

**A CASE OF LEARNING MATHEMATICS THE HARD WAY AS A
TEACHING ASSISTANT**

Pat Drake

Sussex School of Education, the Sussex Institute, University of Sussex, Falmer, BN1
9QQ.

ABSTRACT

This paper develops early data from a qualitative longitudinal study of the first cohort of five students making the transition from teaching assistant in secondary school to specialist teacher of secondary mathematics. Data from a second cohort of four women and one man starting in 2003 is less complete, but used as appropriate. Bernstein's work on subject classification frames an argument that this student group navigates simultaneously two mathematics discourses: 'hard' university mathematics, and 'everyday mathematics' as experienced by the lower ability school pupils that the students support. This raises questions about the purpose and scope of the students' work in school with respect to their mathematics learning, and vice versa. The study of conventional mathematics undergraduates for the ESRC (Macrae, Brown, and Rodd, 2003) provides a foil against which to compare approaches to learning mathematics, raising the possibility of a rethink of pre-requisite pre-qualification, and potential relations between university mathematics and work-place learning in secondary schools.

INTRODUCTION

This paper draws upon the experiences of students making the transition from being a teaching assistant in secondary school to becoming specialist teacher of secondary mathematics, via a local degree programme set up specifically for this purpose. The progress of these non-conventional students towards a strongly mathematically oriented degree via professional and academic learning is considered from two directions:

- relationship between high level mathematical discourse in the academy and low level mathematics in the workplace or in school;
- comparison of the students' experience with that of conventional undergraduate mathematics students.

In the context of mathematics I suggest in this paper that 'university mathematics' and 'school-based, or professional' mathematics are different discourses, so that the extent to which learning in one discourse is applicable in the other must be explicitly questioned. In comparison with conventional mathematics undergraduates, the study draws attention to approaches to learning adopted by the students that seem to aid mathematical progress despite unconventional and low-level formal mathematics pre-qualifications.

A study (Thorp et al, 2002) showed that progression opportunities for teaching assistants were practically non-existent, those that did exist being fragmented and incoherent. This coincided with efforts by the university to widen access to unconventional students. The fact that the university is a campus university with both a mathematics and an education department, both of which were under financial pressure, led to co-operation between the departments that had not happened to any great extent previously. The nature of the university – 'old' in relation to its 'new'

near neighbour – resulted in a decision to develop two Honours degrees for secondary teaching assistants, in Mathematics Education Studies, and in English Education Studies. Both universities were members of a local consortium attempting to develop progression routes for teaching assistants, and the new university developed a Foundation degree for primary teaching assistants. Work in 2001 and 2002 on a Diploma in Professional Education Studies became the first year for all the degrees and a prerequisite for the second and third year of the honours programme. The first cohort of students enrolled on the second year of the new BA in Mathematics Education Studies in September 2003. One of the requirements for progression to the second year was that students support mathematics in a secondary school¹.

The degree includes three components each week during school terms: a day's worth of taught courses at the university; a study day; and a large component of work-based learning to provide a context for mathematics and for professional issues. Sufficient hours are provided for an honours degree to be achieved in three years through explicit articulation of learning in context, and through extension of the university terms to the length of school terms, i.e. 39 weeks per year instead of 30².

The first cohort of students, all women, were aged between 35 - 49 on entry to the university, and all working as teaching assistants in three schools, two in each of two schools, and one in a third. Occupationally the women would at the beginning of their studies be placed in National Statistics Socio-Economic Class 6, semi-routine occupations. Comparison with UCAS data for university applicants in 2002 and 2003 (UCAS, reported in Hansard) shows more than half are from families classified as NS-SEC 1 or 2 i.e. themselves large employers, or higher managers, or professionals or from technical occupations (although the majority of applicants will be classified according to their parents' occupations rather than their own). Most people working towards a degree qualification in the UK in 2003 were under 30 years old, with less than a fifth being over 40 (Labour Force Survey, Office for National Statistics, 2004). This positions the students as older than almost three-quarters of the undergraduate population and in a lower socio-economic category than about half of them.

