TEACHERS DISCUSSIONS ABOUT PARENTAL USE OF IMPLICIT AND EXPLICIT MATHEMATICS IN THE HOME

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Embedding everyday mathematics in home learning is considered by educationalists as one of the best mediators for learning. There is also evidence that everyday mathematics, such as cooking or the use of board games, is not used as a resource for learning by all parents. This paper examines how teachers make sense of embedded everyday mathematics at home in relation to parents' practices. The theoretical concepts of Boundary Crossing and Implicit/Explicit practice will form the basis for this paper. Data comes from interviews with eight teachers who work in culturally diverse school settings. The analysis focuses on teachers' narratives about the complexities of shared boundary crossing and home constraints which make everyday mathematics learning problematic.

Key words: everyday mathematics, teachers, boundary crossing, implicit/explicit

EVERYDAY MATHEMATICS

Embedding everyday mathematics into learning in the home has been considered beneficial in both academic circles (see Young-Loveridge, 1989) and educational policy within the UK (The Williams Report, 2008). We argue, like Street, Baker, and Tomlin (2008) that embedding everyday mathematics at home is a complex business as it involves more than the inclusion of mathematics activities and procedures. Numeracy practices are enabled or constrained by sociocultural contexts, values and representations (Gorgorió & Abreu, 2009), social and institutional relations (Street, Baker, & Tomlin, 2008) and personal histories (O'Toole & Abreu, 2005). In culturally diverse home and school settings the use of mathematical practices and the resources parents draw on to make sense of their children's learning can be contradictory and complex (Crafter, 2009). This paper asks, what are teachers understandings of parents home mathematics practices? This paper uses two theoretical constructs to attempt to understand how teachers makes sense of embedded home mathematics learning – 1. Boundary Crossing and 2. Implicit/explicit numeracy practices.

BOUNDARY CROSSING AND IMPLICIT/EXPLICIT LEARNING

Until recently, both traditional and sociocultural traditions in cognition have focused on learning progression within particular communities. The situated cognition tradition for example, centred on movement from periphery to full legitimate participation in a particular community (Lave, 1988; Lave & Wenger, 1999). Developmental psychological research investigating the interplay between culture and cognition has looked at the change of mathematical practices over time (Saxe & Esmonde, 2005). Movement of knowledge between or across communities has been of interest for some time, first in the form of transfer which suggested that knowledge used in one context is utilised in another (Thorndike & Woodworth, 1901). While this idea has been taken up in areas like mainstream cognitive psychology, it has been widely recognised that knowledge, including mathematical knowledge, is culturally situated to particular contexts (Abreu, 1995; Nunes, 1999; Nasir, 2008).

The change of focus from the concept of transfer to transition proved much more helpful for those of us interested in studying the cultural nature of mathematical knowledge. Transitions could come in different forms – some transitions are consequential, because not only can they be a struggle, but also they have the potential to alter 'one's sense of self' (Beach, 1999, pp. 114). In other words, they usually have an impact on the individual and the social context that they inhabit. The type of transition that a child makes between home and school is called a 'collateral transition' where, historically speaking, activities are taking place simultaneously. The child is in a continuous process of moving between these two major communities of practice and therefore the construction of meaning is ongoing for all the key players of those communities.

More recently, attention has (re)focused on the notion of boundary crossing. It is still not clear to us what distinguishes the forms of transition mentioned by Beach (1999) from boundary crossing. Perhaps it is that boundary crossing encompasses more than strategic knowledge to include symbolic resources and representations (Zittoun, 2010). For Wenger (1998) boundary crossing, seems to emphasise the practices themselves as units of analysis whilst for the purpose of this paper, the representation of the practice takes centre stage. However, Wenger's (1998) conceptualisation of boundary crossing is useful in that it addresses the continuities and discontinuities to the forms of practice which are enacted when moving between one community and another.

Some forms of mathematics knowledge have greater power and status than others (Nasir, 2008). Some practices are deemed more worthy than others (e.g. boards games are valued mathematics practices by the school while dress making and carpentry largely go unnoticed – see González, Andrade, & Civil, 2001). The mathematical value of dress-making might not be recognised by school (the more powerful community). When certain practices are reified they are imbued with greater status than others. Boundary crossing from a cognitive perspective connotes a shared knowledge (Akkerman, et al., 2007) but we question where this shared knowledge begins and ends.

