

Numeracy for Preservice Teachers: Focusing on the Mathematics and its Discursive Powers in Teacher Education

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To be considered numerate beyond 2 000 preservice teachers need to know more than some basic mathematical concepts and skills; they need to know and value the mathematics and know themselves to be competent and agentic in its articulation. Teacher education programs attempt to realise these ideals but are hampered by what I consider to be untenable assumptions regarding agency for preservice teachers; that rational reflection leads to progressive change, and that knowledge is power. These assumptions are based on humanist versions of a person where agency is taken to be a feature of any adult, human being. In this paper I argue rather for a poststructuralist understanding of preservice teachers as discursively constituted through power relations, both in schools and in tertiary education, where agency, or the lack of it, lies in the constitutive power of discourse. I explore what this might mean for mathematics teacher education beyond 2 000.

It has become quite commonplace for mathematics teacher educators and researchers to bemoan the appalling lack of mathematical knowledge and skills, and poor attitudes, of students entering teacher education programs (Carroll, 1998; Clarkson, 1998; Department of Employment, Education and Training, 1989). This is exacerbated by the fact that the preservice teachers do in fact know a lot about what mathematics is and how it should be taught that is not thought to be useful considering the more investigative or inquiry based teaching methods deemed appropriate in a postmodern world (Foss & Kleinsasser, 1996). While I appreciate and accept all that this research has to offer in making clear some of the parameters within which teacher educators work, the time now seems right to make use of this data in as positive a manner as possible to perhaps improve the effectiveness of teacher education programs, which have in the past been shown to have little effect on preservice teachers' beliefs and practices (Foss and Kleinsasser, 1996; Raymond, 1997). In this paper I argue that a view of agency for preservice teachers as discursively constituted, rather than as unproblematically flowing from (re)constructed knowledge and critical reflection, might facilitate an easing of, and perhaps even an eventual moving beyond, a rather serious case of institutional cramp currently thwarting everyone's best efforts in teacher education.

The *Discipline Review of Teacher Education in Mathematics and Science* (DEET, 1989) encapsulates the key theoretical framing and assumptions of contemporary practice in teacher education; that active individuals having constructed knowledge through rational and critical reflection in supportive contexts will unproblematically implement this knowledge when teaching. Throughout this paper I argue that this thesis is based on traditional, though untenable, assumptions regarding the nature of knowledge and the human subject; as well, it ignores the power relations that inhere in all learning encounters, and their constitutive force. It may be that as teacher educators attempt to teach preservice teachers the mathematical concepts, ideas and relationships not properly understood in school, and the various theories their students will need to inform classroom teaching, that they unintentionally reproduce entrenched notions of the unquestionable authority of the teacher/lecturer and of mathematics as a difficult and confusing subject. My concern is that traditional power relations may endure which (re)form at least in part, the teachers of the future.

The Humanist or Discursively Produced Subject?

Humanist discourses suggest that any adult, sane individual *has* identity. This identity is unified, rational and coherent. The use of language is seen to be transparent and used by individuals to describe and analyse the real world and make choices based on rational thought. Through a process of socialisation an individual internalises norms and values and ways of operating which become an integral part of that individual. Currently, most teaching and teacher education programs are founded on these particular notions of the learner. In poststructuralist theory, which is developed in large part in contrast to humanist understandings of the individual, the person is the effect of a production, produced in power relations in many overlapping and intersecting discourses throughout life. The experience of being a person is captured in the notion of subjectivity (Davies, 1991). Subjectivity is constituted in discourses and is not under rational nor conscious control; it is contradictory in that one discourse that contradicts another does not undo one's constitution according to the first discourse. Rather, as Davies (1996, p. 17) makes clear, all discourses through which one is constituted leave lingering legacies, desires, that are not easily erased or replaced:

Old discourses exist amongst/with the new. Ways of knowing and desiring overlay each other, bump into each other, inform each other. Like the palimpsest of writings on an old parchment, where the old was partially rubbed out and the new overlaid on the old, the old can still be seen, and shapes, at least in part, how we see the new.

