

STORYING MATHEMATICAL IDENTITIES WITH CULTURAL MODELS

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When we build our narratives of identity in interviews, we make use of “cultural models”, culturally normative rules, schemas, ways of describing people, activities and ways of being. In this study we identify cultural models used by two mathematics learners in the stories they told us about their lives, including their experiences of learning mathematics and their disposition to study mathematics in the future. Each model provides a tool for identifying or dis-identifying with mathematics. While some models might be thought more ‘positive’, and others more ‘negative’, students positioned with strong imagined life stories or ambitions can turn these models to their own purposes. Thus maths is ‘hard’ can sometimes be storied as ‘challenging and fun’ rather than ‘too hard and boring’. The significance of the educational culture is discussed.

INTRODUCTION

In part of our Widening Participation project *Opening doors to mathematically-demanding programmes in Higher Education (HE)* (www.lta.education.ac.uk/TLRP.html) we are exploring the ways in which young students tell of their disposition to go into further study, particularly in Higher Education, and particularly to study courses in which mathematics might be relevant. One part of the research involves a survey and *quasi experiment*, in which measures of ‘disposition to study in HE’ and ‘disposition to study more mathematics’ are constructed as outcome variables. However, to complement this quantitative study we are also conducting multiple case studies of students as they progress through a year or so of Further Education (usual age 16-19). We are interviewing the students about their ‘background history’ (including whether they would be the first in their family to enter HE, etc.) their experiences with mathematics and disposition towards future study; their current attitude to their experiences in mathematics classrooms is also of interest, as this helps reveal how their identity work makes use of or is influenced by pedagogy.

Our project is informed by the Cultural-Historical Activity Theory (CHAT) perspective on identity in practice, the corpus of which is usually attributed to the original Marxist troika of Vygotsky, Leont’ev and Luria, as interpreted and developed in multicultural contexts its later generations by Cole, Engestrom and

others. (See Williams & Wake, 2006a,b; Roth, in press; also Roth, Hwang, Lee, and Goulart, 2005; and websites such as www.edu.helsinki.fi/activity/people/engestro/). Many CHAT scholars such as Wertsch, Wells and others also incorporate Bakhtinian and even Hallidayan discursive and dialogical constructs of voice into the theory (see eg Holland 1998; and many works by Gee, such as Gee, 1999, 2001). Even Bruner's account draws powerfully from the Vygotskian perspective (Bruner, 1996).

Identity is here seen as emerging from engagement in joint object-orientated activity; socio-culturally mediated 'activity'. This is because, as Vygotsky pointed out, the use of 'psychological tools' (such as language) in practice is always double edged, what is used in social interaction comes reflexively to be used internally, on the self. Thus, one 'becomes' what one 'does' and, importantly, one comes to 'think' what one 'says': reflexivity and self- and social positioning ensures that we become the player that we perform (see Jenkins, 2004, for an account that integrates the social theory of Goffman, and Barth). While 'activity' is always driven by a 'community' motivation the individual is always 'positioned' (by self and others) in a division of labour, held in place by 'rules' governed by cultural norms and expectations. Holland and Quinn (1987) originally developed the notion of 'cultural model' to describe the culturally derived rules and schema used by students to tell stories of themselves and their everyday activity- tools for doing their identity. Gee and others have expanded the concept to include everyday cultural concepts and conceptual frameworks that govern what we can perceive, but also what we can tell. Thus, cultural models provide a resource – and a constraint – for reflective identity work.

We find the more recent notion of a kind of cultural landscape of 'cultural models in figured worlds' evocative (see Holland et al., 1998); one's narrative of identity can be told as a path through our available 'figured world'. Thus, a student might tell of their identity as someone who "likes to work alone ... and always needs to know there is a 'right' answer." Such self-identification might lead to such a student coming to be regarded – and to regard themselves - as a potential mathematician, if the dominant cultural model of doing mathematics in the culture/subculture is that of a lonely, black-and-white activity. Many in our culture tell of mathematics as a 'hard' subject; a student who wants to position themselves at a distance from mathematics may say "mathematics was too hard for me". But for another, it turns out, mathematics is hard 'but challenging'.