Using the notion of implicit/explicit practices may provide a useful mechanism for looking at the boundaries of mathematical practice across the communities of home and school. Tomlin, Baker and Street (2002) explore in their research those practices which are more visible or explicit, and are recognised by all concerned as improving mathematical skills. However, some mathematical practices are viewed as less salient, or are more implicit, because they often go unrecognised as contributing to the mastery of mathematical skills. There are a number of crossovers between schooled mathematics and out-of-school mathematics practices such as working on number bonds, times tables, dates, measuring, money and playground games. Other practices such as homework and shop bought textbooks also transcend both contexts. Out-of-school mathematical practices like laying the table, counting stairs, setting the video and producing calculations from looking at car number plates reveal how varied numeracy learning can be. These examples further highlight how much the uses of home mathematical practices are reliant on the social characteristics of engaging in numeracy.

This has led to some questions - what is constrained or facilitated in the boundary crossing? What forms of mathematical knowledge (implicit/explicit) make it possible to address the continuities or discontinuities across communities? This paper explores how teachers talk about tensions and expectations on home mathematics learning across the boundaries of home and school when thinking about parents' practices.

THE EMPIRICAL STUDY

To examine teachers' representations of parents uses of everyday numeracy practices we draw selectively on findings from interviews with eight teachers who participated in a wider ethnographic study exploring home and school mathematics learning. The teachers taught children from three different primary schools situated in a small industrial town in the South East of England, known as school A, and school B (all catering for pupils aged between 5-11 years). In school A the proportion of ethnic minority pupils could be described as 'culturally mixed'. School B was a mainly white school whereby 17 % of the children in the target years were from ethnic minority backgrounds, which was below the national average. At the point of data collection pupils, parents and teachers were sampled from the highest and lowest achievement groups in the year. The exception being Richard's class in school B (see table) which had a policy of mixing different achieving children.

School	Teacher	Year Group	Achievement Group
School A	Catherine	Ages 6/7 years	High
School A	Jane	Ages 6/7 years	Low
School A	Anna	Ages 10/11 years	High
School A	Mary	Ages 10/11 years	Low
School B	Richard	Ages 6/7 years	Mixed
School B	Chris	Ages 10/11 years	Low
School B	Susan	Ages 10/11 years	High

The empirical data we use in this paper to illustrate our thinking was collected using the episodic interview and analysed using episodic analytic technique (Flick, 2000). Selections of questions which are pertinent to the data explored in this paper are:

> In your view, how important is it that parents are involved in their children's school learning? Could you tell me about a situation around that?
>
> Why do you think some children do better in their mathematics than other children? Can you tell me about it?
>
> Do you think that practical [mathematics] work is more beneficial at home than the more traditional academic work, can you describe how you feel about it?
>
> Which type of work do you perceive as being more appropriate for parents to do at home, can you describe that for me?

SHARED BOUNDARY CROSSING

Everyday mathematics which forms that grey area between implicit and explicit mathematical practices was a central feature of the teacher narratives in this study. In a previous paper we argued that there are some home mathematical activities which are obviously explicit – homework, mimicked school-like activities like shop-bought books (O'Toole & Abreu, 2003), etc... This first quote from Jane highlights what she perceives as some of the discontinuities between her own perspective/practices and those of some parents. She has been shown a vignette from another teacher who argues strongly in favour of everyday embedded mathematical activity as a learning tool. There is not space to put the whole vignette but it provides a general idea:

> I have a real antipathy towards homework for children on this age. I would much rather that the parents were helping the children in general ways, to learn. For example, if they wanted their maths to improve, I'd much rather see them taking their children shopping and talking to the children about, 'oh, you know, these apples are £1.50 and kilo, you know, how many do you think we're going to get', and just bringing mathematics into their everyday life. I tend, I do find in this school, and I don't know whether it's a generalisation, you know, or whether its true everywhere, but the parents tend to want a sheet of sums,

She responds:

Jane: I agree with her that maths should relate to the everyday life, I don't dispute that. And again, there's a big difference, and it's been studied with my own son – stairs, count them as you go up and as you come down, pre-school thing. There are parents who don't believe unless you have a sheet, because they remember their own homework but what they're remembering is high school homework. Unless you've got a sheet folded in half, sums down there and sums down there.