With one exception, all had been supporting mathematics for at least two years. The one student who did not support mathematics transferred into the mathematics department at her school in January 2004, and there was immediate and noticeable improvement in her mathematics at university.

The students all had GCSE or O-level mathematics attained in the earliest case in 1973 and most latterly in 2000. None had higher than Grade B Intermediate GCSE in mathematics, but one student had Accountancy O-level grade A, and another had completed one Open University entry level 1 course in mathematics. Other qualifications ranged from O-level, GCSE and A-levels achieved at school, and all had qualifications gained through continuing education as adults: in counselling, embroidery, art, design, numeracy, literacy and computer qualifications between

them. One student had a basic skills teaching qualification, and continues to teach adult numeracy.

The students represented an unusual and unfamiliar group of learners of mathematics. It was important that, the university having provided a very arduous opportunity (combining part-time work with full-time study compressed into three years), it took responsibility for success or failure of the programme. The research question '*What is relevant in understanding the development of mathematical understanding in these adult learners?*' was of central interest. I became interested in finding out what attracted these adults to engage with learning mathematics, and why choose this means of doing so. We wanted to find out whether and how students' awareness of their mathematical understanding changes over time, and how we could describe this.

As one of six tutors on the programme I had very privileged access to the group and was able to elicit co-operation in participating explicitly in the study as part of the programme. Rather than attempting to arrive at an unnatural reconciliation between myself as an observer/researcher and myself as teacher, I tried to work within the paradigm of feminist researchers such as Patti Lather (1991), to encourage ambivalence, and imagine a space in which I was also a subject. This meant that over time I applied my research questions to myself and my own assumptions about learning mathematics were questioned throughout the degree. As this paper arises out of early stages of this project whilst the students were in their second year, the 'findings' reported here are reflected into the third year of the programme, and have informed teaching and learning with the second cohort.

Data has been generated via:

- systematic scrutiny of students' files from 2001 onwards;
- scrutiny and assessment of students' course work in July 2004;
- notes from individual tutorials during 2003-4;
- structured interviews with each student in March/April 2004, recorded and transcribed;
- structured interview with the other course tutor in June 2004;
- research diary notes.

In fact all the students are highly skilled and motivated, and enrolment at university was a natural extension of much study behind the scenes, motivated through family, or leisure activity at first, and then via professional development. All had acquired additional qualifications since leaving school, and each was used to 'being a learner'. Typically one commented:

for most of my adult life since I've left school I've actually studied something so I like learning just for learning's sake, so I've virtually always done some form of study that's

more pleasure orientated, and gradually getting higher qualifications, this will be the highest one.

One student's pathway on to the programme was because she had joined originally a basic numeracy class taught by one of the other students:

I only really only got interested in maths when my daughter, who is now eighteen, started here, and brought some homework, and asked for some help, and I couldn't help her. And then I noticed that the school ran an adult basic skills class. So I originally came to adult basic skills class to get help with my daughter's homework, and from that I got interested in maths, and I took a Number Power, which was an adult achievement award, and then I moved on to GCSE foundation and then to GCSE intermediate. I just found that I, you know, quite like maths. It was interesting and a completely different experience than I had when I was learning it for myself.

That this student was also actually working in the school that she had attended (and disliked) as a pupil, and that her daughter also attended reflects geographical stability on the part of the whole group. Each was committed to East Sussex, and three of them were working in the schools attended by their own children (although in each case, the children had grown up).

I'd always done an evening class or something, and always I'd been getting a bit of training through work and to be honest some of it was damn easy, well I wanted to something a little bit more advanced. I got on to the Diploma and enjoyed it so I thought I'd give it a go. And there was an element of there not being many maths teachers, and seeing people coming in and thinking I'm sure I couldn't do any worse than they do. I might not be able to do any better but I don't think I could do any worse. It sort of spurs you on.

