Intimations of class in responses to innovative mathematics pedagogy in initial teacher education

Colin Jackson and Hilary Povey
Sheffield Hallam University, UK

Abstract
This paper reports on a small scale study in mathematics subject knowledge teaching in secondary initial teacher education. A student-focused, inquiry-based pedagogy is adopted on the course. Accounts from two participants are offered and the suggestion is made that the student responses have classed dimensions.

Introduction
It used to be assumed that, for entrants to teaching, mathematical subject knowledge itself was unproblematic and that initial teacher education was simply about how to teach that content (Ball, 1988). However in the last two decades a significant body of research has been conducted which relates to mathematics teachers' subject knowledge and its relationship to effective mathematics teaching, showing that the previous assumptions cannot automatically be taken for granted (Silverman and Thompson, 2008).

Gess-Newsome (1999), developing the ideas of Ball (1988) and Shulman (1987), proposes two models for working on subject knowledge in initial teacher education: the integrative model and the transformative model. He posits that the integrative model has major problems. In the integrative model, student teachers have independent knowledge bases of subject matter and pedagogy which they then need to integrate to create effective learning opportunities. This represents the current experience for some students on initial teacher education courses who struggle to put together such compartmentalised knowledge in order to be effective teachers of mathematics. In contrast to this, the transformative model offers experiences which are themselves purposefully integrated, connecting mathematical and pedagogical understandings. In this study we report on a course the philosophy of which is firmly wedded to this second approach.

One of the key issues in the education of mathematics teachers is what has been termed the “baggage” they bring with them to their initial teacher education. Everyone who is going to teach mathematics has been a pupil in schools for many years and as a consequence prospective teachers enter teacher education programs already feeling quite at ease with their knowledge of what teaching and learning look like. (Nolan, 2012, p202)

For many, developing a pedagogy that teaches for understanding may be extremely difficult as many will never have experienced it themselves. Teaching mathematics will be about learning rules, tricks and definitions and there will be limited capacity to transform and connect knowledge and to respond flexibly and appropriately to classroom contingencies. These difficulties are well established. What has been less the focus of attention is the extent to which the so-called "baggage" is classed, 'raced', related to age and gendered. Here we draw on a small scale exploratory study from which class issues (and to some extent those related to gender and age though they are not dealt with here) emerged in students' response to inquiry-based, student-focused pedagogy.

The study
The context for this study is a two year route into teaching where the first year is concerned with subject knowledge enhancement and the second is concerned with professional studies
and professional practice. The data reported here are drawn from one cohort of twenty who formed part of a larger study. Several of the students also participated in a mathematics enrichment project which involved running several workshops for students in the second year of secondary school. The students were each interviewed in small groups and the first named author then transcribed the data, initially longhand into notebooks, and subsequently onto the computer. Permeating the accounts was a sense of the interviewees' dispositions towards mathematics; one thing that emerged was a sense of the classed nature of these. Within this cohort there were two distinct groupings where the students had much in common and tended to gravitate towards each other. In particular there was a group of working class men in their early 40s to early 50s and a smaller group of younger middle class women. We use these social class terms intuitively based only on our observations of their speech patterns, dress, humour and so on and our informal conversations with them over the course of the research. We decided to focus on data from two individual students which, through comparison and cross checking, seemed to us to exemplify what we had observed.

The accounts

Here, then we offer the accounts of two students: Brian and Debbie. (Both names are pseudonyms.) We seek to tease out and illustrate their relationships with and to mathematical learning and mathematical subject knowledge, bringing this ‘up close’ as opposed to ‘out there’ distant and abstract' (Gudmundsdottir, 1997, p1). We wanted to achieve this “up close”-ness for ourselves, our colleagues and other readers of this research. In experiencing “up close” the perspectives and interpretations of our students, we have a significant catalyst for changing our practice. In this way we hope to enrich the understanding of the 'complex world' (Doyle, 1997, p 96) of initial teacher education mathematics classrooms.

Brian

Brian was a working class man in his early forties. He had spent many years working as an engineer before he started the initial teacher education course. He decided to apply for the course because he was concerned about the future of engineering in the region and hence about his future employment prospects. At the beginning of the year Brian's mathematical subject knowledge was insecure; he lacked confidence and needed a lot of reassurance about his mathematics.

Before he started the first year of the course he had conceived ideas about it that were fundamentally wrong and seemed to reflect back on his own schooldays. Despite clear statements to the contrary in the course publicity and at the course interview, when talking about the lecturers he said 'I thought they were going to go through ... differentiation and the best ways of teaching it.' Despite the very clear and public focus of the course as being about studying undergraduate mathematics, he thought 'that we'd spend a lot more time in schools. I was shocked when I found out it wasn't that really.' He thought there would be 'more about classroom behaviour and how to deal with unruly students in certain situations'.

