

An enquiry into transitions

From being a 'learner of mathematics' to becoming a 'teacher of mathematics'

Liz Jones Manchester Metropolitan University

Tony Brown Manchester Metropolitan University

Una Hanley Manchester Metropolitan University

Olwen McNamara Manchester Metropolitan University

Question. How do you feel about mathematics ?

Answer. Maths is the demon that jumped out of the closet and licked me in the face.

[Third-year student, currently training to be a primary teacher]

Demons are abhorrent creatures. They instil fear and are best avoided. Yet mathematics as a demon has managed to 'lick' this student. Does this imply that the demon has been tamed and that some kind of affection lies between the student and the subject? Has the student's own fear of the subject been licked? If it has, how were the transitions between fear and friendliness, abhorrence and affection, made?

Many transitions are potentially problematic. But for students entering initial training as primary teachers, who so often perceive mathematics as a source of anxiety, the movement between the two locations of learner and teacher seems especially fraught. This exploratory article marks an attempt at having some appreciation of the various kinds of 'self work' (Stronach and Maclure, 1997, p. 135) that is undertaken by students when making the move from being a 'learner of mathematics' to becoming a 'teacher of mathematics'. We suggest that for such students 'identity' can be seen as a key feature in easing those tensions which lie between the two sites. Subsequently we try to show how particular constructions of the 'self' are used to surmount and negotiate hurdles and boundaries. This includes perceived lack of mathematical competence. Our main interest, then, is perceptions of the 'self' and how, in relation to mathematics, it is talked about, described and generally theorised. In part, this involves looking at the kinds of emotional baggage that centre on mathematics and which students have collected over a period of time. We are particularly interested in those ways 'identity' seems to assist in both accruing and jettisoning such baggage. We also note and discuss how accounts of past mathematical experiences are filtered through current perceptual frameworks. It is this crisscrossing between present perceptions of mathematics and the self, memories of mathematics and the self, and how together these feed into and help fashion future constructions of the self as 'teacher of mathematics', that we attempt to address.

In exploring the uneven territory between being a 'learner of mathematics' and being a 'teacher of mathematics' this article offers a series of interpretations based on interview transcripts. These interpretations are personal readings and cannot be considered 'hard-edged analyses' or indeed 'authoritative accounts'. Despite that, however, we believe that the readings take tentative steps in increasing our understanding of 'transitions'.

We begin by situating this study in relation to some existing work on student transitions. There follows a more detailed account of how we perceive 'identity'. Finally readings based on interview transcripts are offered. Here our task is to show how 'identity' becomes a means of reconciling the past with the present and the future. Our suggestion is that, because certain reconciliations have been effected, transition between the two sites of learner and teacher becomes possible.

'Transition': what the papers say

Research into student transitions can be roughly grouped into two domains, cognitive and affective. In recent years the first arm of this body of literature seems to have taken its lead from Shulman (1987) with the focus on Pedagogical Content Knowledge (Wilson *et al.*, 1987; Livingston and Borko, 1990; Ball, 1991). Here consolidating and acquiring knowledge and expertise are perceived as a way of moving from the location of learner to that of teacher. Ball (1988, p. 12), for example, believes that a 'knowledge of mathematics is obviously fundamental to being able to help someone else learn it'. Research into the affective domain meanwhile spans both sociological and phenomenological perspectives. Lortie (1975), for example, who is guided by the former, suggests that student teachers, when at school, have spent time in an 'apprenticeship of observation'. That is, as school pupils they have absorbed a range of values, outlooks, practices and processes which work at fashioning perceptions of teacherhood. This point is extended further by Zeichner *et al.* (1987), who suggest that students' general philosophies concerning teaching showed very little sign of change as a consequence of professional training. Similarly, Harel (1994) notes that notions concerned with teaching, particularly the teaching of mathematics, are tacitly formed by the way students have been taught the subject, prior to college. However, Su's (1992) research highlights the general influence of school-based experience when training to be a teacher. More specifically, however, it is the 'pupils' reactions, feedback, and performance' (p. 254) which are seen by the student teachers as the most important indicator of their effectiveness in becoming teachers. Meanwhile other researchers guided by the individual student's specific perspective (e.g. McNally *et al.*, 1994; Guillaume and Rudney, 1993) indicate how students will cite comfort in personal relations with both staff and pupils as evidence of their final transition to teacher status.