Thus, in our theoretical framework, cultural models such as 'maths is hard', 'maths is black and white', 'maths is lonely' or 'maths is for geeks' (all models we have found in our interviews) are models that students learn in practice from social activities in general and classrooms in particular, and they can provide tools for students doing identity work of various kinds. Students are presumably not totally free to narrate themselves as they wish using these models, first because they may not wish to align themselves with a particular position (e.g. 'being a geek') and second, because positioning oneself is always a 'claim' that may be subject to social confirmation, or

dispute. For us then, it is an empirical question to answer: “how can/do students draw on cultural models in telling stories about their identity (in relation to mathematics)?” and “how can/do these stories produce/reproduce a disposition to study mathematics, or not?”

Our methodology is informed by this theoretical framework: we are pursuing interviews with 50+ students (three each, transcribed) over the course of a year or so during which their early pre-university course studies gather pace and when they make decisions about university applications. These students were selected to ensure that ‘middle’ attaining students likely to drop out of maths at advanced level and those ‘first generation into Higher Education’ families are included. In interviews we ask about their biography, their dispositions and future intentions (we also have survey instrument data including dispositions that serve to locate these students against the canvas of a larger population). We also ask about their engagement in mathematics classes (some of which we observe). In the following we examine two cases of students with low-ish grades who both chose to do advanced mathematics despite having a difficult time at their previous secondary school: in their interviews they used some of the same models as resources but in very different ways, partly reflecting their very different experiences in their current College mathematics programmes. These are chosen for analysis because they provide such a contrast: one engages with mathematics in her classroom as a sociable activity in which she is always ‘having a go’. The other is withdrawn and even isolated in his class, positioned as being ‘struggling’.

One might think that the common cultural model ‘maths is hard’ is one that is used by low attaining students to speak of their dropping of the subject, and this is the way the model comes to be used by the student who is becoming isolated from mathematics. However, for the ‘engaged’ student it becomes used as a positive resource for narrating herself as an engaged mathematics learner.

GEMMA’S STORY

Gemma will be the first from her family to go to university. In fact she cannot name anyone she knows in her circle of friends and family who has been to university. But there is no question in her mind that she WILL go, she says, “I’ve been going to uni since I was 8”. She has lived ‘locally’ all her life in a community that has all the ‘poorest’ social indicators. Her principal and teacher described, with almost ironical pride, the local community as sitting regularly at the bottom, or near the bottom, of every league table of performance and social index of deprivation the government has produced. Gemma tells us that her mother’s work as a cleaner and shop worker is stressful, which has helped to motivate her as “I see my mum, like, working in a shop and cleaning and I don’t want to do that, so that’s kind of influenced me in my own work not to follow that path cos she gets stressed out and stuff”. Gemma tells us

several times that her mum has been very supportive of her and encouraged her ambitions all her life (as has her mother's partner). She did well at Primary school: "I was always into books at school and I was always levels ahead". She said that getting level 5 – a very high grade - at age 11 in the National tests was an important marker for her. She experienced her Catholic primary school as relatively – compared to secondary – 'inspiring'.

At age 8 she decided she wanted to become a marine biologist so she could work with Orca whales: "I've just always taken a fancy to Orcas, ... Killer whales, ... Free Willy is my favourite movie (laughs)." Even though her mother thought she would 'get bored' of this particular ambition, Gemma has stuck with it and her mum has continued to support her; she got advice during secondary school from the 'connections' service and knows exactly what she has to do in her AS and A level grades in science and maths to get to university and then to do a PhD in Marine Biology. She knows she will spend 6 years at university and which one she wants to go to for her studies, as it has a connection with research into Orcas. In fact she tells us that the field she will need to follow to get to work with Orcas is more specialised, those who study big sea animals are called marine mammalogists, and "you have to be one of the top ones" to get into it.

Her experience of secondary school was very mixed, with classrooms being boring and classroom behaviour off-putting. The teaching was often uninspiring and she lost interest or a while: "From when I went to secondary school I lost interest in quite a lot of my study ... at (Primary school) there was more passion in it while at secondary school it was just "you've got to get through this.." In contrast to her self-ranking in mathematics at Primary school, she says now "I wouldn't class myself as that good but maybe a bit above average". However, she describes maths as being 'challenging' rather than hard: "... there was a lot of noise in the class ... [disruptive?]. yes; but I enjoyed it and it was a challenge as well ..."