MATHEMATICS, THE ACADEMY AND THE WORKPLACE

Bernstein (1996, 1999) suggests a model of knowledge discourses explained through reference to horizontal and vertical axes. Horizontal discourse consists of everyday, oral, commonsense knowledges, and are not represented as forms of explicit knowledge in schools and universities. Acquisition of this knowledge is likely to be through watching someone and may not even be made explicit. Vertical discourse is a coherent, explicit knowledge structure, based on systematic principles, hierarchically organised and written in form. The natural sciences and mathematics exemplify conventional vertical university knowledge structures.

Despite a considerable literature on the development of mathematical understanding and performance of children in mathematics, work on development of mathematical understanding in adults until very recently has been limited to studies in learning low-level practical mathematics (often called numeracy) in context. There is a body of work in the tradition of situated learning of mathematics (e.g. Lave, 1988; Harris, 1992) in which it is loosely recognised the mathematics that is practised in the

workplace or in everyday life is learned more successfully than that which occurs in the mathematics classroom.

Within the last ten years, political intervention in mathematics learning in schools has been associated with a flurry of interest in the purpose and scope of mathematics teaching, the attainment of students, and the effectiveness of the learning for the purpose for which is taught. There have been investigations in three main fields relating to post-compulsory schooling:

- mathematics required professionally by workers in specific occupations (e.g. Hoyles, Noss and Pozzi, 1999; Evans, 2000), and the implications of poor mathematical skills (e.g. Bynner and Parsons, 2000);
- the preparedness of school students for mathematics learning post-16 (e.g. Sutherland and Pozzi, 1995; Kahn and Hoyles, 1997; Sutherland, 2002, Smith, 2004);
- take up of mathematics by students exercising choice post-16; Dolton and Vignoles, 2002; Wolf, 2002, Smith, 2004).

This work tends to veer away from advocating learning in context, in favour of addressing known mathematical difficulties (e.g. algebra and proof) by targeting these separately. Using Bernstein's analysis, this focus is on mathematics as a vertical knowledge discourse and offers a significant challenge to the orthodoxy both of relevant and practical mathematics curriculum as not providing suitable preparation for the post-16 pursuit of mathematics. This discourse also imposes the need for specialist mathematics school professionals to be successful in negotiating the high status vertical discourse of mathematics as practised and perpetuated through the university.

Dowling (1998) claims school mathematics students are positioned differently according to social class, with working class pupils remaining in everyday mathematics, and middle class school students positioned towards esoteric mathematics. Thus the question arises as to how, for these students, mathematics work at the university relates to their mathematics work at school. This can be construed as problematic in three dimensions: first, as teaching assistants, the students are working in school with mainly pupils in the bottom sets, pupils who are positioned through class/ability in everyday mathematics discourse. Second, the previous mathematics experience of the students themselves locates their mathematics understanding to date in this discourse. And third, the programme structure mirrors this dilemma, in the attempt to bring together the 'everyday' work experience of the students into the higher education mathematics discourse.

It is not surprising then, that when asked whether there was any relationship between the mathematics they study at the university and what they do in school, students articulated really very little resonance in terms of mathematics, because of the school pupils that they worked with.

From the TA point of view no, because we work with the basic level kids who are nowhere near that level. Probably from the teaching point of view no because I only work with year seven and year eight.

It did seem that this student at least thought that connections were desirable, for she goes on to say:

But this week was cross curricular week and I was with year eleven and the GCSE stuff and there's been things like the graphs and loci; the gradients and quadratics and formulae and stuff, and it's come in useful for that, but then I don't really work with year elevens.

However, the students did make sense of the question in terms of pedagogy, for example, seeing their struggles with university mathematics as providing insight into school pupils' difficulties, even though the specific difficulties may be different, as in this example with algebra:

We've started doing some more algebra, so that was my difficulties, getting to grips with quadratics, it's easier for me to see how when students are having difficulty to try and help them get round it. Not the same difficulties, they had problems with relating letters what does that letter mean, why are we using a letter? Having had that difficulty with quadratics and not being able to get my head round it to start with I can identify with – I've been trying to find ways to make it more easier for them.