Elsewhere we seek to reconcile the apparent dichotomy between phenomenological and 'official' perspectives (Brown *et al.*, 1999). In this article,

however, we shall restrict ourselves to the phenomenological experience of students seeking to reconcile their personal experience of learning and teaching mathematics with the professional frames they need to inhabit.

The study

Identity should not be seen as a stable entity – something that people *have* – but as something that they *use*, to justify, explain and make sense of themselves in relation to other people, and to the contexts in which they operate. In other words, identity is a form of argument. As such it is both practical and theoretical. It is also inescapably moral: identity claims are inevitably bound up with justifications of conduct and belief. [Maclure, 1993a, p. 287, author's own emphasis]

The notion that 'identity' is something people *use* became a significant research theme. Using interview transcripts, drawn from an ESRC project entitled 'Primary student teachers' understanding of mathematics and its teaching' (see Brown *et al.*, 1999), the task centred on discerning the ways in which the students chose to describe themselves. So those ways in which the 'self' perceived the world, including certain worries concerned with the learning and teaching of mathematics, became in our view central to how such concerns were confronted and addressed (Munby, 1986; Schon, 1979). Taking note of the figurative language that was used by students when talking about themselves, particularly in relation to mathematics, allowed us glimpses into some of their beliefs and orientations about learning and teaching. In some respects the research echoes that of Kagan (1990), who, in seeking to develop alternative ways to evaluate newly qualified teachers' thinking, focused on their choice of metaphors. These were perceived as reflecting how they characterised: 'the nature of learning, the teacher's role in the classroom and the goals of education' (Kagan, 1990, p. 423). In this way beginning teachers' metaphors offered some insights into how they had filtered and modified their university training.

The idea of identity as being something that is *used* as a 'form of argument', and which, moreover, could assist in negotiating the boundary between student and learner, became key in the formation of our research focus. As a consequence, particular attention was paid to those parts of the texts in which the students talked about themselves as 'learners of mathematics' and where they foresaw themselves being 'teachers of mathematics'. The methodological framework used when analysing the data is loosely derived from conversational analysis and ethnomethodology. Both these approaches, whilst having certain distinct characteristics, nevertheless share the view that language, action and knowledge are inseparable (Stubbs, 1983, p. 1). Our studies were not undertaken to find the 'true' identities of the students, nor were they undertaken to find the 'truth' about transition. Rather, our efforts were directed at unearthing the ways in which notions of self get talked about and how such notions become the means of negotiating and staking out particular claims, and become 'theorised in discourse' (Maclure, 1993b, p. 377).

Two key focuses emerged from our reading of the transcripts: first, how students used the past, present and future when accounting for themselves, and, secondly, how in describing their past mathematical experiences it seemed that negative perceptions of self were resituated as positive traits. The article suggests that, by displacing certain negative perceptions and locating them as a positive term, transitions between the two sites of learner and teacher became possible.

This article is based on four transcripts which were collected during the first round of interviews for the study. Specifically, the body of students that the research focused on were those who were training to be primary teachers and who, as part of their professional brief, would have to teach mathematics. Significantly, whilst all the students that were interviewed held a GCSE mathematics qualification, none had pursued mathematics as an A level subject. Nor had any of the students elected to study mathematics as either a first or second subject as part of their university course. The research set out to investigate the ways in which such non-specialist students conceptualise mathematics and its teaching and how their views evolve as they progress through an initial course. In all, twenty-seven students were interviewed and each student was interviewed three times at strategic points during the academic year: at the beginning of the year, whilst on school experience and at the end of the year. A particular point was made of interviewing the first-year intake before they had received any mathematics education input. Elsewhere more concise details concerned with methodological procedures are available (Brown *et al.*, 1999, pp. 303–5).

The four transcripts that feature in this article were chosen because the students themselves share certain similarities and the transcripts reflect concern with learning and teaching mathematics. Thus all four students, one from each year of the course, were women who, when starting the course, were aged between 18 and 19. Three of them had gained a C grade pass at GCSE whilst the fourth had acquired a B. All four had expressed a dislike of mathematics when they were at school, and each of the students maintained that they lacked competence in the subject.

Rereading the transcripts

The interview began with the question ‘What is the first thing that comes into your mind when you think of maths?’

I know I’m not very good at it

It’s a way of adding and multiplying and taking away certain things ...
Maths relates to numbers ... It’s so big. [Year 1]

Maths is scary ... I’ve always not been wonderful at maths. [Year 2]

The second-year student then expanded on ‘what maths is’:

... numbers, problems, day-to-day activities. I know maths is involved in more or less everything I do in my life. We talked about that in lectures ...