Preservice teachers, and teacher educators for that matter, have constituted subjectivities and desires that have been formed in discourses of parenting, child care, health and safety, classroom management, school mathematics, child development and teacher professionalism, to name just a few, that inform pedagogical practice. Constituted subjectivities are fragmentary, malleable and changing, in contrast to the knowable identity of humanist understandings of the individual; in this case there is no essential rational self to which teacher educators, curriculum planners and policy writers can appeal.

Central, too, to poststructuralist theorisations of the individual is the interesting notion of desire. Desires are *imagined possibilities*, signifying pleasurable and rewarding states of being within a discourse. Davies (1991, p. 43) states that: "Desires are integral to the various discourses through which each person is constituted and are not necessarily amenable to change through rational analysis". In teacher education, it may be that preservice teachers choose a certain course of action based on what they consider to be rational analysis, though in the end, in the classroom, this may be subverted by constituted desire. For example, a preservice teacher may write or speak of the importance of collaboration and group work in learning mathematics though, in practice, may defer to constituted desires to care and nurture, and possibly control children, and end up implementing classroom practices where the students sit at individual desks so that s/he can keep tabs on what each child is doing and make sure all are constantly engaged. Schuck (1999) reports that her students' desires to give the children they teach a different experience of mathematics from that they had in school, and their desire to show empathy and have fun with children, obviate their teaching mathematics competently. I see it as a matter of some regret that preservice teachers have desires to foster a certain kind of nurturing relationship with children though many of them appear not to have the desire to share with children the wonder and power of mathematics as a field of study.

In poststructuralist theory all knowledge is discursively constituted; thus both *what* is taught in teacher education programs and *how* it is taught matter enormously as each is co-constitutive of the lives and future teaching practices of preservice teachers. Though a

poststructuralist notion of knowledge construction can tell us little about the physiological cognitive processes that comprise mathematical construction, it can, through the concepts of constituted subjectivity and agency, inform our pedagogical endeavours. Future teachers need to be competent and agentic in the classroom and, since agency lies in the room for movement that arises when discourses collide and contradict each other, there is much that might be attempted in preservice teacher education and in teacher development programs.

Preservice Teachers

As previously mentioned, there is a more or less general acceptance of the fact that preservice teachers, especially those in primary and early childhood programs, have serious gaps in their knowledge of mathematical ideas, patterns and relationships (DEET, 1989). However, a research literature is developing which demonstrates that these students do indeed come to preservice teacher education with an extensive pedagogical knowledge. However, as Crawford and Deer (1993, p. 119) note this unquestioned social knowledge leads to resistance to change and state: "It seems to us that one reason for the glacial rates of change in educational practice is that *everybody* knows what teachers do and *everybody* knows about learning in school". Schuck (1996), too, reveals that most of her students in preservice teacher education see the role of the teacher as revolving around telling facts, providing demonstrations and explanations, and checking exercises for correctness. Foss and Kleinsasser (1996) add the sobering rider that these constituted beliefs are not greatly affected by teacher education programs and preservice teachers may not reconceptualise their roles as future teachers of mathematics. One reason for this might be that teacher educators subscribe to overly optimistic notions of agency; that the ability to know, and implement, an alternative mathematics flows unproblematically from rational, reflective thought and knowledge (re)construction.