One of the key features of the year is there is a strong emphasis on learning in groups; this is very much a new experience for the vast majority of the students. Brian appeared to find it problematic to be working in a group with people who he felt were very unlike him:

they set up little cliques. I think that's what happened; there were little cliques within groups ... if they could do it, they’d do it well and do it quickly and then start discussing other things.

This suggests he did not feel agentic in a group which included people from different backgrounds from himself. He expressed concern that one of the other working class men had been in a group in which he had 'nothing in common' with the other people. Brian thought that if the groups had been mixed up differently then this colleague might have worked with him and rest of the group of working class men.
He had a fairly instrumental way of understanding the benefits of group work:

*when you were doing some problem solving in class, you did get a lot out of it, from the other people as well 'cos obviously if they'd come across it and they'd been doing it recently they went, "ah yeah, you apply this to it" and you will learn off of them and you say, which way, how do you do that?*

To support their mathematical studies these working class men had set up a 'revision' group outside of classes. Brian described it as having gone *back to basics*, drawing on a discourse of mathematics teaching and learning associated with a narrow curriculum and rote learning.

These understandings were not monolithic however. Brian had been involved in the mathematics enrichment project for pupils which had given him a different perspective on mathematics teaching and children's relationship to it. Brian thought that

*if you make something creative and get [the pupils] involved you know how much they get out of it as well as you.*

Brian's involvement with the mathematics project seemed to have shown him the value of creativity in mathematics in a way he had not taken on board through his experiences on the course of working on his own mathematics.

Despite the first year being very different from his preconceptions, it was, in his own words

*a lot different from what I expected, more maths orientated ... I really enjoyed the course. I thought ... it made you think deeply about situations, it made you read articles you wouldn't read. I think you're a better person for it 'cos it stretches you in different areas, sometimes painful but it's rewarding.*

He thought that what the course was really about was *discovering yourself, discovering that knowledge working with other people*. He said it had been quite painful at times, that sometimes *'you were out of your comfort zone – I found every unit challenging to one degree or another.'* It seemed to us that Brian had constructed his story about the journey he had made as one being in terms of personal discovery about himself and not primarily about the mathematics or his relationship to it.

**Debbie**

Debbie was an articulate, slightly unconventional young woman of middle class origins in her mid twenties. She had completed a psychology degree previously and had been working as a careers advisor at a local college. Quite out of the blue she had thought about teaching mathematics. She'd done some research on the internet and then in the space of two weeks applied for the course, been interviewed and accepted, quitting her job in the process. She said,

*I applied late [so] I didn't really have time to think about it.*

She compared the course with her previous degree, saying

*It [is] smaller and more intensive here. I didn't expect to be in from nine to four every day.*

Debbie said she had really enjoyed the course but reported that when describing it to her friends she had a tendency to describe the course in quite trivial terms:

*All I ever tell my friends is, I've been colouring today, I've been making shapes.*

When challenged about this she said that it was not her intention to put the course down; she had really enjoyed it. She contrasted her experience on the course with her expectations. She said she expected that the year of mathematical study *'was just a year I had to get through'* because she had a friend who had done a mathematics degree which he had just hated and she thought her experience would be the same.
The thing she found most unnerving about the course was that there had been no early written feedback.

*I had no idea [talking about mathematics assignments] what the standard was ... I could write essays ... and I could tell that essay is going to pass, but I had no idea with some of my projects. They could have failed and I wouldn't have been majorly surprised.*

As Debbie was a PGCE student all she was required to do was obtain a pass in each module. Despite this she said

*It's been a good thing on the course that I've been interested enough that I wanted to make my project better ... I'm still quite annoyed about that project, there was loads more I could have done and it was really interesting, I'd have liked another week please.*

There was a culture of continuous work and tutors cared about whether you were getting on with your work. She liked the fact that she had to be in from nine to four, four days a week. On her previous degree she had gone to the first lecture on one module, decided it was not going to be that interesting and not gone to any more. She said that was accepted practice and she'd still managed to pass with a good mark. She said it

*did me no harm whatsoever but it would do you a lot of harm if you didn't turn up for the lectures here*

She liked watching different people learn and she liked the range of people on the course because of that. She found it interesting to see how some people could get frustrated with the way they were being taught.

Debbie had found the course quite challenging at the beginning as she hadn't done any mathematics for five years. Like many others on the course she had thought that there would be a bit of a refresher but

*No, none of that! Just throw you straight in and hope for the best which was fine but it was a bit disorientating at first. I really liked it in the end.*

Debbie said it was a complete luxury to have spent a year learning mathematics but she felt the contrast with what was expected of her in school:

*Nobody wants to play. They don't like all my exciting ideas, they just want me to write things on the board that they can copy down ... I know it's a long slow process and you just have to. At least we've got the idea that we don't just want to write things on the board and have people copy it down.*

She believed that 'teaching interactively' was 'doing the right thing'. Her involvement with the mathematics project made her want to lobby for more mathematics trips because *mathematics never gets any because nobody expects mathematics to be fun, nobody expects mathematics to be the subject where you go on trips*; and she did not see much difference between running such a workshop and teaching.