There's the very complicated side of maths ... When you're sat down and doing sums intensely, GCSE, algebra, that sort of thing ... but if you're going back to the roots, back to the simplest basic points of maths, then it's to do with day-to-day problems and helping you through life ... We talked about that ... It's sorting out of things as well as the complicated side of things ... organisational skills ... sorting washing, blacks and whites ... that's all maths ... Common factors or differences ... that's maths ... I didn't realise this before I came on the course ... We've unpicked a lot on the course ... and it's made me think maths isn't just scary numbers on a piece of paper, which I used to think.

This student appears to have developed a means of managing mathematics, and in part her strategy is a consequence of college sessions. Mathematics, it would seem, is conceptualised as a series of binary oppositions. On the one hand there is the 'very complicated side of mathematics' whilst on the other there are the 'simplest basic points'. Using these two polarisations the students' responses could be presented as follows:

Complicated maths

Sat down
Doing sums
Algebra
GCSE
Pieces of paper
Scary numbers

Simplest basic points

Active
Going back to roots
Day-to-day problems
Helping you through life
Common factors
Differences in things
Numbers, money
Shopping lists
Grouping things
Sorting things out
Organisation

It would seem that through a process which is captured in the statement 'We've unpicked a lot of things on this course' the student makes certain moves. It is a collective move in which she and her year group, together with the college tutor, work together at 'unpicking' mathematics so that aspects of it may be valorised. By way of the discursive practices of college mathematics the student is motivated to leave behind that 'scary maths' which is located in and associated with 'doing sums intensely'. Rather, she finds herself moving back to the 'roots' and to the 'simplest basic points' in order that she may progress forward towards teacherhood. And as she travels there is, we believe, a sense of her beginning to collect some of the cultural baggage which has come to be associated with primary mathematics; certain terms – for example, 'groups', 'common factors', 'organisation' – signal her entry into the discourse of primary mathematics. In effect, emotional and cognitive shifts are taking place within the self. There are the internal realisations that mathematics both exists and – importantly – can be *understood* even within mundane activities of everyday life. Simultaneously external changes also occur; she is now beginning to sound like a primary teacher.

And what of the third and fourth-year students? How did they use notions of ‘identity’? It appeared that the fourth-year student also dichotomised mathematics. She polarised the subject as either ‘do-able’ or ‘not do-able’, where by implication mathematics is subdivided between that which can and that which cannot be understood. She says:

Simple calculations – adding, subtraction, multiplication and division – I can do, no problem. When you get into algebra ... I can’t do it ... It’s the more complicated things like statistics that frighten me ... I love addition because it’s simple. I do things like area, capacity and volume because they’re practical. I liked trigonometry ... you were given a question – you had a triangle in front of you and you could see that one of the the sides or one of the bases was going to be longer than the other, or whatever, so you could work out roughly what it was going to be, whether it was going to be a reasonable answer or completely out of this world ... whereas algebra ... it doesn’t really mean anything.

Her response could be arranged as:

<i>Not do-able maths</i>	<i>Do-able maths</i>
Complicated algebra	Simple basic calculations
Fear	Love
Completely out of this world	Reasonable answer
Doesn’t mean anything	Means something

Meanwhile, the third-year student posited the following theory which, so it seemed, helped in explaining her lack of mathematical competence:

Somewhere along the line I just think that I’ve not understood it properly ... I personally feel that maths – to know how to do things you have to understand it in you as a person ... Sometimes I ponder over it, and then I think, ‘I should know this anyway.’

What is being implied here? Does the student, for instance, conceptualise the learning and understanding of mathematics as occurring along a linear developmental line? So that when she does master a particular problem her success is never read in fulsome terms. Rather, she thinks, ‘I should have known it anyway.’ That is, she should have learned ‘it’ at some specific or particular point *en route* to the present. By constraining herself within a particular way of perceiving mathematical knowledge and its development, it would seem, a lack or gap will always exist between herself and the idealised mathematics student, ‘who can understand it in you as a person’.

Echoes of this notion of ‘understanding it in you as a person’ could be found in the transcripts of the other students. There were, of course, variations in the ways it was expressed. For example, the first-year student categorised people as either ‘mathematical sorts of persons’ or ‘arty sorts’. Furthermore, because she defined herself as an ‘arty sort’ she considered that her chances of fully understanding mathematics were curtailed. To quote:

I think if you sat there and learnt and learnt and learnt I still don't think you could change the way you were. I don't think you can suddenly become a mathematical sort of person. I mean, I had tutoring for my GCSE and I had a lot of help from my teacher and no matter how much they explained things it still took me a long time ... other people got it just like that.