More than one student made connections with the approaches to learning mathematics considered at university:

A few weeks ago you gave us a chapter to read on strategies to help learn maths, and then I pulled out some of the points and discussed it with one of the other teachers who was trying to help a GCSE class revise and there were points in that like writing notes, reading it to yourself, trying to do examples, strategies like that to help them get through problems.

In assuming an embodied knowledge relation between workplace everyday mathematics classrooms, or horizontal mathematics discourse, and that this will shed light upon possibly one of the most vertical of the vertical discourses, i.e. university mathematics, is asking for the dizzyingly impossible! Thus we must look elsewhere to justify the requirement for students to be working in school mathematics departments.

UNDERGRADUATE MATHEMATICS STUDENT EXPERIENCE

The first serious attempt to investigate the actual experience of learning mathematics in higher education is a recent ESRC longitudinal study '*Students Experience of Undergraduate Mathematics*' (SEUM, 2000 – 2003, Macrae, Brown and Rodd), which was conducted in order to explore students' choice of mathematics at university, and choice of teaching career. Of concern was understanding how positive attitudes to mathematics are built up, how attitudes change, and what helps/hinders students develop positive attitudes to mathematics, and the study included an attempt

to identify ways of encouraging students to complete their mathematics degree successfully. Two cohorts of single honours undergraduate mathematics students were tracked throughout their mathematics degrees at two universities. The study identified several interconnected factors that characterise experience of 'traditional students' (i.e. higher than average points scores on entry, and mainly following on straight from school. This study is useful in fore-grounding the experiences of traditional mathematics learners at universities. All 'able', many are successful through a combination of previous experience, good luck in being born into supportive families, personal characteristics of tenacity and motivation, and teaching that suits them. However others are not at all successful or happy with their experience. Some individuals are powerless to address difficulties with mathematics or the manner they are taught, and do not know how to help themselves.

If academic subjects such as mathematics are to be available to a wider group of students, understanding of the range, continuum and experience of mathematics learning at the university on the part of adult students with differing profiles becomes a priority.

In comparison with the SEUM students, these mathematics education students seem vulnerable on several counts. For a start, unlike conventional mathematics undergraduates, none has any parents, brothers or sisters that had attended university, and only one has graduates in her immediate family: her husband and daughter. Secondly, in terms of class background, these students are an under-represented group of the university population as a whole. And most obviously none had what could even remotely be translated into the equivalent of high points scores in A-level mathematics.

So, the interviews were constructed to pursue themes identified in the SEUM study: attitudes; lifestyle, experiences and knowledge including that gleaned from friends and relations; helping/hindering strategies; what is envisaged helping students complete; and ambition to teach mathematics.

For the BAMES students, attitudes to mathematics have changed since they were school students themselves. School mathematics was described in interview in depressing ways that will be familiar to nearly all readers:

'monthly tests', 'wanted to do A-level but I was told I wasn't good enough', 'solving problems and lots of examples', 'really nice teacher in the first year/horrible git in the second year, and again for O-level, I'd have done better with the nice teacher', 'didn't understand it', 'wasn't keen until the teacher made it relevant'.

Following an approach described by Barbara Miller-Reilly (2000), I asked the students to generate metaphors in response to 'if mathematics is the weather/ kitchen utensil/animal/ way to travel, what would it be now.' Not unexpectedly, the students expressed ambivalence, for example:

...it would be a saucepan because things go in and get all mixed up and sometimes something nice comes out

In terms of study, life style and organisation, students' study habits had changed since studying mathematics. Organisational factors, such as realising that it was necessary to set aside regular time to do it in, environmental factors, and factors related to the actual mathematics are all articulated. It is evident that these women must integrate their study with family life, and each seeks to find time to work at home when other family members are out. The study day is critical in this respect. All have space at home, described in affectionate terms, for example:

'very quiet, on the dining room table, I can see out of the window, many distractions watching the birds'

in the case of one student. Two students take their study day in school, working together in the maths office 'busy, with children popping in and out'. One relates home to school – 'I've got my own part of the house where I can leave everything out, at school I work with .. either on an actual job together or because we've both got laptops we work separately on assignments or on directed tasks.'

