TAKING THE "FORM" RATHER THAN THE "SUBSTANCE": INITIAL MATHEMATICS TEACHER EDUCATION AND BEGINNING TEACHING

Paula Ensor
Department of Education
University of Cape Town

This research paper explores the relationship between initial mathematics teacher education and beginning teaching. It describes a longitudinal study which tracked a cohort of seven student teachers through a one-year, full-time, preservice university-based teacher education course and then as secondary mathematics teachers into their first year of teaching in the Western Cape region of South Africa. Qualitative data in the form of interviews, students' reflective journals and other written materials as well as lecture and classroom observation data were collected over a two-year period. The study found that in constituting their teaching repertoires, beginning secondary mathematics teachers appeared to take the "form" rather than the "substance"[1] of their mathematics method course. They used a number of discrete tasks introduced there, as well as a professional argot, a way of discussing the teaching and learning of mathematics. There appeared to be a disjuncture between the practices privileged on the preservice course, and those used by beginning teachers in mathematics classrooms. A socio-cultural explanation for this is offered which turns centrally on the extent to which student teachers are given access to the recognition and realization rules of "best" practice.

Introduction

It is widely recognized that teachers do not always implement in their classrooms, or at least do not seem to implement, the practices they acquire on teacher education courses. If they draw on these courses at all, they appear to take on the "form" of these rather than their "substance". This disjuncture has been variously explained: Lortie (1975) attributes it to educational biography and the 'apprenticeship of observation'; Zeichner and Tabachnik (1981) to school setting; Lacey (1977) to differential engagement by students with their teacher education courses, and Cooney (1985) and Thompson (1992) to a failure to change student teachers' and teachers' belief systems. Less commonly, the seeming disjuncture is related to the structuring of the teacher education courses, be they preservice or inservice (although see for example, Borko et al, 1992 and Eisenhart et al).

This issue is an important one, since the entire rationale for teacher education rests upon its ability to prepare students as classroom teachers. In the South African context most particularly, where the educational system is in so many respects dysfunctional, the manner in which teacher education might be used to change teachers' classroom practice has particular saliency. The professional development of teachers, through both preservice and inservice teacher education

[1] I am grateful to Karin Brodie and Lynn Slonimsky for the formulation of the problem in this way. See Brodie et al. (2000).

programs, is regarded as a central pivot for educational transformation.

Inservice and preservice providers attempt to make available to teachers a privileged repertoire, a particular encapsulation of "best practice". How this is configured clearly varies according to the particular teacher education program on offer, but in all cases the question arises: how are the principles underpinning this privileged repertoire made available to students (or in the case of inservice education, qualified teachers), and to what extent do teachers draw upon it in developing their own teaching repertoires?

The study

These questions provided the focus of a two-year longitudinal study (see Ensor, 1999a, 1999b) that tracked a cohort of seven students through the mathematics method component of a preservice Higher Diploma in Education (HDE) program and then as beginning secondary mathematics teachers into schools. The aim of the study was to provide a theoretical account of the recontextualizing of pedagogic practices by beginning teachers from this mathematics method course. Recontextualizing is a notion drawn from Bernstein (1977, 1990, 1996) and Dowling (1996, 1998), and points to the transformation of discourses as they are disembedded from one social context and inserted into others.

The study was stimulated by a broad theoretical interest in the articulation between sites of practice (such as signaled in the work, for example, of Rogoff & Lave, 1984; Carraher et al, 1985; Lave, 1988; Noss & Hoyles, 1996; Walkerdine, 1988, and others). It was concerned with how privileged forms of knowledge and practice about teaching were made available to student teachers and the extent to which these were used by beginning teachers in classrooms. Drawing on the work of Basil Bernstein (1990, 1996) and Paul Dowling (1998), a model was developed to provide an analysis, from a socio-cultural perspective, of a mathematics preservice teacher education course, of secondary mathematics classroom teaching and the recontextualizing of practices between them.

