

# Recognizing and Realizing “Best Practice” in Initial Mathematics Teacher Education and Classroom Teaching

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This research paper describes a longitudinal study which tracked a cohort of seven student teachers through the secondary mathematics method component of a one year, full-time, preservice university-based teacher education course and then as beginning 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 students’ texts as well as lecture and classroom observation were collected over a two-year period. The study found that in constituting their teaching repertoires, beginning secondary mathematics teachers recontextualized certain discrete tasks introduced on the mathematics method course, as well as a professional argot, a way of discussing the teaching and learning of mathematics. There appeared to be a disjuncture between what student teachers were taught on the preservice course, and the way in which they practiced in mathematics classrooms. There also appeared to be a disjuncture between what teachers said about their classroom practice, and the way in which they actually taught. An explanation for this seeming hiatus emerges from a sociological model developed from the work of Basil Bernstein and Paul Dowling and turns centrally on the extent to which student teachers are given access to the recognition and realization rules of “best” practice.

## Introduction

Why is it so often the case that teachers do not implement in their classrooms, or at least do not seem to implement, the practices they acquire on teacher education courses? This has been variously attributed to educational biography (for example Lortie’s (1975) ‘apprenticeship of observation’), school setting (see for example Zeichner and Tabachnik (1981)), differential engagement by students with their teacher education courses (see for example Lacey (1977)) or a failure to change student teachers’ and teachers’ belief systems (Cooney 1985, see also Ensor, 1998). Less commonly, the seeming disjuncture is related to the structuring of the preservice teacher education course (see for example, Borko et al (1992) and Eisenhart et al (1993)).

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

Any teacher education course, whether preservice or inservice, elaborates what I would call a *privileged repertoire*. Such a repertoire is privileged because it involves a particular selection and combination of mathematics for the production of pedagogic tasks, a particular selection of pedagogic resources to facilitate this and the arrangement of these tasks into sequences as lessons. The privileged repertoire also includes features of classroom arrangement, the regulation of teacher-pupil communication and the deployment of appropriate forms of assessment. The task of inservice and preservice providers is to make

available to teachers this privileged repertoire, this particular embodiment of “best practice”. How this is configured clearly varies according to the particular teacher education program on offer.

In some cases, it may be the intention of teacher educators simply to make available to student teachers and/or teachers a varied collection of resources from which they can select at will. Hatton (1989, 1997) refers to this as *bricolage*. Such resources might include exemplary mathematical tasks, particular ways of organizing classroom communication and so forth. Or, teacher educators might want to make available to teachers not only this “smorgasbord” of resources, but also the principles for selecting one set of resources over others, producing new and different resources consistent with their particular, privileged view of teaching, as well as the principles for evaluating classroom practice. The question must then be asked, how are these principles made available to students (or in the case of inservice education, qualified teachers) and to what extent do teachers draw on these practices in developing their teaching repertoires?

## The Study

These questions provided the focus of a two-year longitudinal study (see Ensor, 1999a, 1999b, 1999c) 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. By ‘*pedagogic practice*’ I mean any practice, whether utterance or action, which is implicated in the transmission of a pedagogic discourse, such as for example school mathematics, and which forms part of a teaching repertoire. The privileged repertoire of teacher education is constituted by pedagogic practices, as are the repertoires of beginning teachers. 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 and Lave (1984), Carraher et al (1985), Lave (1988), Noss and 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 (1977, 1990, 1996) and Paul Dowling (1996, 1998), a model was developed to provide an analysis 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 student teacher texts, such as reflective journals, examinations, a curriculum project and 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 is a species of speech genre (Bakhtin, 1986), a register (Halliday, 1978) of terms and modes of argument used by members of a profession when either engaged in it or discussing it. What aspects of the argot are foregrounded or backgrounded 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 than with a layperson. A professional teaching argot comprises part of the privileged repertoire, and provides the student teacher with access to a vocabulary and modes of argument to describe “best practice”. What is significant about the particular preservice course of my study is 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 in the following extract from an interview with a student teacher, Thabo Monyoko, towards the end of the mathematics method course:

Since the beginning of the academic year I think my whole perception of what mathematics is and importantly how it is supposed to be taught has undergone a complete revolution (Saul changed Paul on the road to Damascus). Previously the impression I had of maths was that it is a theoretical subject having nothing to do with some practical, experiential activities. In this respect I think through the whole lot of activities we did during our lessons, I have developed a different view of how maths can/should be taught, which is indeed a marked departure from traditional method of teaching, the “mug and jug” method.