Students comment that they have had to increase the time they allow for academic tasks as it always takes longer than they first imagine. Two of them note that working together is most helpful but needs to be thought about:

Originally we used to start off working on our own and then get together to see what we'd done, whereas now we do it the other way round, we sort it out together, and then once we've got it straight in our own heads then we can go away and work on our own, otherwise I was finding that if I got stuck I would stay stuck sitting at home on my own, whereas coming in and talking to people helps.

When asked what helps with difficult mathematical ideas, the students have each developed strategies for support, some of which seem more successful than others. Unlike the SEUM students who relied largely on lecture notes, there seem to be a range of approaches including using text books, tutors, other mathematics teachers in school the internet, and each other. Two students, like some successful SEUM students, work together, but in school. Whilst talking enthusiastically about this, they raise the fact that there is a tension in so far as they have reservations about approaching teachers who are visibly busy with other duties. This is a critical point in terms of distinguishing between school mathematics and university mathematics. These two students are forthright in using the school environment for what they see as being its mathematics function, i.e. to engage in a vertical mathematics discourse.

I would say four-fifths of what we do is together and then we go off and do things on our own at home I ask ..., and anyone who'll listen - anyone who's not teaching I can grab! Well any of the maths departments, any of the science department who stray into the maths department, and who look like they might know what they are talking about, um, student teachers, Dave is good. Well, he's not here at the moment, he's gone back in September, he's the student we had. Possibly because he's not so busy, the others would always help, in their marking and preparation time, but he would always come up and

say, what are we doing today, we wouldn't have to ask, and it is quite nice not to feel you're badgering people.

In so far as what makes mathematics difficult, the students, like their traditional counterparts, referred to the speed at which topics were dealt with in class. All have developed strategies for addressing this, such as revision at home, and repeated practice, but the students vary with respect to their confidence in being able catch-up things that have not been understood, and gave examples of specific topics. In addition, and perhaps fundamentally, students recognised the need to become adroit with algebra, and were explicit about the difficulties in 'applying squiggles', 'reading symbols', and the need to grasp the concept of a variable:

All these silly little symbols that don't have any meaning, and you can use them in more than one context and they haven't got a set value. Squiggles like pi I can cope with because it's a number though it's not a fixed number, a never ending number, I can cope with that. I can cope with e because it's the same number but it's when they change numbers and they have different values. Well like delta has different symbols, different numbers, different values, depending on what context you're using it in. Then there's all these phi's and all these Greek and stuff. It's just because they haven't got a set value, That's where I get confused. Because they keep changing.

The students were asked about being stuck, whether they had been, and what they did about it. All of them laughed at this point in the interview, and gave at least one example of an occasion when this had happened to them. Each had developed strategies for dealing with being stuck, e.g. getting other people to explain, reading aloud, sleeping on it, looking at books, working backwards from the answers, making a physical model (sometimes these were very elaborate), looking for examples on the internet. Although confident in approaching tutors for assistance, it seemed to me that the students all tried other approaches before contacting me or my colleague, and over the year reacted to being stuck in different ways. Students did not like being stuck and reported feelings of frustration, annoyance, and feeling stupid. However, one student declared that it 'doesn't bother me as much as it used to' and went on to produce a reflective autobiographical piece for assessment called 'On Being Stuck' in which she posited the state of 'Stuck' as being the normal status quo position, and 'Unstuck' as somewhere to work towards. In this respect it seems that these students may articulate resilience, and the ability to cope with difficulties in mathematics as they see them. What was not apparent from the interviews at this stage was the level of agreement between the perception of an individual student on their degree of 'stuckness', and that of my colleague, the mathematics tutor (see note 1), but what did emerge was that the students were able to articulate their mathematical difficulties, for example as with the algebra example above, and differentiate these 'incomprehensions' from 'being stuck' which appeared to be applied to particular problem-solving activities.