Similarly, the second-year student talks about her brother as able to do mathematics 'just like that'. He, apparently, 'doesn't spend hours doing maths, but when he has to do it, it comes, just like that'.

What are some of the consequences of these perceptions? What, for example, are the effects of placing oneself in the 'not capable' category? One reverberation, which is highlighted in the third-year transcript, is that mathematical achievement is perceived as paradoxical; success is always shadowed by failure: she 'should have known it anyway'. Similarly, the fourth-year student found the learning of mathematics 'very, very hard. For some people it just *naturally* clicks but I have to work and work and work at it' (our emphasis). What are the implications for being 'teacher of mathematics' when the student has located herself within the 'not-capable of mathematics' category? It would seem that, rather than being perceived as a hindrance, this particular construction appears to become a strong motivating force. Thus the first-year student – who, it should be remembered, has had no college input – foresees that because she has 'struggled so much, I think it would benefit me.' She goes on to map out certain ideas for the teaching of mathematics:

I'd want to give them as much of the basics as I could because I think that would prepare them more ... I'd do it very practically. I'd say, 'Count these and count these ... what happens when you put them together? I wouldn't say, 'Now add them up,' I'd say, 'What happens when we move this pile of bricks to this pile?' How many are there altogether?

whilst the third-year student would

Try to understand where the children were coming from and where they got their ideas from to start with ... and I would ... break things down step by step rather than everything just seem like taught as a whole

The fourth-year student, so it would seem, credits the university course with helping her make the transition from 'learner' to 'teacher':

And it was kind of ... we are going to teach you how to learn this the same way that children will, and that gives you a very good understanding of how the children learn maths, as well ... You've been through that same process, as you are going to teach the children, and you know what to expect and you know broad outcomes of what might happen.

From this we offer the following speculative thoughts. It would appear that, for the fourth-year student, shifts in location, including that between being 'learner of mathematics' and being 'teacher of mathematics', is not a linear process. In order to take on the future role of teacher, the student feels that within the context of college mathematics sessions she is repositioned as 'the child'. As 'the child' she can attend to the 'basics' and the 'simplest points of

maths' and in so doing she can leave behind all those negative aspects of mathematics. Upon entering school as a teacher she will be able to demonstrate that she is indeed a teacher; she will be able, for example, to control, organise and structure the primary classroom (see Brown *et al.*, 1999, p. 313). But when it comes to the teaching of mathematics, internally she will be in many ways 'the child' and it is this imaging of herself that will provide her with the confidence to teach.

Rereading the scripts, it seemed to us that, because of their own struggle with mathematics, the students were determined to deliver the subject in terms other than those of their own experience. As teachers they will learn from their own gaps, omissions and deficiencies in the subject. In effect, they will take all those things that in the past they have perceived as preventing them from developing mathematical competence and they will assert the authority of the 'opposition'. So the students did not, it seemed, want to become 'mathematical' types; rather, they appeared to draw strength from being the Other to this construct (Walkerdine, 1990, p. 62). And it would appear that college helps to strengthen this persona:

I didn't enjoy it because it was ... complicated, ... intense, difficult, hard. Didn't like it – boring ... so I thought, from that, well ... the children I was going to be teaching, I don't want them to be taught like that, so I've been thinking about different ways of teaching which have come from university. They've helped in, say, in practical sessions, relating it to the home ... You use maths every day in everything that I never thought of ... washing, sorting out, organisational skills, variation in things, differences in things, common factors in things like three people have got brown hair, that's maths, it's relating it to just people. It doesn't have to be difficult like I did at GCSE to be able to understand maths, so I thought, I like this approach, I enjoy it, it's easy to relate to, it's not tedious, it's interesting ... Went on my school experience ... did a practical approach, and it worked, so therefore I've got confidence. I know what works. I know I have to go into everything thoroughly before I teach, but as long as I make it interesting, don't let the children lose it, get bored, then it should be OK. [Year 2]

Concluding thoughts

Our readings should be regarded as tentative explorations which nevertheless can work at focusing attention on the significance of identity and its relation to transitional journeys. So, for the students we have met in this article, in order to succeed, mathematics must feature 'in the "genes"' (be part of your identity, make-up). It just 'clicks' or it doesn't. If you are an 'arty person' any success in mathematics tends to be overshadowed by the failures of the past, and in this way future experience with mathematics is always prescribed. The non-specialist trainee teacher, destined to include mathematics in her professional repertoire, appears to be wedded to the failed pupil but seeks to revoke those characteristics of mathematics classrooms that are associated with failure. In some measure this means declining to assume the

identity of 'a mathematical sort of person', frequently pathologised in the figures of mathematics teachers assembled from the past.