This was not necessarily an opinion shared by her colleagues. Just to give you a flavour of variation around the boundaries of implicit/explicit mathematics practices another teacher says:

Susan: ... I think a lot of parents just do what she's saying automatically, and kids these days will, you know 'just whip round the corner shop and get me a loaf of bread and a pint of milk and make sure you get the right change' and they can, I think they're far more streetwise these days than they've ever been, so they're getting that kind of experience. We laugh about the traveller kids who are not necessarily that good at maths but if you give them a money problem and they've got it like that, because they've got the experience of actually going out and spending money and dealing tangibly with coins.

Her mention of the traveller community and "kids these days" is interesting in that it shows recognition for both the cultural situatedness of everyday mathematics but also alludes to the historical aspect of boundary crossing which will be addressed more deeply in a moment. Jane raises an aspect of the implicit/explicit dilemma of mathematical practice which was a feature of most teacher narratives – laying the foundation of number in pre-school.

Foundation laying

From the interviews with these teachers it would seem that implicit mathematical practices are most valued when children are young, prior to coming to school. As such, parents are ideally expected to lay the foundations of their child's learning in the first five years of life. The expectation though, is that this is a 'natural' activity that is implicitly embedded in everyday practice. This foundation then sets the child up for the boundary crossing into school. Catherine is responding to the quote from the teacher about everyday mathematics mentioned already:

Catherine: I mean the idea is that parents give them support. I find that most of the parents do give them support but I think this what she's talking about here, about real life maths, like going shopping, then I think hopefully the parents are doing that anyway as well. And have been doing that ever since they were, I mean that's what makes these children better mathematicians, better at anything. That from day one when they were tiny babies you start counting their fingers and counting their toes, and doing things like that. The parents either do that naturally or they don't. They don't teach them to do it. And the ones that started with the baby counting its toes will be at the shop saying 'well, you tell me what the change might be' ...It has an impact on how they come into school, and what they can do when come into school. I mean, some come into school really quite numerate and literate really. Knowing lots of nursery rhymes and all these sort of things. And other children come to school knowing absolutely nothing. And they're not necessarily less intelligent at the end of the day, but just have not had five years of education, or whatever, that their parents would have given them.

Work from the 'funds of knowledge' research suggests that parents do not always "naturally" undertake mathematical practices valued by the school (see Gonzalez, Moll, & Amanti, 2005 in the US or Andrews & Yew, 2006 in the UK). Wenger (1998) talks about boundary peripheries – the trajectory where a newcomer to a community becomes a full member of that community with time and experience with the practice. In a school setting it is almost impossible for a parent to become a full member of the community because their connection through a third person (the child) keeps them on the periphery. The direction of knowledge is assumed to go from school to home, not the other way (Gonzalez, Moll, & Amanti, 2005). Yet in the case of foundation laying, parents are expected to develop the right kind of knowledge prior to their child arriving in the school community:

Mary: Children really from year dot should be learning how to speak, and if it isn't - you know, your phone number, your door number, numbers all around you, I think that helps a lot. And then they're not frightened of it and don't look at it and think 'ah, it's totally scary'.

Foundation laying was in some cases recognised as a historical activity within the home community:

Catherine: I think its one of these things, you know, if your dad is really good at maths or your mums really good at maths it will show through in the child.

Sociocultural theories and Communities of Practice recognise the importance of mutually engaging histories by members of communities or societies. Parents own mathematical past experiences are recognised as having an influence on their current mathematical endeavours (O'Toole & Abreu, 2005).

Resisted boundaries

Some parents whose knowledge in one community is enough that it can carry to another community may resist institutional boundaries placed on them. Parents who are themselves teachers have full participatory knowledge in one context which crosses the boundary to another. Anna discusses her resistance to some mathematical practices sent home from school, which she subsequently reconstructs:

Anna: though my son is only five, during the Easter holidays and half holiday, this list came; he has this maths booklet at home, which I must admit we very rarely look at. And there was this list saying do page fourteen, fifteen, sixteen, you know, about ten different pages. And I looked at that and I thought, and I did look them up and see what areas it was and then I thought no, he's not doing that we're not going to sit and he doesn't have to write it or anything or take it back to school. But I just thought I'm not going to slog through this during his holidays, but I thought we could spend our time much more valuably. And so we did, he had 50p during the holiday and we took him to

> the shop 'right ok, you can buy yourself a treat', 'how much have I got mum?' 'well you've got 50p there' and it was about his change or whatever. And then another time we were cleaning out the car and it was all the money that we found underneath the seat.