CONCLUSION

It would seem that these students from the position of age, class and previous academic attainment in mathematics appear to be disadvantaged with respect to academia in general and mathematics in particular. Widening participation rhetoric focuses on enticing people into learning who would not otherwise be there. In this case we are working with people who are really just asking to be enticed, and once enticed, are determined to continue. These are people who are already in educational institutions, i.e. schools, and for whom progression, not entry, is what is desired. Arguably these students have undergone a long, and autodidactical preparation for university study, illustrated in a variety of ways through personal and professional engagement with learning. The pressure of combining study with work in schools is one that these women are prepared to navigate, although one did say 'you couldn't do this course if you had young children'. This reversal of chronology – work preceding study – in contrast with traditional young undergraduates deserves further investigation in relation to mathematics.

It may be misconceived to try to integrate mathematics learning in the academy with the school classrooms in which the students work, as the discourses are different, and transfer is problematic. However the school setting can provide a fruitful environment for:

- extending the students' access to mathematical understanding beyond lecture notes;
- the opportunity to notice and reflect on difficulties in learning,
- a social setting for working at problems;
- access to specialised help;
- providing modelling of mathematics learning for school pupils.

These students exemplify a different type of mathematics learner, those for who mathematics has never been easy, have never been recognised as talented, and who have developed as a consequence successful strategies for dealing with the practically inevitable difficulties. They add a further dimension to the idea of both widening participation and learner career, as for them, professional progression combined with personal disposition and serendipity is what brings them to the academy. In so doing their arrival forces us to think about what is important about knowledge acquisition in mathematics, and to begin to take a stance on professional learning and widening participation.

¹ For subsequent progression to qualified teacher status to be possible, the degrees must include a substantial proportion of subject knowledge. Reaching high enough standards in mathematics knowledge was a challenge to the programme designers, and led to an unusual structure, decoupling 'level' from 'stage'. This meant that levels 5 and 6 courses that depended on students' work placements were included in year 1 of the programme as well as thereafter, and levels 4, 5 and 6 mathematics work was introduced in Years 2 and 3, with students attending two level 4 first year mathematics degree courses in year 3.

The issue of mathematical competence remains of continuing interest and concern to the programme tutors as well as the students, and it is probably true to say that it is the single issue that the mathematics tutors spend most of their discussion time talking about.

² During the year, the Teacher Training Agency introduced Standards for Higher Level Teaching Assistants (HLTA Standards) and two of the group were successfully assessed through the pilot programme, and the remaining three have been accepted for the first cohort next academic year. Thus pressure on the students to complete work alongside study and paid employment was greater than anticipated. Students were engaged continuously in trying to edit academic work so that it 'counted' for the practical and professional HLTA assessment without too much adjustment, although adjustments were needed, and the portfolios constructed for each set of assessments were not the same.

ACKNOWLEDGEMENTS

I am grateful to Máireád Dunne for her help with the construction of this paper, to my colleagues Lori Altendorff, Giles Dickins, Julia Sutherland and Simon Thompson who have been kind enough to join in attempts at eliciting insights, and to the participants in the study who have been so trusting with their thoughts, feelings and confidence in us to guide their academic development. The reviewers then provided an external critical friendship which I very much appreciate.

REFERENCES

- Bartholomew, H. & Rodd, M. (2003) "'A fiercely held modesty": the experiences of women studying mathematics', *New Zealand Journal of Mathematics, Proceedings of Remarkable Delta:03, Fourth Southern Hemisphere Symposium on Undergraduate Mathematics and Statistics Teaching and Learning*, Vol.32, Supplementary Issue pp 9-18
- Bernstein, B. (1996) *Pedagogy, Symbolic Control and Identity: Theory, Research and Critique*. London : Taylor and Francis.
- Bernstein, B. (1999) Vertical and horizontal discourse: an essay, *British Journal of Sociology of Education*, Vol. 20, No. 2, pp. 157-173.
- Bynner, J. and Parsons, S (2000) 'The Impact of Poor Numeracy on Employment and Career Progression' in Tikly, C. and Wolf, A. (Eds.) (2000) *The Maths We Need Now: demands, deficits and remedies* Bedford Way Papers No. 12 Institute of Education University of London.
- Coben, D., O'Donoghue, J. and Fitzsimons, G. E. (2000) *Perspectives on Adults Learning Mathematics; Research and Practice* Dordrecht/Boston/London: Kluwer Academic Publishers.
- Crossan, B., Field, J., Gallacher, J., Merrill, B. (2003) 'Understanding participation in Learning for Non-traditional Adult Learners: learning careers and the construction of learning identities'. In *British Journal of Sociology of Education*, 24,1 pp 55 - 67
- Dolton, P.J. and Vignoles, A.F (2002) 'The Pay-off to Mathematics A-Level' in Tikly, C. and Wolf, A. (op cit).

