MATHEMATICS AS SOCIAL PRACTICE: AN INVESTIGATION INTO PRIMARY STUDENT TEACHERS' RESPONSES TO MATHEMATICS.

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Abstract

"Public" concerns about standards of attainment in mathematics in UK primary schools have led to the development of a National Curriculum for ITT. Such a curriculum is founded on the belief that teachers' subject knowledge is an essential ingredient for successful teaching. Simplistic responses to teachers perceived lack of mathematical knowledge include provision of more inputs of the same kind. This article questions whether the adoption of a social practice model with its explicit acceptance of maths education as a socio-cultural, ideologically constructed process and acknowledging the complexities of learning, teaching and schooling is an attractive alternative worthy of further exploration with potentially significant pedagogical implications both for student teachers and their future classroom practices.

Introduction

Teaching and teacher education is more inspected, measured, analysed and publicly judged than ever before. The frightening centralisation of control instigated over the past 18 plus years shows no sign t of abating. Structures which expose and weed out teaching failure and attempts to provide remediation programmes for what is perceived as national educational under achievement have . become powerfully dominant. At the same time some educational research is attempting to understand the complexity of the educational endeavour rather than to respond with simplistic rhetoric. Two such are in literacy and numeracy education. Surprisingly, given its autonomous image, mathematics education e-mail networks buzz with challenge to the over simplistic reaction to international league tables and with debate about new models of socially defined cognition. Mathematics holds a powerfully privileged position in the order of higher status knowledge, a position reflected in the National Curriculum and in the NC for ITT, (TTA 1997). It is also the most incontestable and autonomous discipline of the school curriculum. "Mathematics and science are the two areas of the curriculum where the effects of the educational system outweigh the effects of home background" (Reynolds 1996, p 2). It is in this climate and context that an attempt was made to apply a socio-cultural model of mathematics to modules addressing concerns about subject knowledge. Such a model could have significant pedagogical implications both for student teachers and their future classroom practices. This paper seeks insights into the current situation in mathematics education through an implementation of a social practice approach. It explores student responses to challenges to their models of knowledge and beliefs about teaching and learning. Interpretation of the emerging data and the implications for both teacher education and pedagogical practices are discussed in the light of an analytical framework developed during the research.

Background

> "Maths crisis diagnosed. One in three English children leaves school unable to do simple sums, a failure which drives them into an underclass of young people unable to get jobs." (The Times Educational Supplement July 18, 1997)

This claim is based on data in TIMSS (Keys et aI, 1996). It seems that children in England tend to score poorly on international numeracy tests both in comparison to similar countries and in comparison to earlier surveys. Although there is debate about the validity of the data and of the conclusions drawn, the frequency of appearance of such statements over the last few years reflects a substantial and growing concern about achievements in numeracy that warrants careful consideration

and response, (cf. Brown, 1997). However, low achievement is seen only in relation to specific areas of mathematical content without any reference to context, culture or ideology. This fits with my analysis that current practices are viewed and researched from an implicitly neutral socio-cultural position. It is also worth noting concerns about primary teachers' subject knowledge in mathematics which is seen as a possible contributor to low achievements in numeracy, (OFSTED, 1994, 1996). This is clearly a complex issue (Askew et al, 1997; Jeffery et al, 1995). The former claims that it is the interconnectedness between, and the beliefs about, mathematics which are important rather than the quantity or security of that knowledge.

I was concerned, therefore, to question dominant approaches to the subject knowledge issue in mathematics which sees the provision of more content courses for student teachers as ~ solution. Instead I wanted to consider more complex social practice analyses. Here students would no longer be considered "in deficit", pathologised by earlier failures but, in confronting mathematics in new ways, would be enabled and encouraged to reconstruct their own pathways into understanding.

Theoretical framework

I need first to explain the theoretical framework which provides an unusual perspective to view and understand education practices. Recent work (Baker & Street, 1994; Street, 1995) has developed a cultural model which conceives of literacy and numeracy, as social practices. Traditionally, 'numeracy' concerned a technical capability in understanding and manipulating numbers. These were not seen as social practices but rather as mechanistic skills to be acquired and in which one's competence could be objectively measured. This conceptualisation is described by Baker & Street (1994) as 'autonomous' and is characterised in terms of simplicity, singularity and without explicit ideology. In this autonomous model, mathematics would be perceived as a unified, determined and legitimated body of knowledge, a set of conventions and procedures, abstract in nature, value free and universal- a dominant view ofthe subject. In a social practice model, however, numeracy, is seen as a highly complex region of human activity within the social arena. It is described as 'ideological'. The model acknowledges that the contexts, values and beliefs and the power relationships in which knowledge is sited affect both ways of making meaning and ways of knowing. The autonomous model does not acknowledge the ideological nature of knowledge whereas the ideological model exposes the ideological, cultural, pluralistic and contextual nature of that knowledge. I do not view these as dualisms but as representing different ways of making meaning and knowing. There is considerable evidence that the autonomous model is currently dominant in formal education, (Baker, 1996~ OFSTED, 1994; Keys et al, 1995). Challenging this has significant implications for teaching, learning and classroom practices. At the same time as challenging the dominant 'autonomous' model of knowledge my experiences with student teachers, led me to design a two-dimensional analytical framework. This described the student teacher from 'compliant', through 'reflective' to, 'interrogative' and evolved from a framework previously designed by Baker (1994) along with the currently dominant model of 'reflective practitioner' originating in the work of Schon (1987) and developed further by Miller (1996). One critique of Schon foregrounded his lack of any acknowledgement of the socially constructed nature of knowledge itself (Smyth, 1991) and thereby inhibiting any sense of the dialogic nature of reflection. In other words, and most importantly for my thinking, the "reflective practitioner" is still an autonomous rather than ideological thinker. What was needed was a progression beyond the idea of

