

# **SOME UNDERGRADUATES' EXPERIENCES OF LEARNING MATHEMATICS: (HOW) CAN NARRATIVE FORM ENABLE US TO CREATE KNOWLEDGE?**

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*One theme of current research about higher education students of mathematics concerns those who fail. At our institution, some of the entrants are students who have previously failed in mathematics; others come to us with a comparatively weak mathematical background - perhaps through an Access Course, perhaps through a Foundation Course, occasionally with only a grade E at Advance Level. Most of these students go on to become confident and effective mathematicians, some even achieving first class honours. We believe that understanding something of their perceptions of this experience may contribute to the current debate about who succeeds and who fails in higher education mathematics study and why. This paper has two purposes: it begins a discussion about how this success is achieved; it also raises questions about methodology.*

## **INTRODUCTION**

Our interest in researching how previously failing students become successful was prompted by recent research into students' experience of undergraduate mathematics at a traditional English university (see, for example, Macrae, Brown, Bartholomew and Rodd, 2003). This university was among the elite institutions for mathematics with 63% entering with at least a grade A in Advanced Level mathematics.

Attending a seminar reporting aspects of the research and hearing some of the individual tales of failure, we were struck by two things. First, we could not imagine some of these students failing at our institution: so what makes the student experience of learning mathematics different? Second, we were not convinced that a shared vocabulary of what it means to teach and to learn mathematics could be assumed across the higher education sector in England. To begin to explore these possible contrasts, we asked ourselves: how do we conceptualise our practice as mathematics lecturers and, therefore, what ways of understanding themselves as learners of mathematics are readily available to our students? We decided to research these questions with a small cohort of our current students where such patterns of a weak entry profile followed by success in mathematics were clearly evident.

## **CONTEXT OF THE STUDY AND DATA COLLECTION**

The students are following one of the longer routes into secondary mathematics teaching. On their course, they study undergraduate mathematics for two years within the context of a Mathematics Education Centre; (this is followed by a professional year). Their mathematical studies comprise the equivalent of three quarters of a first year of undergraduate mathematics followed by the equivalent of half a second year and half a third year; there almost no options. (The remainder of

their studies relate to the teaching of mathematics and other educational and professional concerns.) In other words, they study mathematics to honours level but within a narrower range than would a single honours student. Many of the students come from either non-traditional backgrounds or an experience of previous failure in higher education or both. Many of them become engaged and successful mathematicians.

We interviewed each of the students, sometimes alone and sometimes in pairs. We asked them, for example,

- whether or not and in what way(s) they thought their relationship with mathematics had changed and developed during their current studies
- whether or not they thought they had changed as mathematicians
- whether what they thought about mathematics itself had changed.

We taped and transcribed the interviews and then began working with these texts in a familiar way. We each read and re-read the transcripts, immersing ourselves in the data and searching for themes. Separately, we each derived some themes from the data and coded the transcripts accordingly. Next we met to discuss our themes and our coding and to agree on an initial key theme emerging from both of our first analyses: we called this theme, after a phrase from one of the participants, '...not maths as in school maths, maths as in wondering maths'. We then re-worked the data and ended up with about a dozen quotes which drew from all of the transcripts and which addressed this first key theme.

We believe that useful knowledge will come from this approach (one author with greater conviction than the other!) and will pursue this further subsequently.

However, we both felt that much was lost by cutting up the transcripts and thus losing the narrative threads present in the interviews. We therefore want to experiment here with an alternative approach: we present instead a "story" of one of the participants, hoping in this way to stay more faithful to the data.

### **A STORY ABOUT GEOFF**

This, then, is a story about Geoff: it is the story which we heard Geoff tell. It draws on things that he said in his interview with a fellow student and the two authors. We have tried to balance presenting this data intelligibly with staying close to what Geoff said. We are mindful of the warning of Wendy Hollway and Tony Jefferson that

the idea that an interviewee can 'tell it like it is' still remains the unchallenged starting-point for most ... qualitative, interview-based research. One revealing effect of this is that the questions the interviewer asks in order to get responses to 'tell it like it is' are often not considered worthy of mention. (2000, p.10)

We have therefore included as a minimum interventions from others when they seemed significant. We have also attempted to offer Geoff some anonymity by changing details that seem to us non-essential in coming to understand this particular story about him. We do not claim that this is Geoff's story nor that it represents him

in any essentialist way. Rather we hope to present a story from which we can acquire knowledge.