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

Evans, J. (2000) *Mathematical Thinking and Emotions: A Study of Numerate Practices*, London: Falmer Routledge.

Fitzsimons, G.E., and Godden, G.L. (2000) 'Review of research on Adults Learning Mathematics' pp 13 – 46 in Coben, D. et al (eds.) *Perspectives on Adults Learning Mathematics; Research and Practice* Dordrecht/Boston/London: Kluwer Academic Publishers.

Hansard, 26 Apr 2004 : Column 813W

Hoyles, C, Noss, R and Pozzi, S (1999) 'Mathematizing in Practice' in *Rethinking the Mathematics Curriculum'* Hoyles, C, Morgan C and Woodhouse G.(eds) London: The Falmer Press

Fitzsimons G.E. (2001) 'Is There a Role for Mathematical Disciplinarity in Productive Learning for the Workplace?'. In *Studies in Continuing Education, Vol. 23, No. 2, 2001*

Juergen Maasz (2002) 'Topic Group A Developing a Theoretical framework for Adults Learning Mathematics Thinking about Theory and Practice in the Area of ALM' in Evans, J. et al (2003) *Policies and practices for adults learning mathematics: opportunities and risks*. Proceedings of the 9th International Conference of Adults Learning Mathematics (ALM9) (op cit)

Macrae, S., Brown, M. and Rodd, M. (2003) *Students Experience of Undergraduate Mathematics*. Report to the Economic and Social Research Council No. R000238564

Macrae, S., Brown, M., Bartholomew, H. and Rodd, M. (2003) 'An Examination of one Group of Failing Single Honours Students in one University' in *MSOR Connections* August 2003, Vol 3 No 3.

Miller-Reilly, B (2000) 'Exploration and Modelling in a University Mathematics Course: Perceptions of Adult Students'. In Coben, D. et al (eds.) *Perspectives on Adults Learning Mathematics; Research and Practice* Dordrecht/Boston/London: Kluwer Academic Publishers.

Reay, D., Ball, S.J., David, M. (2002) 'It's Taking Me a Long Time but I'll Get There in the End': mature students on access courses and higher education choice.' In *British Educational Research Journal*, Vol. 28, No. 1, pp 5 - 19.

Social Trends (2004) Vol 34 London: The Stationery Office, and on the web <http://www.statistics.gov.uk/statbase>

Sutherland, R (2002) 'Disjunctions between school and University: the Case of Mathematics' in Tikly, C. and Wolf, A. (Eds.) (op cit)

Smith, A (2004) *Making Mathematics Count*. The report of Professor Adrian Smith's enquiry into Post-14 Mathematics Education, February 2004, London: The Stationery Office.

Tikly, C. and Wolf, A. (Eds.) (2000) *The Maths We Need Now: demands, deficits and remedies* Bedford Way Papers No. 12 Institute of Education University of London.

Tikly, C. and Wolf, A. (2000) 'The State of Mathematics Education' in *The Maths We Need Now: demands, deficits and remedies* Bedford Way Papers No. 12 Institute of Education University of London.

Wolf, A. (2000) 'Mathematics for Some or mathematics for All? Curious UK practices in International Context' in Tikly, C. and Wolf, A. (Eds.) (op cit).

Thorp, J., Robinson, C.A., Jacklin A., Drake, P. (2002) *Routes into Teaching for Teaching Assistants*. A DFES project at the University of Sussex Institute of Education A summary of research activities and key findings. July 2002