A variety of data was collected for the purposes of the study. In the first year, I took field notes of sessions of the mathematics method course and interviewed the two teacher educators responsible for it. I also collected a range of materials written by student teachers, such as reflective journals, examinations, and a curriculum project, and I conducted interviews with students. In the second year of the study, I interviewed each of the group of seven teachers four times over the year, and in conjunction with the third set of interviews, video recorded a number of lessons with each teacher on a specific day. I also interviewed the head of the mathematics department in each school, or, where there was no head, a senior mathematics teacher.

From teacher education to classroom teaching

On the mathematics method course, students were exposed *inter alia* to a

range of exemplary mathematics tasks, research in mathematics education as well as an approach to mathematics teaching that favored visualization and intuition as a gateway into formal, conceptual mathematics. “Relational” understanding was privileged over “instrumental” understanding. Students were given access to a range of resources: teaching resources such as geoboards and geostrips; the use of history in the teaching of mathematics; ideas for organizing classrooms, as well as exposure to issues such as racism and sexism. This privileged approach to teaching was made available through a range of exemplary mathematical tasks, and through explicit discussion. All of the teaching took place in the university context, however, and student teachers did not watch their teacher educators teach in classrooms, nor, whilst on teaching practice, did they gain the opportunity to put their own practices up for evaluation by mathematics specialists. In terms of the way in which the teacher education course as a whole was structured, students were supervised on teaching practice by lecturers who were not necessarily mathematics education specialists.

Over the period of the method course, students were given access to a *professional argot*, a way of talking about mathematics teaching which privileged, for example, “visualization”, “verbalization”, “relational over instructional understanding” and learners “discovering things for themselves”. A professional argot comprises terms and modes of argument used by members of a profession when either engaged in, or discussing it. Those aspects of the argot that are foregrounded or backgrounded at any point in time, and the level of specificity of the language used, depend on the evoking context. Different features are likely to be foregrounded when discussing with a colleague, for example, than with a layperson. A professional teaching argot provides a student teacher with access to a vocabulary and modes of argument to describe “best practice”. Of significance in the particular preservice course of my study was that this argot was elaborated independently of reference to actual classrooms, and thus embodied potential ambiguity about what practices would, for example, constitute “relational” and “instrumental” understanding.

Use of such an argot can be illustrated by the following comments by a student teacher, Thabo Monyoko. In his teaching practice journal and in an interview at the end of the HDE year, Thabo spoke positively about the mathematics method course, which he described as having effected a "complete revolution” in his thinking about teaching. He said he had been exposed to a new approach in terms of which “pupils come to discover some of the things on their own […]. They actually see how some of the things they do in mathematics is practical and some of the things they discover on their own.” He no longer "monopolized classroom activities", "standing in front like a priest”, simply giving the formula "raw from the book" so that "people have got to ram it into their heads [..] In the past I would simply give the formula from the book and give them an exercise and they apply the formula, that's all”. On his second teaching practice he said he tried “to implement some of, you know, the hands-on approaches [..] I

remember I implemented some of these self-discovery approaches by pupils, I mean they were very fantastic, they were very interesting to the pupils and I think my lessons went pretty well, you know."

These ideas were re-iterated by Thabo when I interviewed him as a beginning teacher the following year. He indicated that the mathematics method course had "turned me around" in that he was now more "responsive to students' needs" and interacted with them more instead of "teaching from the front". For him, this meant walking around the class and "finding out what pupils were having difficulties with." This he related directly to lessons which I observed him teach. The following is an extract from the beginning of such a lesson on sequences with Grade 12 students.