In keeping with recommendations made in the *Discipline Review* (DEET, 1989) teacher educators have tended to see their role as, in part at least, turning around the lack of mathematical knowledge, poor attitudes and beliefs about mathematics so that their students will be better equipped to teach a mathematics appropriate to a largely unknown future. Emphasis is placed on getting students actively involved in revisiting mathematical concepts and on critical reflection around challenging and confrontational dilemmas in teaching which will hopefully facilitate a (re)construction of prior and present beliefs. Crawford and Deer (1993, p. 119), for example, state that preservice teachers "need to unlearn old beliefs and attitudes before they can begin the process of learning to put theory into practice". This reflective approach may also centre on issues of class/race/gender discrimination and the hope that preservice teachers will become more culturally aware and that this will positively influence their later teaching practice. These practices reflect the belief that rational collaborative analysis and reflection will lead to progressive change in teaching later. However, Brodkey (1992) reminds us that critical reflection has no negotiable currency beyond itself; preservice teachers do not necessarily teach according to what they have deemed to be important in teacher education programs (Foss & Kleinsasser, 1996; Raymond, 1997).

After all, who are these students and mathematics educators who inhabit and give life to the discursive regime in teacher education? Are they rational, primarily cognitive individuals who can and will freely choose to teach according to theories and policies presented and reflectively critiqued in lectures and tutorials? Or are they the constituted subjects of poststructuralist theory, for whom their knowing about mathematics and how it operates is not merely cognitive and rational, but is visceral, emotional and often unconscious? Lather (1991) tells us that in our action is our *knowing*; here she refers to all that we have become, all that

we know and know ourselves to be through our total experiences of living life thus far. Much of it has to do with past positioning within power/knowledge relationships and is beyond the bounds of cognitive (re)construction. Thus preservice teachers may cognitively accept that it would be good if, for example, learners of mathematics were able to actively construct their own knowledge, though in practice later may defer to deeper, constituted (and constituting) knowledges that unconsciously inform them of what is doable/pleasurable/authoritative in a particular schooling site. A preservice teacher (cited in Tillema and Knol, 1997, p. 31) talks about the power that past constitutive experiences have to influence her future practice:

My own experiences are important to me, no matter what I learn here. They are the ones that have left a deep mark. I remember a very nice female teacher who treated us to sweets when we learned a lesson well and a male teacher who could tell exciting stories in history class. I would like to be that way; it gives you a comfortable feeling to try to be that way because you know it worked out so well when you were there.

Although the preservice teacher might readily agree that there is more to history than exciting stories and that one should not need to be rewarded with sweets for learning, this rational, cognitive analysis is forgotten in the face of constituted desire to be a certain type of teacher. If allowed, poststructuralism can tell of the power of constituted subjectivity and desire over human rationality and reason.

Does Knowledge bring Power?

Over the past decade or so mathematics education programs have been influenced by *constructivist* notions of the importance of the active construction of knowledge (DEET, 1989). Framing the suggestion that powerful knowledge can be constructed through active engagement is the idea that such personally constructed individual knowledge is sound and durable and can be applied in diverse contexts. Ernest (1994, p. 1) states:

What the various forms of constructivism all share is the metaphor of carpentry, architecture or construction work. This is about the building up of structures from pre-existing pieces, possibly specially shaped for the task. The metaphor describes understanding as the building of mental structures ...

Although the social or collaborative construction of knowledge has been emphasised by Ernest (1994) and others, an underlying social-psychological understanding of the learner takes for granted a rational and autonomous individual constructing this knowledge. I have already argued that this formulation of the individual learner is untenable in that what one knows has intellectual (mathematical) and social (subjectivity) aspects that together may or may not have empowering potential. A poststructuralist understanding of the individual is that the *social*, including the effects of power relations, is *in* the person not cognitively internalised as in humanist conceptions. Where teachers and teacher educators ignore the fact that learning mathematics involves participating in a social world where established ways of reasoning and acting are not neutral and set conditions on learning, they are able to defer to notions of individual pathology or lack to explain why appropriate cognitive constructions do not occur, especially in the case of minorities, women and the poor.