Gemma got a modest grade in her final mathematics examination at age 16, and then did a statistics course, not being allowed to do the higher mathematics course for some reason. She would be considered a 'high risk' according to statistical trends at post-16, and in many Colleges she would not be allowed onto the Advanced Mathematics course. She says she was worried she might not be able to cope with the Algebra on her current course but actually feels she is doing well, and is enjoying maths now, "... it's a good system here: it gets the whole class involved and you get to hear how others do it and if it's better you can learn" which she compares to the dominant teaching practice in secondary school which is "boring and you forget it..."

Her attitude to mathematics seems to have undergone a transformation since going to 16-19 College: "I am liking Maths as much as I like Biology which is my favourite subject ... so I'm getting really... liking it compared to before." She explains why: Maths is more 'engaging' and she can express her opinion and hear what others have

to say – she even mentions the interactive work with white boards and posters... and maths is now described as ‘fun’.

This story – we call it a ‘restorying’ as it has been constructed by us from her interview - tells us several interesting things about her identity in relation to further study, Higher Education and Mathematics. While her family background does not provide any ‘role models’ of people who went to university, she has developed an ambition that her family supported, and her mother’s ‘stressful’ experience of work has influenced her positively. Her childhood ambition has been nurtured by family and shaped by the education service, and has matured into a career ambition. She knows she will need maths, challenging/hard or not, to achieve her ambition. But recently her enjoyment of mathematics seems to have returned and we can speculate that this will help in some way: we will see when we meet her again in six months time.

The model of a marine biologist and the inspirational film “Free Willy” seems central to her particular story. Many students of this age, just beginning at 6th form of Further Education (FE) College, simply say “everyone I know is going to university” or even “I like science so I’ll probably do something in the sciences but I am not sure what yet.” However, the principal of Gemma’s College told us that stories such as Gemma’s are not unusual: one boy who had been on a work placement developed a specific ambition to work on a particular machine in an aircraft laboratory, and had worked it out that he would need to have a degree in Aeronautical engineering to get into the necessary training programme in the aerospace industry. Thus we speculate that this might be a more common characteristic of some narratives of students from class backgrounds that do not provide many personal ‘models’ of university graduates in their community or family circle.

The particular way that Gemma constructs herself as having a positive relationship with mathematics might be relevant here, we speculate: her early imagined lifestory of ‘becoming a marine biologist’ comes together with her success in Primary school, and “getting a level 5”. As she develops her plan in secondary school she finds out that mathematics will be important to becoming a science student at university. This apparently positive synergy could perhaps have been expected to be dampened or even destroyed by a dull experience in secondary school, but (i) she is at least as good as the average of her peers in mathematics, and (ii) her family – especially her mother – encouraged her, and she finds energy from the thought that she does not want the stress of her mother’s life as a manual worker.

IMAGINING A LIFE STORY: THE JOURNEY METAPHOR

We have speculated that Gemma’s positive disposition to study mathematics is in part at least sustained by her imagined lifestory of a university science career leading

to a career as a marine biologist. We see other important sustaining resources as well, such as her success in Primary school, her relationship with her peers and her recent positive experience of maths learning. These resources are important in providing her story with energy, and we imagine some were central to her in Primary and others later in Secondary school. But we suggest that in her story now there is a prominent central ‘leading thread’ in her work-ambition: this seems to be the central element that provides for a ‘positive disposition’ towards mathematics, which in turn encourages her to see maths as a challenge rather than too hard.

Let us consider for a moment the way a life story like Gemma’s comes to be imagined: and also, by way of contrast, let us consider how the story, with much the same resources, might have been different. Gemma accepts, but makes use of the notion that mathematics is ‘hard’ for her: rather she posits maths as ‘challenging’ and she likes a challenge. But we know that for other students, mathematics is ‘hard and dull’, or ‘too hard’ and thus becomes something to be avoided. Within another lifestory, Gemma might well have adopted this notion as a means of representing a different disposition, of telling a story of a different person and imagined life. Lakoff and Johnson (1999) analysed the metaphor of ‘life as a journey’ and this seems apt to our present analysis. The ‘imagined journey’ in Gemma’s case has a clear beacon in the distance, envisioned for her initially in film, and through other media later. In her narrated ‘troubles’, she meets many obstacles along the road, but also resources: she avoids the secondary school abyss and identifies a challenging climb there. There is an imagined slough of despond in future manual labour that she strives to avoid. In some cases perceived obstacles turn out to be friendly, what was said to be ‘hard’ to do becomes perceived as ‘challenging’. Yet each ‘resource’ has a potential downside: if one experiences failure too often perhaps ‘challenging’ will become ‘too hard’, and the immediate part of the journey too difficult.