> T: Let's say that the sixth term of a geometric sequence is 3125 and the fourth term is 125. Now find the eighth term. [as he speaks, he reads from a textbook and writes on the board:]
> 6th = 3125
> 4th = 125 Find 8th
> [He repeats again, given that the 6th term is 3125 and the 4th term is 125, find the 8th term]
> Now because you don't know the value of a, now remember in a geometric sequence the general term is
> $T_k = ar^{k-1}$ [writes this on the board and speaks as he writes]
> Now in order to find any term of a geometric sequence you must first find the value of a and the value of r. When you have a and r you can then find out the term. Now given that the sixth term is 3125 we can write
> $T_6 = ar^5 = 3125$
> Now let's call this our equation 1 [he writes 1 and circles it after the equation given above]
> Now the fourth term is 125. Therefore
> $T_4 = ar^3$ which is equal to [he turns his head to the class and cocks his head in expectation of a response. Someone says 125] 125 . OK we'll call this equation 2
> (Thabo: extract from transcript of recorded lesson 2)

Thabo continued in this relatively unbroken expository style to solve two simultaneous equations on the board. At one point he turned to ask a student to check a calculation. When he completed the solution to the problem, he turned to the class, and for the first time and ten minutes into the lesson, he asked students by name if they had any problems: "Mr. Nzo, Nyamende, Zola?" He then proceeded to solve another problem on the board. Again, students were required to listen and take notes. Occasionally he posed a question, normally to ask students to calculate for him. After his explanation, he chose a question from the textbook for students to try on their own and walked around the class, discussing with the students in Xhosa and English.

Two interesting issues emerge from this brief discussion of Thabo's

practice. Firstly, there appears to be a variation between Thabo's preferred teaching style and that privileged on the method course, as well as a variation between what he said about his practice and how he actually worked in the classroom. In discussing the lesson afterwards, Thabo pointed to his use of questions, and his circulation around the class towards the end of the lesson, as evidence of the practices he had acquired from the mathematics method course. For him, there was no disjuncture between this course and his own practice, and between what he said about his practice and the way in which he actually taught. Yet, what Thabo said, both as a student and as a teacher, appears to be at variance in both these ways, a variation which was evident across the interviews and classroom practices of all seven beginning teachers. All seven teachers used discrete tasks (exemplary mathematical tasks and pedagogic resources made available to them on the course) and a professional argot of varying range. Teachers tended to deploy this argot, descriptions such as "verbalization", "visualization" and "self discovery", in ways consistent with their *own* practice. Thabo, for example, drew on the professional argot ("not teaching from the front", and facilitating "student interaction") to describe his teaching style, which was in many ways different to the approach developed on the course. So from the viewpoint of the teacher education course, it would seem that Thabo was saying one thing and doing another, taking its "form" rather than its "substance". Yet from Thabo's vantage point, this was not necessarily the case. He had acquired a professional argot and turned it to his own purposes. The ambiguity associated with the transmission of the privileged repertoire made this possible, an issue which I will return to below.

All seven beginning teachers recontextualized a small number of discrete tasks and a professional argot from their HDE method course. However, in interviews with them and in observation of their lessons, I found that they were not able to demonstrate access to the principles of selection, production or evaluation which underpinned this course. For example, they said they could not produce tasks like those introduced on the course, tasks which encapsulated its particular, privileged view of mathematics teaching, and they found it difficult to evaluate their practice in the ways that the teacher educators might do. Putting this differently, I would suggest that these teachers had gained partial access to recognition rules (they could describe aspects of "best practice" via the professional argot, in the ways the teacher educators did) but not realization rules (they were unable to produce tasks themselves which were consistent with the principles underpinning the method course).

Recognition and realization rules

Bernstein (1990) distinguishes between recognition and realization rules in the following way:

> Recognition rules create the means of distinguishing between and so *recognizing* the speciality that constitutes a context, and realization rules regulate the creation and

production of specialized relationships internal to that context. (Bernstein (1990), p. 15 emphasis in original)

Bernstein elaborates these rules as part of his code theory. The present analysis is differently motivated methodologically but the distinction Bernstein makes can be related to the present project. Here we are interested in the extent to which student teachers are given access to both recognition and realization rules, for how "best practice" is to be recognized and how it is to be realized in practice. In the sense in which I am using these terms here, access to recognition and realization rules enables appropriate use of a professional argot (that is, its use as the teacher educators might use it) as well as its realization in practice. Access to recognition rules alone provides students with the ability to differentiate "best" from "poor" practice and to describe "best practice" discursively.