A poststructuralist view of the social/discursive construction of knowledge recognises that as students construct mathematical knowledge, they are simultaneously themselves produced as capable numerate agents, or not. Significantly for preservice teachers many of them will have passed the set examinations in school, yet they may ultimately doubt themselves and their ability to teach mathematics well. That is, they know the mathematics but know themselves to be unable to teach it to others (Ball, 1990). This may be because in order to compete successfully in the discourse of school mathematics they had to abandon or place on hold their already constituted and embodied self, which “while pleasurable because of the illusion of mastery that it brings, is also painful, a denial of the self” (Walkerdine, in Paechter,

1998, p. 66). I am referring here to instances where students engage with mathematical content, complete the exercises and pass the exams though their desires to make sense of lived experience are not met. In mathematics methods subjects, too, a similar situation may arise; students are eager to pass exams with high marks so the opinions they express and the views they hold of what the lecturers are presenting to them will always be influenced by power/knowledge relations. For example, in examinations the preservice teachers are not likely to extol the virtues of the *basic facts* and *sums* if all semester the lecturer has concentrated on investigatory and inquiry approaches to teaching patterns and relationships in mathematics. Thus agency for preservice teachers is quite illusory even in teacher education, especially where lecturers remain blind to relationships of power influencing all that they, and their students, do and say. As Freire has endlessly reminded us, and does so again in the following quote (cited in Price & Ball, 1998, p. 263), the effects of power relations in pedagogy must be acknowledged:

When teachers call themselves facilitators and not teachers, they become involved in a distortion of reality. To begin with, in de-emphasising the teacher's power by claiming to be a facilitator, one is being less than truthful to the extent that the teacher turned facilitator maintains the power institutionally created in the position. That is, while facilitators may veil their power, at any moment they can exercise power as they wish.

Numeracy for Preservice Teachers

Doing mathematics in school or in the wider community can no longer be seen to be learning and applying disparate facts, skills and procedures in a specific context; doing mathematics in a postmodern era is a social practice, in which numerate behaviours are produced and/or suppressed (Walkerdine, 1988). Numeracy reflects the agency one has with/in the mathematical discourse in a context; *with* the content and *in* the discursive power/knowledge relations. Numeracy is not a gift, a thing or an attribute of a person, it is discursively constituted, fleeting, transitory and contextual. Many of the preservice teachers currently entering teacher education consider themselves numerate in that they have passed their final exams at school; however, it may be that successful performance in traditional mathematics classes mainly derived from memorising formula and performing procedures (Ball, 1990). The constitutive powers of school mathematics have taught them that mathematics comprises disparate and unconnected facts and skills and that teaching involves mainly transmission. They have not come to know mathematics as a social practice where powerful mathematical ideas and structures are used in various social contexts for individual and social betterment; nor have they come to know themselves as agentic, confident users of its powerful ideas. Many of them are not well placed to value and implement investigative pedagogies leading to the construction of mathematical knowledge and inquiring habits of mind appropriate to teachers, learners and workers in the new millennium.

When teacher educators, myself included, engage in talk and writing along the lines of "they just don't know the mathematics", or "they have poor attitudes and/or lack confidence" we are designating a perceived student lack that we then attempt to remedy in our programs. We imagine that agency lies in teachable attitudes and skills and that we can give the students the necessary knowledge, as power, to go out there and teach well. If however, we imagine that agency lies in the constitutive power of discourse, or to put it another way, that in the preservice teachers' actions in the classroom lies their constituted *knowing* about mathematics teaching and learning, then our task becomes one of interrupting this already constituted knowing by counterposing an alternative discourse. The effect of this alternative discourse will of course, like all interventions, be problematic and many, especially those preservice teachers who already consider themselves appropriately numerate for teaching, may resist

“because the old discourses are still more convincing and desirable to them and can readily be used to destabilise the new, or because the new can readily be reworked to become the old, since any new discourse is always overlaid on the old, and does not replace it” (Davies, 1996, p. 210).