### **The background**

When he started his current course, Geoff was 32 years old and had spent most of the previous decade working as an HGV driver. His academic profile on entry was as follows:

- 1986 9 'O' levels including grade B in mathematics
- 1987 grade B in additional mathematics
- 1988 grade C in mathematics, grade D in physics
- 1989 failed 4 modules out of 5 at a Scottish technical university
- 1990 failed 2 modules out of 6 at a London polytechnic, average mark overall 39%

On his current course, his results so far are as follows:

- Level 4 mathematics: 90 credit points, average 77%, (overall 120 credit points 73%)
- Level 5 mathematics: 60 credit points, average 78%, (overall 90 credit points 75%)
- Level 6 mathematics: 60 credit points, average 78%, (overall 70 credit points 76%)

### **The story**

The interview began with a prompt for Geoff to consider his vision of mathematics and his relationship to it, what he thought and felt about it, and to reflect on whether or not it had changed during the first two years of his current course.

I think it's changed quite a bit because it is a totally different approach on the last two years because I don't know if you know but I started two degree courses. When I left school, I started a maths and physics degree at [a Scottish technical university], failed most of it then went to a [London Polytechnic] as it was and did a year and a half there and dropped out of that and failed most of that. They were very lecture based courses, big rooms, lots of people, working on your own quite a lot and it was quite difficult and it sort of knocked me quite a bit because at A levels I was reasonably good, O levels I was very good really and it knocked me.

So for 10 years out not doing any maths at all and then it was a bit nerve racking coming back but it's a totally different course. There has not been any big lectures, you can get very involved in a fairly small group, there has only been about at the most 14 in our group so it's has been a lot better and my confidence has come right back really. The first year [of university], I wanted to do the first year again. There was an option that I might have done the two-year course but I thought I would do the first year again and revisit a lot of the stuff. And that built my confidence quite a bit because I did pretty well in all the subjects that I did. So yeah [my relationship to mathematics] has changed quite a lot. I have a lot more confidence in my abilities again.

He was asked what he thought had made the difference.

It's probably to do with how I learn maths. I like to be able to bounce things off people, I like to, if I find something interesting, it's nice to be able to find somebody to talk to about it, whereas in a big lecture approach you don't, you go to a lecture, you go home, you write up the lecture and that's it really. So the fact that both in the sessions and outside the sessions you can talk to people in a small group, people that you know well and that helps me I think.

[There were seminar groups at the other two universities] but again they were big, you know you might have 50 people in there so how can you actually have that relationship with a tutor or anybody like that? If you've got a problem the chances of you actually, you being seen about this problem in a seminar group was very, very difficult. You wouldn't get that chance. I suppose you could have gone to a tutor one to one but [that would be] very difficult to organise and if everybody in the group were trying to do that then you've no chance. So you quickly get left behind if there is something that you don't understand. Whereas now I'm somehow, I'm understanding things that just made no sense previously.

[If they had set up groups of 10], it would probably have made a difference but I think the key to it was that in a smaller group you can basically stop the lecture or the tutor and say "Hang on I don't get this" and chances are that half the group are not going to get it either so it's possible to sort of go back and start again and rework some of the explanations and so on which is impossible to do in a large lecture theatre. Had they set up smaller groups then yeah it would have probably worked as well but they were just not going to do that, you know, so many people on the course that they weren't going to do it.

The nature of the course as well ... sort of building up from the bottom, I suppose, and seeing progression getting harder rather than just going straight in to the hard stuff. It's easier to make the links between things and, as I say, talking to other people on the course, they're able to put links in for you and you are able to put links in for them, you know, that they might not have noticed ...

I think all, if not, well most if not all the tutors that we have here have all been teachers so that makes it a lot easier because their talking from an experience that they've had. The experience where people don't understand something and they have to explain it in a different way, whereas in a solid degree course like the ones that I started before, this was the way you did things and, you know, if you don't understand - how can you not understand, you know, I've just told you how to do it, how can you not understand? I've got my work from previous degrees with a big NO written in the margin all over the place and you can't be wrong whereas here you can be wrong or you can explore and it's taken as, you know, that's part and parcel of the whole thing. I like to explore things. Never before have I sat down in my spare time and just started doodling triangles or something like that, you know, proving things which have been proved many times before but I'm just doing it for my own sake. I've never done that before but I am now ...