As illustrated above, Thabo demonstrated only partial access to recognition rules in that he used the professional argot largely inconsistently with the forms of "best practice" privileged on the mathematics method course. He was also was unable to demonstrate access to realization rules. I have suggested that these issues of access are related to the structuring of teacher education as a form of knowledge.

Teacher education: knowledge forms and pedagogic modes

Teacher education can be regarded as a hybrid of explicit, discursive practices (exhibiting what Dowling, 1998, terms *high discursive saturation*) and implicit, tacit practices (exhibiting low discursive saturation). Highly discursive practices are relatively context independent and can be realized to a substantial degree in language, while tacit practices are more context-dependent, and less easily grasped linguistically. Mathematics teacher education can be thought of as making available to student teachers a form of "best classroom practice" which comprises both explicit and tacit elements. The principles of selection, production and evaluation which underpin "best practice" can therefore be made available explicitly, through language, but not exclusively so. To become a teacher, one needs to watch teachers teach, teach oneself and open one's efforts up for evaluation[2]. Just as the crucial aspect for the transmission of discursive practices is that the generative principles of the privileged repertoire are made explicit in language, the crucial aspect for the transmission of tacit practices is that they are made available and acquired in the site of practice, the school classroom, through demonstration and correction. While it is productive to speak to student teachers or teachers *about* "best practice", we also need to show them what this means, in actual classrooms, and allow them to put their own practice up for evaluation. This provides the basis for acquiring recognition and realization rules.

[2] Cases have been used in interesting ways in teacher education (see for example Merseth, 1996). I would suggest that while the discussion of cases outside of classrooms can effectively provide access to recognition rules, access to realization rules requires this engagement (see Pi-Jen Lin, 2000).

In the case of my study, students were exposed to "best practice", described in part above, exclusively in a university setting. As I have said, because of the way the HDE as a whole was structured, students did not observe mathematics teacher educators teach in classrooms, nor teach in classrooms themselves and have their performance evaluated by mathematics teacher educators. So while students were able to gain some access to discursive aspects in the university setting, the more tacit, implicit aspects, those which required elaboration and exemplification in classrooms, were not made available. The professional argot was thus invested with considerable ambiguity, and teachers were able to use it to describe practices that were in many ways quite different to those privileged on the preservice method course.

Conclusion

In this paper I have briefly described a longitudinal study which explored the relationship between initial teacher education and classroom teaching. All seven beginning teachers in the study took from the course a professional argot and a range of discrete tasks (or, as some would suggest, its "form") rather than working independently with its underlying principles (its "substance"). This variation is commonly explained in research literature on the basis of educational biography and school setting. I have suggested elsewhere (see Ensor, 1999a) that school settings produced constraints on the teachers of my study in terms of how they developed their teaching repertoires, how they taught, and the extent to which they drew on their preservice course in doing this. School settings, however, did not seem to constrain teachers in a simple or obvious way, and did not appear to be decisive in shaping the recontextualizing of pedagogic practices for the teachers of my sample. A further factor which antecedent literature suggested might be important in shaping the development of teaching repertoires, that of educational biography, was also not decisive. What seemed overwhelmingly to affect recontextualizing was access to recognition and realization rules. Access to recognition and realization rules expands the range of tasks and approaches that teachers can draw on and provides the possibility for the production of new tasks and pedagogic choices. In the case of my study, lack of access restricted the recontextualizing potential to tasks actually encountered by students on the initial teacher education course and a professional argot which teachers deployed selectively, and not always appropriately, to describe their own practice.