An alternative discourse that could be appropriately constitutive and relevant for teachers of the future might be one where doing and learning mathematics is shown to be a social practice, with power relations that variously position participants. It is important that they recognise that agency with mathematical (content) knowledge, as in reasoning, conjecturing, problem solving, is not a personal quality or attribute but is constituted by the discursive practices of the community. What I am suggesting here is that students will not reason purposefully and engage in processes of conjecture and hypothesis formation if all the teacher asks is that they complete a page of multiplication algorithms, for example. Agency, which interestingly has not been a formative feature of most preservice teachers previous experiences in school, but which they are meant to make possible for others, involves the discursive constitution of a learner as one who can and should speak the powerful truths of the discourse, and who can and should bring one’s own multiple meanings to bear on the operation of the discourse. Thus, and most importantly, a sense of oneself as valued participant and inquirer may become constitutive of learners and teachers of the future; depending on the extent to which teacher educators themselves take up the challenge, and spark the desire in others, to teach in more empowering and equitable ways.

In Teacher Education

All discourses have constitutive power and all discourses can empower or defeat. Educators can never take a *supportive* learning context for granted and one way for preservice teachers to become aware of the coercive force of discourse is to analyse the activities and practices of past schooling, and those in teacher education, for their oppressive or liberatory tendencies. Preservice teachers need to experience a new discursive practice where “looking with new eyes” is stressed and highly regarded and hopefully constitutive of the preservice teachers’ (and teacher educator’s) future practice. Davies (1991, p. 46) states:

The speaking/writing subject can move within and between discourses, can see precisely how they subject her, can use the terms of one discourse to counteract, modify, refuse or go beyond the other, both in terms of her own experienced subjectivity and in the way in which she chooses to speak in relation to the subjectivities of others.

Thus traditional mathematics teaching (at school, and perhaps in teacher education) is held up against a discourse that reveals its empowering and oppressive potential. Perhaps preservice teachers will learn to speak of, and desire, agency for themselves and their students as they come to realise that having fun and empathy for learners does not necessarily result in teaching practices that are mathematically and personally empowering.

And then of course there is the mathematics. It is highly unlikely that teachers could be effective and competent if they do not know the mathematical content they are to teach. My view is that preservice teachers need to know at least some mathematics well; the onus is upon teacher educators not merely to (re)present lots of disparate facts and skills but to ensure that preservice teachers come to value mathematics, not only as a tool through which to get a job, but for its inherent structure, patterns and relationships and integrity as a field of study. The extent to which this is realised depends to some extent on *what* is taught in teacher education and *how*; because the students are coming to see themselves as teachers, there has to be the *imagined possibility* that they could teach the particular concepts or ideas well. It may be useful, rather than to put the students into potentially oppressive situations of having

to construct mathematical patterns, for example, that these are actually pointed out to them and they then have to speculate on how and why they occur.

Preservice teachers often want practical things that they can use when teaching, so they could compile modules such as “representing fractional amounts”, “mathematical patterns”, “patterns in nature”, “making connections”, “exploring base ten” and “mathematics, a social practice”, for example. Each module could be accompanied by a cover sheet listing the mathematical content and how the activities might be made interesting and relevant to children. The students might share their ideas and it is important that they learn to speak about what they have discovered and how they will explore these ideas in the classroom. Strangely enough, many of them have not previously spoken mathematical terms, nor learned to explain aloud mathematical ideas. The aim is always to make learning mathematics less threatening and to have preservice teachers view mathematical knowledge as accessible and useful; and to regard themselves as agentic and appropriately numerate for teaching. The extent to which these aims are realised will be the subject of intense debate with the preservice teachers hopefully recognising the power relationships at play in all interactions. Ultimately, the aim is to have preservice teachers recognise that all teaching/learning interactions, whether they feature the use of textbooks, worksheets, group work, transmission, or games, have empowering and liberatory potential. The difficult part is to know where and when each resource and type of interaction is most appropriate. Adhering to poststructuralist notions of the discursive construction of knowledge, better interactions are those that take account of who students are, their desires, and their hope to make sense of their mathematical, and for student teachers, pedagogical worlds.

