher educators at school and

university sites, listen and learn as much as the students. Perhaps the gradual implementation of ICTs into the university and school classroom will assist in the realisation of this learning culture.

It is interesting and challenging to contemplate just what a culture of inquiry, dialogue and potential might look like in teacher education. Certainly, from an educators' perspective, the first concern must be for the preservice teachers' learning of mathematics and how to teach it. Initial thoughts turn to 'constructivist' forms of practice which value students' active engagement, voices and points of view, just the right amount of challenge, relevance, dealing with 'big ideas' rather than disparate bits of information and assessment as an inherent part of learning (Brooks & Grennon, 1999). However, from a poststructuralist understanding of mind/body as inseparable, caution is needed. Primary and early childhood teachers, in particular, have often had 'bad' experiences of learning mathematics in school, they find it irrelevant and they are not motivated to construct the mathematical knowledge they do not have (Klein, 2002). Further research is needed on innovative pedagogies in teacher education programs that may be less stressful and alienating for those students poor at mathematics; somehow these students too, who one day will be teachers, must come to know the power and regularity of mathematics in ways that they find engaging and rewarding. This is a very serious issue for teacher education and the future of mathematics education in schools; those prospective teachers who exit university still not finding mathematics as a social practice rewarding will, I imagine, inevitably reach for the textbook when teaching (or not teach mathematics at all). The point I want to make here is that if through innovative, inquiry-based pedagogies in teacher education preservice teachers could be 'switched back on' to mathematics, perhaps they would be motivated enough to learn the necessary concepts as they progress as teaching professionals.

Forging Something New...

From a poststructuralist perspective, the quality of the pedagogic process or learning journey is enormously important. Traditionally it has been important primarily because of the pedagogic and intellectual knowledge and skills constructed, but more recently also because of its constitutive force, and how it moulds and shapes ways of being a teacher and learner of mathematics in New Times. The pedagogical changes hoped for in the DEST (2003) document require more than changes in teachers' skills and knowledge, though these changes, especially in the areas of mathematics, are important. Teachers at all levels are confronted with new understandings of what it means to teach, indeed to educate, in the new millennium. In the above sections of this paper I have argued that if novice teachers are expected to be able to act in innovative ways, to think and act 'outside the square', then spaces have to be made for them to invent themselves as teacher/learners in these particular ways in teacher education.

However, there remains a worrying problem in that teachers can act in innovative ways, for example, as suggested in *Australia's Teachers: Australia's Future* (2003, p. 131) they may see themselves as learning facilitators, as fostering inquiry and problem-based learning, as collaborative reflective practitioners yet operate in totally teacher-centred and didactic ways. This happens when teachers hold on tenaciously to notions of knowledge as absolute (the children have to know these facts, skills and procedures in mathematics) and they see learners in humanist terms as essentially motivated/not motivated, clever/dull, Anglo/Indigenous. So, for example, problem based learning can mean getting to the 'truth' of the matter as efficiently as possible, the teacher not recognizing how non-participation

by part of the class tarnishes and restricts their learning experience. At the heart of this centuries-old problem is 'deficit' thought and talk, that comforting refuge of pedagogues unwilling (perhaps they are more or less *unable* to change, as they view their students in essentialist terms, good/bad for example) to change how they interact and work with children. Luke (2003) explains deficit talk:

Everybody is deficit: kids are empty vessels, they're watching too much TV, they can't speak English properly, their parents don't parent, nobody reads to their kids. The language of deficit is proliferating in staffrooms right across the country as we face the effects of the new poverty, of culturally diverse populations where previously we dealt with homogeneous ones. (p. 79)

Of course we were never dealing with homogenous populations even though we may have thought we were. Within teacher education discursive spaces need to be made for the preservice teachers to recognise this through naming the educational, cultural and biographical discourses that have shaped them; they need to recall the discursive practices of the mathematics classrooms in which they grew up, how these practices supported or suppressed their learning and their sense of themselves as competent and confident numerate persons. From the different stories the preservice teachers tell, of how they were positioned in the classroom and the effects on developing identities, they will realise how identity is shaped or constituted in discourse, and how malleable and changeable identity can be. Throughout the program they should celebrate difference, difference not as something to be controlled or 'handled' by the teacher, but difference as potential to interact in new and exciting ways with learners and other teachers.

Conclusion

To me, the inherent worth of poststructuralist theorising is its interruption of taken-for-granted notions of rational, autonomous individuals able to understand the importance of, in this case, innovative classroom practice in mathematics, and act on this understanding. In making the agency to act innovatively or 'outside the square' problematic, given that everything we do is discursively constituted, poststructuralist thought forces educators and researchers to attend to the social as well as the intellectual quality of teaching/learning interactions and relationships. This analysis of *Australia's Teachers: Australia's Future* (2003) is offered not to expose a hidden truth that will solve all pressing educational problems associated with the teaching and learning of mathematics, but rather, as Rose (1999) puts it:

It is to reveal the historicity and the contingency of the truths that have come to define the limits of our contemporary ways of understanding ourselves, individually and collectively, and the programmes and procedures assembled to govern ourselves. By doing so, it is able to disturb and destabilise these regimes, to identify some of the weak points and lines of fracture in our present where thought might insert itself in order to make a difference. (pp. 276-77)

As mathematics educators and researchers of a new millennium we must continue to be vigilant in our advocacy of teachers, preservice teachers and mathematics education; but more than this, confronted with policy documents such as *Australia's Teachers: Australia's Future* (2003) we must act courageously to uphold the integrity of mathematics as a field of inquiry and to think much more deeply and innovatively about where and how the capacity to be innovative is generated and mobilised.

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