This paper has been concerned with why teachers appear to practise differently in their classrooms from the ways privileged on the preservice and inservice courses they attend, and from the ways in which they speak about them. I have attempted to offer a possible reason for this in the particular structuring of teacher education discourse and its modes of pedagogy. Insofar as teacher education occurs exclusively in a site removed from that of classroom practice, it is difficult to make available fully the principles, the recognition and realization rules, that generate any particular view of "best practice". Instead, the latter will

stand as a collection of resources for potential, selective recruitment by teachers in forming their individual teaching repertoires. For this reason they may appear to appropriate the "form" rather than the "substance" of best practice.

References

Bernstein, B. (1990). *The Structuring of Pedagogic Discourse Vol. 1V Class, Codes and Control* London: Routledge.

Bernstein, B. (1996). *Pedagogy Symbolic Control and Identity Theory, Research, Critique* London: Taylor & Francis.

Borko, H., Eisenhart, M., Brown, C.A., Underhill, R.G., Jones, D. & Agard, P.C. (1992). Learning to teach hard mathematics: Do novice teachers and their instructors give up too easily? *Journal for Research in Mathematics Education*, *23*,3, 194-222.

Brodie, K., Lelliot, T. & David, H. (2000). Developing learner-centred practices: teachers' take up from the University of the Witwatersrand Further Diploma in Education. Symposium presented at Southern African Association for Research in Mathematics, Science and Technology Education Conference, Port Elizabeth.

Carraher T.N., Carraher, D.W. & Schliemann, A.D. (1985). Mathematics in the Streets and Schools *British Journal of Developmental Psychology*, *3*, 21-29.

Cooney, T.J. (1985). A beginning teacher's view of problem solving. *Journal for Research in Mathematics Education*, *16*,5, 324-36.

Dowling, P. (1998). *The Sociology of Mathematics Education Mathematical Myths/Pedagogic Texts.* London: Falmer.

Eisenhart, M., Borko, H., Underhill, R., Brown, A., Jones, D. & Agard, P. (1993). Conceptual Knowledge falls Through the Cracks: Complexities of Learning to Teach Mathematics for Understanding. *Journal for Research in Mathematics Education*, *24*,1, 8-40.

Ensor, P. (1999a). A study of the recontextualising of pedagogic practices from a South African university preservice mathematics teacher education course by seven beginning secondary mathematics teachers. *Collected Original Resources in Education*, *24*,3. Also available as a Ph.D. thesis, University of London.

Ensor, P. (1999b). The myth of transfer? Teacher education, classroom teaching and the recontextualising of pedagogic practices. *Pythagoras 50* , 2-12.

Ensor, P. (2000). Accessing discursive and tacit practices in teacher education and classroom teaching. *South African Journal of Education 20*,3, 210-212.

Lacey, C. (1977). *The Socialization of Teachers*. London: Methuen.

Lave, J. (1988). *Cognition in Practice*. Cambridge: Cambridge University Press.

Lortie, D.C. (1975). *Schoolteacher: A Sociological Study*. Chicago: University of Chicago Press.

Merseth, K.K. (1996). Cases and case methods in teacher education In J. Sikula, T.J. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education* New York: Simon & Schuster Macmillan.

Noss, R. & Hoyles, C. (1996). The visibility of meanings: modelling the mathematics of banking. *International Journal of Computers for Mathematical Learning*, *1*, 3-31.

Pi-Jen Lin (2000). On developing teachers' knowledge by using cases constructed by researcher and classroom teachers. *Proceedings of the 24th Conference of the International Group for the Psychology of Mathematics Education Hiroshima, Japan*, 3,231-238.

Rogoff, B. & Lave, J. (Eds.) (1984). *Everyday cognition: its development in social context*. Cambridge, Mass: Harvard University Press.

Thompson, A. (1992). Teacher's beliefs and conceptions: a synthesis of the research. In D.A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning*. New York: Macmillan.

Walkerdine, V. (1988). *The Mastery of Reason*. London: Routledge.

Zeichner, K.M. & Tabachnik, B.R. (1981). Are the effects of university teacher education 'washed out' by school experience? *Journal of Teacher Education*, 32,3, 7-11.