In his teaching practice journal and in an interview at the end of the HDE year, Thabo spoke positively again 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 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:]

$$6\text{th} = 3125$$

$$4\text{th} = 125 \quad \text{Find 8th}$$

[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

$$T_k = ar^{k-1} \quad \text{[writes this on the board and speaks as he writes]}$$

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

$$T_4 = ar^3 \quad \text{which is equal to [he turns his head to the class and cocks his head in expectation of a response. Someone says 125] 125. OK we'll call this equation 2}$$

Now we have two simultaneous equations with two unknowns. We don't know the value of a and we don't know the value of r. We have two variables which are unknown so we must find the value of a and r. Now in solving simultaneous equations you must first do away with one variable. In this case here we want to do away with a so we are left only with r. Once we are left only with r we can be able to find a. Now in finding the value of r we divide our equation number 1 by our equation number 2. We divide the big r by the small r. [He goes on to explain that "you can divide equation number 2 by equation number 1" but this gives rise to a negative exponent which makes calculation more complicated so they should "take the big r and divide by the small r"] (Thabo: extract from transcript of recorded lesson 2)

Thabo continued his explanation from the board, turning at one point 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.

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 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 with what he did in the classroom, an apparent 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 (a way of describing forms of classroom practice). Teachers deployed 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 classroom practice, which was in many ways at variance with the approach developed on the course. From the *viewpoint of the privileged repertoire*, it would seem that Thabo is saying one thing and doing another. Yet from Thabo’s vantage point, this is not necessarily the case. He has 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 from their HDE method course, discrete tasks and a professional argot. However, in interviews with teachers and in observation of their lessons, I found that they were not able to demonstrate access to the principles (or “rules”) of selection, production or evaluation of the privileged repertoire. They said they could not produce tasks like those introduced on their mathematics method course, that is tasks which embedded its particular, privileged view of mathematics teaching, nor could they evaluate their practice in the way that the teacher educators might do. Putting this differently, I would suggest that these teachers had gained some access to *recognition rules* (they could describe aspects of “best practice” via the professional argot) but not *realization rules* (they were unable to produce tasks themselves which were consistent with the principles underpinning the privileged repertoire).

## 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: how a privileged repertoire 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 as well as its realization in practice. Access to recognition rules alone provides students with the ability to differentiate "best" from "poor" practice and a professional argot that enables acquirers to describe "best practice" discursively. However, since this argot was not demonstrated or illustrated in the site of application, it is potentially ambiguous with regard to the classroom practices it indexes.

The ambiguity referred to above stems from the particular structuring of teacher education as a form of knowledge. Teacher education can be regarded as a hybrid of explicit, discursive practices and implicit, tacit practices. Discursive practices exhibit what Dowling (1998) refers to as high *discursive saturation* (DS+), which means that they are relatively context independent and can be realized to a high degree in language. Tacit practices are those which exhibit low discursive saturation (DS-), which are more craft, context-dependent activities and which cannot be grasped fully in language. Mathematics teacher education can be thought of as making available a form of "best classroom practice", a privileged pedagogic repertoire, which comprises both explicit DS+ and tacit DS- elements. This means that the principles of selection, production and evaluation (which comprise what I call, following Dowling, an *esoteric domain*) can 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. Just as the crucial aspect for the transmission of discursive (DS+) practices is that the generative principles are made explicit in language, the crucial aspect for the transmission of tacit (DS-) practices is that they are transmitted and *acquired in the site of practice*, through demonstration and correction. It is not sufficient to speak to student teachers or teachers *about* "best practice"; one has 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.

In the case of my study, students were exposed to the privileged repertoire, 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. This means that while students were able to gain some access to discursive aspects of the privileged repertoire in the university setting, the more tacit, implicit aspects, those which required elaboration and exemplification in classrooms, were not made available. This invested the professional argot with considerable ambiguity, restricting access not only to realization but also recognition rules. This allowed teachers subsequently to use it to describe practices that were in many ways quite different to those privileged on the preservice method course.

## Conclusion

I have suggested that teacher education and classroom teaching are hybrid activities, incorporating both explicit, discursive aspects as well as tacit, non-discursive aspects. The implication of this for pedagogy is that teacher education courses need to incorporate explicit discussion of privileged forms of teaching, as well as provide opportunities for these to be "tried out" in classrooms.

In my study, which for reasons of space I cannot discuss fully here, I suggested that

school settings produced constraints on teachers 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 potential of tasks and approaches that can be drawn on and provides the possibility for the production of new tasks and pedagogic choices. Lack of access restricts 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.

I began this paper with a question about why teachers appear to practice differently in their classrooms from the ways in which they speak about them, and from the ways privileged on the preservice and inservice courses they attend. I have attempted to offer a possible reason for this in the particular structuring of teacher education discourse and its modes of transmission. Insofar as teacher education occurs exclusively in a site removed from that of classroom practice, it is not possible to make available fully the principles, the recognition and realization rules, that generate any particular privileged repertoire. Instead, the latter will stand as a reservoir of resources for potential, selective recruitment by teachers in forming their individual teaching repertoires. Insofar as they turn a professional argot to describe their own practices, they might well seem to be doing other than what they say, and what teacher educators advocate.

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