Conclusion

The pedagogical ideas canvassed in this paper are speculative and so far untried in mathematics teacher education. The ideas are based on the (constituted) notion that teacher educators who ignore subjectivity and desire do so at their peril! Preservice teachers have lived many years of classroom mathematics; they have come to know teaching and learning mathematics cognitively, emotionally and physically. This constituted knowledge of mathematics is powerful, and though it may be debated and challenged in teacher education programs, is not so easily erased. It seems clear that new theorisations of the human subject and of knowledge as discursively constructed may go some way towards properly addressing this important and challenging issue in mathematics teacher education programs.

References

- Ball, D. (1990). The mathematical understandings that prospective teachers bring to teacher education. *The Elementary School Journal*, 90(4), 449-466.
- Brodkey, L. (1992). Articulating poststructural theory in research on literacy. In R. Beach, J. Green, M. Kamil & T. Shanahan (Eds.) *Multidisciplinary perspectives on literacy research* (pp. 293-318), National Conference on Research in English & the National Council of Teachers of English, Urbana.
- Carroll, J. (1998). Developing a framework for viewing affective and knowledge factors in teaching primary mathematics. In C. Kanes, M. Goos, & E. Warren (Eds.), *Teaching mathematics in new times*. Proceedings of the 21st annual conference of the Mathematics Education Research Group of Australasia (pp. 137-144). Brisbane: MERGA.
- Clarkson, P.C. (1998). Beginning teachers problems with fundamental mathematics. In C. Kanes, M. Goos & E. Warren (Eds.), *Teaching mathematics in new times*. Proceedings of the 21st annual conference of the Mathematics Education Research Group of Australasia (pp. 169-176). Brisbane: MERGA.
- Crawford, K. & Deer, C. (1993). Do we practise what we preach? Putting policy into practice in teacher education. *South Pacific Journal of Teacher Education*, 21(2), 111-121.
- Davies, B. (1991). The concept of agency. *Social Analysis*, 30, 42-53.
- Davies, B. (1996). *Power/knowledge/desire: Changing school organisation and management practices*. Canberra: Department of Employment, Education and Training.

- Department of Employment, Education & Training (DEET) (1989). *The Discipline review of teacher education in mathematics and science*. Canberra: Australian Government Publishing Service.
- Ernest, P. (1994). Varieties of constructivism: Their metaphors, epistemologies & pedagogical implications. *Hiroshima Journal of Mathematics Education*, 2, 1-14.
- Foss, D. & Kleinsasser, R. (1996). Preservice teachers' views of pedagogical and mathematical content knowledge. *Teaching and Teacher Education*, 12(4), 429-442.
- Lather, P. (1991). *Getting smart*. New York: Routledge.
- Paechter, C. (1998). *Educating the other*. London: Falmer Press.
- Price, J. & Ball, D. (1998). Challenges of liberatory pedagogy in mathematics and teacher education. *Theory Into Practice*, 37(4), 256-264.
- Raymond, A. (1997). Inconsistency between a beginning elementary school teacher's mathematics beliefs and teaching practice. *Journal for Research in Mathematics Education*, 28(5), 550-576.
- Schuck, S. (1996). Reflections on the dilemmas and tensions in mathematics education courses for student teachers. *Asia-Pacific Journal of Teacher Education*, 24(1), 75-82.
- Schuck, S. (1999). Teaching mathematics: A brightly wrapped but empty gift box. *Mathematics Education Research Journal*, 11(2), 109-123.
- Tillema, H. & Knol, W. (1997). Collaborative planning by teacher educators to promote belief changes in their students. *Teachers and Teaching: Theory and Practice*, 3(1), 29-46.
- Walkerdine, V. (1988). *The mastery of reason*. London: Routledge.