reflection into the critical, or what has been termed the 'interrogative', (Miller, 1996). I have done this in response to increasingly centralised systems of education where compliance is demanded by educational authorities as an essential characteristic of the educational professional. In my view, this compliance is retained in the concept of 'reflective practitioner' whose drive is towards finding optimal teaching approaches and strategies within the given educational structures, systems and curricula. It is "pedagogical polishing" (Baker, 1996). The 'reflective practitioner' model privileges improving the behaviour of the teacher within dominant paradigms. Interrogation, on the other hand, opens spaces to challenge the models of knowledge framing school curricula, underpinning values and beliefs, relations of power and pedagogical practices.

The project

The project involved designing and implementing elements in a curriculum mathematics module in a teacher education programme from a social practices approach. This approach survived considerable opposition from colleagues in an otherwise autonomous module where workshops were provided to help students "fill gaps" in their knowledge. The rationale for the module was that students, "extend their own knowledge and understanding of mathematics in order to teach it more effectively". (University of Brighton, 1996). The beliefs underlying the module, supported by TTA frameworks (TTA, 1997) and OFSTED standards, were that increased subject knowledge was necessary for more effective teaching. Workshops based on a social practices approach were characterised by asking students to work in particular ways on their mathematics; both on their strengths and their concerns. Working on and re-framing areas of strength gave them a positive starting point and an opportunity to reconstruct their existing knowledge whilst encouraging them in making connections between different aspects of their knowledge. The approach involved four phases, describing, informing, confronting and reconstructing, derived from Smyth (1991). Firstly, they had to describe their position in an area of mathematics in terms of both content and context; secondly, they informed themselves about the reasons for that position, uncovering hidden beliefs and values behind it; thirdly, in confronting the area, seeking to make power relationships explicit, they discussed why knowledge about the area was important, was valued and had status, and what their relationship was to that knowledge; finally, they worked on reconstructing their pathway into knowledge through their own research, working with others or seeking activities or help from a tutor. This I have identified as a social practices approach because it makes underpinning power relations, content, context, values and beliefs explicit.

I selected a small group of students as a source of data which was collected through individual student diaries, group interviews and individual interviews at the start and again towards the end of the semester. The selection was made to provide the most telling cases from their acknowledged weakness or strength in classroom practice. This characteristic was expected to expose the greatest range of difference in terms of compliance, reflection or interrogation. I sought evidence of these three models in terms of the second dimension of the analytical framework which contained the students' subject knowledge, beliefs and values, power relations and pedagogical practices.

Interpretation of data

The first concern was with students' epistemological JOdels, that is to say their perceptions of, attitudes towards and relationship with mathematics lowledge. Evidence suggested the ·compliant'

student teacher perceives the knowledge as context and value free, that she 'gets it' and that, " it is having that knowledge to give to other people", a simple sufficiency of understanding from the given canon. The 'reflective' student teacher has considered the relationship of school-sited mathematics and the everyday, " I could do capacity and volume in school. But I suppose you don't use them". She is aware of the differences in the two practices but also of a real boundary between them. She is aware of different understandings, different ways of knowing. Identifying behaviour that is seen as the 'interrogative' is harder to find. Elements are demonstrated by the student who observed that basics relate to other practices, "to help you survive the demands of society", thus showing an initial awareness of the social construction of mathematics knowledge. Data provided me with telling evidence of underlying beliefs and values. The compliant student teacher's interest in the subject extends only to her teaching needs, hence, "I don't want to develop my understanding of it in any great detail. Just enough so that I can actually teach it". Evidence of reflection on practice appears in the comment, "some will get it before others, and some will be able to do it", implying a child

centred approach. The student moving towards the interrogative position begins to question the role t of the social in education processes " .. you've got their social and cultural background .. the home that they come from", implying a belief in teachers as mediator between child and knowledge as well as the social context of that knowledge and of schooling. Awareness and explicit acknowledgement of power relations are a crucial indicator in a social practice model and evidence was apparent of a clear range here. Compliance is expressed as," ... they say I've got to teach it, so I will"; the reflective student is aware ofthe gatekeeping role played by maths, " ... if you haven't got English

and maths you aren't going to do anything"; in moving towards the interrogative a student expresses disquiet about the dominating role of SATS, the consequent importance of memory in learning mathematics: "you've got to revise this, remember that. I didn't like it at all."