We end by offering a caricature of the journey made by the students. First, mathematics as a demon is powerful and in various ways it subjugates the student and fills them with fear and loathing. But, in jumping out of the closet, mathematics is 'outed'. It is removed from the dark and abstract underworld. In the light it is possible to see mathematics's softer side. This aspect, besides being fun, is also basic and practical. In fact maths is so friendly that, besides letting it loose with children, you can, if you are so inclined, let it lick you.

References

- Ball, D. L. (1988), 'Unlearning to teach mathematics', *For the Learning of Mathematics* 8 (1), 40–8.
- (1991), 'Research on teaching mathematics: making subject knowledge part of the equation', *Advances in Research on Teaching* 2, 1–48.
- Brown, T., McNamara, O., Hanley, U., and Jones, L. (1999), 'Primary Student Teachers' Understanding of Mathematics and its Teaching', *British Educational Research Journal* 25 (3), 299–322.
- Guillaume, A., and Rudney, G. (1993), 'Student teachers' growth towards independence: an analysis of their changing concerns', *Teaching and Teacher Education* 9 (1), 65–80.
- Harel, G. (1994), 'On teacher education programmes in mathematics', *International Journal of Mathematical Education in Science and Technology* 25 (1), 113–19.
- Kagan, D. (1990), 'Ways of evaluating teacher cognition: inferences concerning the Goldilocks principle', *Review of Educational Research* 60 (3), 419–69.
- Livingston, C., and Borko, H. (1990), 'High school mathematics review lessons: expert–novice distinctions', *Journal for Research in Mathematics Education* 21, 372–87.
- Lortie, D. C. (1975), *School Teacher*, Chicago: University of Chicago Press.
- Maclure, M. (1993a), 'Arguing for yourself: identity as an organising principle in teachers' jobs and lives', *British Educational Research Journal* 19, 311–22.
- (1993b) 'Mundane autobiography: some thoughts on self-talk in research contexts', *British Journal of Sociology of Education* 14, 373–84.
- McNally, J., Cope, P., Inglis, B., and Stronach, I. (1994), 'Current realities in the student teaching experience: a preliminary enquiry', *Teaching and Teacher Education* 10 (2), 219–30.
- Munby, H. (1986), 'Metaphor in the thinking of teachers: an exploratory study', *Journal of Curriculum Studies* (18), 197–209.
- Schon, D. (1979), 'Generative metaphor: a perspective on problem setting in social policy', in A. Ortony (ed.), *Metaphor and Thought*, Cambridge: Cambridge University Press.
- Shulman, L. (1987), 'Knowledge and teaching: foundations of the New Reform', *Harvard Educational Review* 57 (1), 1–22.
- Stronach, I., and Maclure, M. (1997), *Educational Research Undone: the postmodern embrace*, Buckingham: Open University Press.
- Stubbs, M. (1983), *Discourse Analysis: the socio-linguistic analysis of natural language*, Oxford: Blackwell.
- Su, J. (1992), 'Sources of influence in preservice teacher socialisation', *Journal of Education for Teaching* 18 (3), 239–58.
- Walkerline, V. (1990), *School Girl Fictions*, London: Verso.
- Wilson, S. M., Shulman, L. S., and Richert, A. E. (1987), 'Those who understand: knowledge growth in teaching', *Educational Researcher* 15 (2), 4–14.

Zeichner, K. (1987), 'The ecology of field experience: toward an understanding of the role of field experiences in teacher development', in M. Haberman and J. M. Backus (eds), *Advances in Teacher Education* III, pp. 94–117, Norwood, NJ: Ablex.

Acknowledgement

This article reports on the Primary Student Teachers' Understanding of Mathematics and its Teaching project funded by the Economic and Social Research Council, project No. R000222409. The research team would like to express its gratitude for this support.

Address for correspondence

Dr. Tony Brown, Didsbury School of Education, Manchester Metropolitan University, 799 Wilmslow Road, Didsbury, Manchester M20 2RR. *E-mail* A.M.Brown@mmu.ac.uk