All the things are supposedly proved and are correct mathematically, all came from dead ends and so on, you know. All the great mathematicians made mistakes and said, "Well, that didn't work". You don't see it any more because it's all been polished up into the thing that is correct but there are so many mistakes that are quite valid and certainly things come from them sometimes.

Geoff was prompted to consider if there were differences in the way that the mathematics was presented on his current course, whether the tasks set were different. If so, what were the differences and were they good or bad.

I don't know. Again it's a very different course. The others were predominately exams which makes a big difference. The fact that you are doing coursework and can investigate - as we've said it's not about getting the right answer a lot of the time, so that the whole work we've been asked to do, it is just so completely different, I can't really relate the two at all. You're taught, you do an exam and you either pass or fail whereas here it's like "Well now you go and find out something" or you work something out for yourself. We have done a couple of assignments where you start without looking at any reference material at all, it's just your own - you're given a starting point and go off and work it out for yourself sort of thing. I don't know - it's just completely different. I can't say a great deal more ... An assignment is never really finished.

Geoff was asked to consider the role of examinations on his current course, particularly a level 6 unit in pure mathematics.

It's quite bizarre really saying that I don't like exams. I've only done two on this course so far and I did really well in both of them that - having said that, I don't particularly like them. I don't know, I sort of, I got back a little bit into the old style which was get all the information in the sessions and then, a week before the exam or a few days before the exam, you then think about organising your notes and seeing whether you can actually remember any of it. So it was a bit of a cramming session really. That's not to say that I didn't pay attention in every other session because I did and I enjoyed a lot of the work that we did but it was very much of a "I can put this thing aside until I really need it just before the exam" which is not necessarily the best way to do it. But fortunately for me it worked okay and I did okay in the exams. But no I would prefer to have a coursework or assignment set up in that way so you're using the stuff as you're going along. In sessions you are gaining more stuff to put into your assignment to develop it really ...

For that systems and structure [unit], I mean, I admit that I didn't do any extra work, I didn't follow it up. I did far too much work in other units which were less credit but that's because it was coursework, it was an ongoing thing and I kept going back to it and, you know, sharpening it up and adding extra bits and so on and - that's probably what happens when it's an exam thing, an exam at the end, you can put things aside and not look at them again. So the coursework keeps you actively involved in the subjects that you're looking at really ...

I think I was very lucky in the exam. I mean I didn't touch the group theory, I didn't touch it at all, I don't think. I don't think I quite got it sorted in the sessions. I missed

one session which was quite important. I did have the notes from somebody else but when it's somebody else's you don't look at them. I am one of these people who when I take notes in a session I go home and type them up and I suppose that process of typing them up, it's going in. And I'm probably quite lucky that when I'm doing that I actually remember things, so I rely on that, I think, in the exams, that I've just remembered things rather than actually revising or possibly rather than understanding them and I can do, I can just recall how to do something but that's not the same thing as what's done in assignments. Because I understand the things that I am writing down for an assignment, all that I am working on for an assignment, because you're actually doing it rather than just recall I think.

Geoff was asked what he expected to be like as a teacher.

I get really interested by, you know, resources and gadgets and so on. At home I've got a shelf full of Soma cubes and pyramid balls all that sort of thing, I like that sort of thing so, yeah, I like practical maths and sort of learning how you can relate those things to maths, you can pull the maths out of them and that sort of thing, like pyramids, triangle numbers and that sort of business. So yeah I would like to do that. I don't want to be a text book teacher - I think my only fear is that in some schools in some classes that's all you can do ... that worries me slightly, that that's where I'll end up. I don't want to lose the enthusiasm for interesting things ... I know it's going to happen. I am going to go into a class and I'm going to show the pupils something and going to say "Isn't that absolutely amazing?" and they're all going to look at me stony-faced and say "No it's really boring". Because I find it really interesting and not everyone's going to be like that ... it's a thought process ...

### **SO OUR QUESTION IS ...**

So our question is: does this story reveal truths that we can share? We have heard Geoff's account of himself and can begin to see some of the discursive frameworks within which he has been embedded/ has been able to embed himself. What could we claim to know on the basis of Geoff's story? How is this different from thematic analysis? What has to be done to legitimate the claim to knowledge? This is work in progress and the methodological dilemmas are genuine!

### **REFERENCES**

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