**Discussion**

Debbie, an apparently very capable young woman and a high attainer, was worried in the first semester about whether she could pass the course. But, when she talked about one particular project that she had undertaken later in the course, she expressed annoyance that she had not been able to continue working on it due to an assessment deadline and thus improve it. She thought she could have done a lot more with it, a sign that she was now confident in judging mathematical value. She had entered thoroughly and unproblematically into the group-work based pedagogy of the modules and used it to develop her thinking about both mathematics and teaching and learning. She expected mathematics to be both exciting and fun. She
wanted and expected to make links between her own learning experiences on the course and her subsequent teaching.

Of all the students Brian was probably the most challenged by the course. He had expected something quite different when he had started, and he was one of the weaker mathematicians. In the second semester he had, along with several other students, set up a 'back to basics' revision group, perhaps reflecting the struggle he was experiencing with the mathematics at that time. Brian portrayed himself as being on a journey of self-discovery on the course, one that he had found challenging but ultimately enjoyable and rewarding. But the ideological overtones of 'back to basics' raises a question about the extent to which he had incorporated in that journey a new disposition towards mathematics. He did not volunteer any connections between his own experiences on the course and his anticipations about teaching.

As noted earlier, we regard these students as "typical" though, of course, not representative in any formal sense. We claim that the social practices that these “typical” students met in our mathematics classrooms were differentially available in non-random ways to the students and that these differentials were in part a consequence of their classed social heritage (Jorgesen, Gates and Roper, 2013, p8). As with Lubienski's findings (2000) about her school students, the pedagogy we espouse and the culture of our classrooms seem to have aligned in fundamental ways more smoothly with our middle-class students' 'preferred ways of communicating, learning and knowing' (p398). Lubienski (2002) highlights two key aspects that were differentially experienced by students from different socio-economic backgrounds: discussion-based activities and problem-based inquiry. She writes:

*Researchers and educators should not assume that learning mathematics through problem solving and discussion is equally natural for all students. Instead, we need to uncover the cultural assumptions of these particular discourses. (p120)*

The accounts above give testament to similar responses from our students. First, the students were required to be active participants, and not just passive recipients, in making the mathematics. Many of the tasks they were set involved open-ended problems for which no given method of solution was provided which contrasted strongly with their previous mathematical experiences. For all the students, there was some unresolved tension noticeable between the "respectable" mathematics they expected to experience and the less conventional aspects of the course. But, for Debbie, the gap was a source of pleasure as well as surprise. Brian had to work harder to accommodate the disjuncture and it was not clear that he ever did. Second, we also heard differences in the way the students responded to working with other students in discussion-based ways. Brian talked about the desire to be with "people like us" and he recognised that he struggled to "play the same game" as others who were unlike him. Debbie, in contrast, had welcomed the opportunity to work with others who were different from her so that she could learn how other people thought.

These findings are not presented as anything other than speculative. But they challenge us to re-think our practices to open up our process-based curriculum more effectively for all. As Gates and Noyes (2014) have noted, 'Class, in some guise or another, is always a latent variable whose invisibility obscures possibilities for action' (p46, original emphasis). We believe that we had failed to notice this dimension in the responses to our students to our mathematics teaching. Writing generally about mathematics initial teacher education courses, Jorgensen *et al* (2013) suggest that they need to broaden in order to encourage new teachers to examine the nature of social conditions in schools and theorise the lack of fit between some but not all pupils and the demands of mathematics education. (p17, original emphasis)

Whilst wholly sympathetic to this, we also believe that we need to explore ways in which, within the mathematics subject knowledge teaching itself, we can help all our students appreciate the differential access experienced to inquiry-based, student-focused pedagogies,
pedagogies which have the potential to be empowering for all (Povey and Angier, 2004). We need to enable them to understand the sources of that differential access:

...when certain elements of cultural capital are prerequisites for success in mathematics classrooms, and when educators make faulty assumptions that these prerequisites come "naturally " to "all students", inequities could be exacerbated in reformed classrooms. (Lubienski, 2000, p399)

But we need to do this in ways which also open up for all of them the transformative possibilities of such pedagogies in our own teaching and their learning of mathematics.

References


Gudmundsdottir, S. (1997) Introduction to the theme issues of "Narrative perspectives on research on teaching and teacher education". Teaching and Teacher Education, 13 (1) 1-3.


Address for correspondence:

colin.jackson@shu.ac.uk