On the face of it a ‘cultural model’ seems to afford a way of overcoming an obstacle on one’s life path through one’s cultural landscape or ‘figured world’ and as such is a bridge for all who want to pass that way. But some models are not like that; turning an obstacle like “maths is hard” into an affordance as in “maths is challenging and I like a challenge” may be more possible for some students than others. It is as though different students are offered different landscapes to do their life journey through, that is, different social groups are offered different figured worlds. The educational institution and classroom, and pedagogy appear to provide different tools also. To illustrate this, we now present the narrative of another student, Lee, who constructed a less positive account of his experience in studying mathematics and his disposition to continue doing so.

LEE'S STORY

Lee also hopes to be the first in his family to go to university, although unlike Gemma, he says his mother has a fairly high status job [Deputy Manager in a bank] which he describes as 'quite up there'. Lee is also less clear than Gemma regarding his future career trajectory stating that he wants to "get a good job" but "to get a good job, you got to go to Uni". When asked what he will study, he answers "I am not sure, one of the subjects I am doing now at A level probably" [Politics, Psychology, Sociology and Maths].

Lee says that he was one of "the clever ones" at primary school, with Maths as his strongest subject. When asked if he liked maths, he says: "Yes. I was always good at maths, pretty much. (...) I never struggled in maths, it was pretty easy. I got like top levels and stuff, in primary."

However, at secondary school he says he lost interest: "No, it's not something that interests me. I am good at it, but it didn't interest me. I don't see the point of it" and identifies his relationship with his maths teacher (the same one throughout secondary school) as particularly problematic. Despite his lack of interest, Lee got a Grade B at Higher level in his final exam and chose to take up Advanced maths when he started college because it would "look good for university". However, he began to struggle with the subject and as a consequence, was encouraged by his teacher to transfer courses from Mathematics to 'Use of Mathematics' as an easier option.

"And I was doing... all right in maths, and then I just... I don't know. I was like that in all subjects because when you... like do a step up to college, it's quite different to secondary, isn't it? [...] Because it's more work, it's like less time spent on one particular way, [...] And I just weren't used to it. [...] And then, like the math teachers, ...they were saying if you are struggling now you won't pass your January mock, you know there is an exam in January. So if you struggle... and because like I got a couple of bad results in the tests, like practice tests kind of thing. I got to kind of lost it one day. [...] So it was like December, November time, he said 'I think it's best if you do Use of Maths which is like this course', so I was like 'Oh, it's way too late now'. He said 'you'll do all your exams in May, June, whenever it is', and he says 'you will do it at the Uses and you should do coursework, someone like you will do that easy and pass quite easy'. [...]"

Lee says that he thinks the reason he struggled was because he did not keep on top of the workload and it was no longer possible to "just go through the course and pass it like ...quite easily like I did (before)". But the Use of Maths course has also been problematic for Lee and he predicts that he will "completely fail the course". He has tried dropping out a number of times and has remained in the class only because his teacher has insisted he stay. This, he feels is a waste of time:

“[...] I have to do 4 exams, and I know I can't do it, I have not done the coursework, so...it's just a waste of time for me. I could have concentrated more in my other subjects.”

Lee particularly identifies his isolation from the rest of the class as central to his negative experience:

“[...] like I sat over there, because that's where my chair was because all other seats were taken, I am just sat there and it's like just pop in alone, day dream, because it's no like nobody to tell you, you've got to...work kind of thing. Because there is no pressure to finish.”

When asked why his relationship with maths deteriorated, Lee draws on the cultural model of 'maths as too hard'. He says “it was like, you got all like harder stuff coming up obviously, like formula, and stuff like that” and that “I just don't see the point”. Indeed, the fact that the Use of Maths (UoM) course was presented to him as easy but turned out to be harder than he expected is central to his account of why he is going to fail.