The evident range of models, understandings and beliefs appear to result in different pedagogical practices. Compliance is demonstrated in the student who accepts transmission from the teacher, "gives the knowledge to others", and for whom, " everyone should have a good grounding in the basics". The reflective student rates helping the individual as important, "you can try and help children of lower ability" . The interrogative is again not so evident but some acceptance of multiple ways and of valorising children's work appears in " ... why should we dictate your adding in your head, your way of doing it?"

This two-dimensional analytical tool has proved useful in enabling the three models of student teacher to be differentiated. Evidence from the group of students suggested that they tended to be either compliant or reflective. There was little evidence of the interrogative in the sense of genuine challenges to or questioning of accepted practices. As the group presented the widest range of classroom skills, it indicated that student teachers tend to be compliant and reflective rather than interrogative, certainly in their epistemological models. The implications of this will be discussed in terms of current concerns, student responses and observations on the application of a social practice model.

Implications

In terms of gaining insights into current concerns, the implications of the study of student teachers are that their understandings and practices maintain autonomous approaches to both subject knowledge and pedagogical practices - they accept what they are told to do and how they are to do

it - or that they seek best ways of teaching given content. Pedagogical practices, from transmission of knowledge to mediated exploration dominate their classroom approaches. This means that they take little account of the sitedness of children's knowledge or of children's practices and when difficulties arise they continue to pathologise the children or to see themselves, their knowledge and attitudes as the problem. Students as reflective teachers continue to try to mediate between the children and curriculum. In many cases these attempts are directed towards motivation of the children through a veneer of the everyday and not genuinely situated teaching and learning. Further, problems some children have in crossing boundaries between different practices, (cf. Baker 1996), are not acknowledged nor genuine attempts made to ameliorate the problems whilst neither curriculum nor pedagogy are interrogated. The reflective practitioners are therefore providing at best a marginal improvement in children's access to mathematics. My conclusion is that while this autonomous model persists so will the status quo of the failing state of mathematics education. Adoption of a social practice model with its explicit acceptance of education as a socio-cultural, ideologically constructed process and acknowledging the complexities of learning, teaching and schooling is an attractive alternative worthy of further exploration.

The views expressed by the small research group on subject knowledge and their revealed beliefs, values, perceptions of power relations and their classroom practices were significant in one or two important aspects. A perception of a personal "deficit" in mathematics subject knowledge in many cases resulted from continual perceived failure over years of formal schooling. Images of the subject as hard, as abstract, as gendered and with negative relevance to them persisted in terms of their articulation of the formal subjects themselves. Although they expressed needs relating to both subject knowledge and pedagogical knowledge, when challenged about their formal mathematics knowledge on, say, fractions, they accepted that they had the subject knowledge and what they really need was knowledge of a variety of ways of teaching it, i.e. pedagogical knowledge. Responses to mathematics seemed mainly compliant. I contend that this is in part due to the abstracted, de-contextualised nature of dominant formal mathematics practices. The students saw mathematics as important but often hard and irrelevant. One said:

> "I think maths is important because I suppose it's socially accepted for whatever reasons by employers for whatever you're doing ... [but] .. I've never used it since school. .. Maths is hard .. I also think it is perhaps quite more abstract than - it's a lot of the things you can't physically see or grasp".

Compliant or reflective student teachers will retain this image of mathematics. It is only the interrogative who will have the drive and means to confront their position and then to reconstruct both a more positive image and a more secure and confident approach to mathematics in schools.

Finally, what lessons have been learned about introducing a social practice model? The severe resistance to these ideas from outside the School of Education are evident in official documents and statements. What was surprising was the extent to which these attitudes and resistance were evident not only within the School but also had been intemalised by individual academic colleagues. This bodes ill for the development of the reflective practitioner let alone the interrogative learner in the present educational and political climate. Yet the development of social

Practitioner approaches to teacher education: BSRLM modules in mathematics like the ones briefly described

here might make for more intellectually assertive and confidently interrogative teachers. Developing beyond the reflective practitioner, student teachers would be able to unpack underpinning ideologies, become teacher-as-researcher in a critical manner to move into new ways of knowing, valorising learners and so on. It will provide them with a depth of understanding and a fuller range of strategies to deal with the demands on their subject and pedagogical knowledge that will be placed on them as they develop from NQT to "expert teacher". Resistance to these approaches will result in continuing concerns about mathematics education, continuing difficulties in recruitment to mathematics teacher education courses and prevent complex, radical attempts to address concerns in mathematics education. Instead there will be a reliance on the quick and straight forward responses to the concerns that will have no more than a marginal effect.

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