“So when I came here [UoM] I wasn't interested in the first place and then it was harder, I wasn't interested. []...I think if I'd really gone on on it [the previous maths course] I would have been able to pass at least, but then I got told that this course is ...you were going to get UCAS [university] points and stuff, and that it was quite easy...”

He also questions the relevance or “Use” of maths to his future plans in life:

“Like, they say it's real but I don't want to know about how much coffees and coffee (are?), ...[] No, it's not relevant to me. I don't need to know that. [] But I don't need to know how to do trigonometry, in everyday use. So I don't see that as real life context. Unless I am going to be like...whatever you need to use it for. Because maths is just like equations and stuff like that, and numbers, [...]...you either like maths or you don't. I don't like it, so...that's how I see it.”

The way Lee constructs his story regarding his relationship with maths highlights how not all students are equally positioned in terms of drawing on particular cultural models. Like Gemma, Lee draws on the notion that 'maths is hard' but instead of using this to positively align with the subject as 'a challenge', he uses it to position himself away from maths because it is 'boring' and 'not relevant to me'. We suggest this more negative use of 'maths as hard' as a cultural model may relate to Lee's disposition as marginalised from maths in college. In both his Maths classes, Lee has been positioned as a 'struggling' student by his teachers and even his physical location, seated on the margins of the UoM class (as a late entrant), appears to have exacerbated a sense of increasing isolation. Thus, we argue that the way Lee uses the notion that 'maths is hard' in his lifestory is an attempt to reflexively distance himself from the marginalised social position his teachers have assigned him, and which he has accepted.

This suggests that crucial to the use of cultural models in students' narrative accounts is *how they are positioned* by teachers and institutional policies, e.g. who 'can do' and 'can *not* do' mathematics. Gemma, who in another college would have been prevented from taking Advanced mathematics, is given the space to construct her narrative around the notion that mathematics is 'challenging,' providing potential energy to 'maths as hard' that could otherwise become 'maths is too hard'. Meanwhile, Lee finds himself marginalised from mathematics due to his insitutional position as a 'struggling' student and consequently finds a way to construct a narrative which reconciles this sense of 'not belonging'. But in another sense, the idea that mathematics as 'too hard, irrelevant and boring' may also provide potential energy to Lee's identity work - as one who does not see any 'use' for mathematics, as a non-mathematician, perhaps one who will study politics etc. (there is not enough of a biography in the above account to see how this will work out positively yet).

These two narratives illustrate how in understanding life stories we need to look at the affordances and constraints of the relevant cultural models that students can use, and in each case ask how they might be resources for representing distinct dispositions, e.g. expressing students 'leading' ambitions on the one hand, or obstacles and troubles for students on the other. We suggested that one leading social influence might be a career ambition; in other cases we have tried and failed to detect any ambition or motive, with students apparently 'living in the moment'. We have seen some signs that such students are likely to be particularly suggestible to short term and local influences, including their social experiences of the mathematics classroom .

However, not all students have equal access to the world of cultural models we have identified: while they have some agency in shaping their positioning, or disposition, they are not freely and equally positioned in society, in their institution and in their classroom. One student finds herself with no 'real' graduates in her family to serve as 'models', but looks instead to the imaginary, fantasy world of films for a marine biologist graduate. Another student told us she has just one example of a graduate in her family, and that the person concerned had a bad time, ending a course with huge debts. She is unsure of whether she should risk the experience, but is continuing at College anyway because there is nothing else to hand other than working in a shop.

The College institution too offers some access to Maths with a relatively risky, weak, previous grade whereas others deny the students this. Our fieldwork provides explanations: some Colleges are themselves positioned differently from others in terms of funding and the student 'market'. In order to maintain a high reputation (mediated through league tables of performance indicators) some Colleges refuse to recruit weak students to mathematics courses, while other Colleges opt out of this competition (or for other reasons are not so competitively positioned) and go for an 'open access' institutional policy that then puts a premium on making mathematics

accessible to a wider group of learners. Similarly some classrooms offer a ‘sociable maths’ that is ‘fun’ and interactive, where for others the dominant model involves ‘working on your own’. In this respect many students’ interviews have suggested there is hope that pedagogy can really make a difference: apart from providing role models, the classroom or College institution may also offer multiple models of learning and hence ‘ways of being’ a learner of mathematics. This is what the project is currently investigating.

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