As a teacher Anna's insider knowledge allows her greater freedom in terms of the boundary crossing between home and school with her own children. Her expert knowledge means she can be resistant to formal mathematical practices sent from school to home. With explicit knowledge this is less complex than implicit knowledge which is largely culturally and experientially driven.

HOME CREATES CONSTRAINTS

Teachers were very conscious of the constraints to mathematical practice in the home. Some of those constraints came about because of boundary crossing with other extracurricular activities such as swimming clubs, sport activities, Mosque or dance. Some of the teachers spoke of the other difficulties in explicitly embedding everyday mathematical activities in the home. Catherine narrates the difficulties in sending practical work home for children to do:

> Catherine: Do you think that practical work is more beneficial at home than the more traditional academic work?
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> Catherine: So what would you put in that, as practical work?
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> Interviewer: Um, what's been mentioned to me before are things like measuring, going in and weighing tins, rather than your sheet of sums
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> Catherine: Which you can end up with a lot of problems giving homework like that, because they can come back and say 'well, I haven't got a tape measure at home or I haven't got a ruler or I have no scales in the kitchen
>
> Interviewer: So it excludes some of the children
>
> Catherine: It does, definitely. I mean you'd be surprised what they say. I gave them some colouring, well it was a homework which said 'colour all these squares blue' or whatever, and I had a child who said 'but I've got no colours at home', so I had to give her some. But you can't give them scales, and you can't give them tape measure, rulers. I mean, even, um, when we did some measuring a couple of weeks ago and one girl in my group came back and said 'well I couldn't do my measuring because my sister took her ruler to school' so we did it in school with her instead. But the point is, they can't all...we even get the trouble with clocks, some children don't even have clocks at home. They'll have plenty of videos and microwaves and things, with digital time on them, but they will not have an analogue clock in the house.

We have argued elsewhere that the resources parents use to understand their child's mathematics learning can be in symbolic form, such as the representations of child development (Crafter, 2009). Resources in the form of artifacts also have the potential to reify participation between two Communities of Practice (Wenger, 1998). In relation to boundary crossing, Wenger (1998) discusses how artifacts (such as colouring pencils or clocks) help organise the interconnections between communities. As Catherine points out, culturally diverse settings can create disconnections which arguably can increase the gap between children who do, and do not engage in implicit mathematical practices at home.

Anna spoke of another form of constraint on children's home and school mathematics learning

Interviewer: Why do you think some children do better in their mathematics than other children? Can you tell me about it?

Anna: Quite possibly the attitude of their household to mathematics. If you have parents who always say 'oh, I was no good at maths at school, oh I found it difficult, oh not maths, don't ask me' I think it tends to show the children that there is something hard about it. Whereas, I actually think that with a positive attitude most children actually enjoy maths. But I suppose it's with any subject you know, some children will find learning numeracy more difficult, but then you'll find other children who find reading more difficult but they're very good at numerical problems.

Chris alludes to a similar issue to that raised by Anna.

Interviewer: Do you think there are any aspects of the home background, which may affect their mathematics? Can you describe anything?

Christ: Again, I think attitudes towards numeracy in general. Again, there doesn't seem to be any shame about not being able to do maths and it's either joked about, whereas you'd never joke about not being able to read, or write. I think that's probably the biggest issue to get over, that it's not ok, not to be able to do maths.

SOME CONCLUDING THOUGHTS

This paper has attempted to make sense of teachers' understandings of parents' everyday mathematics in the home through the theoretical lens of boundary crossing and implicit/explicit mathematical practices. Understanding episodes where implicit/explicit use of mathematics has crossed boundaries seems to be important. Grossen (2010) talks about the ways in which a piece of text in one 'sphere of experience' is incorporated in the social and cultural experience in another 'sphere of experience'. Can we focus on mathematical practice in a similar way? If so, we could perhaps help avoid the tendency that teachers and schools have to 'impose upon' the home the 'right kind' of mathematical practice. Teachers lack of knowledge about the diversity of home mathematics encourages notions like 'foundation laying' which are imbued with notions of 'naturalness.' Foundation laying obviously works well but it is also narrow is its scope in that only certain practices are included in that. While teachers know that parents' mathematical insecurities can pass on to their children there appears to be very little 'mathematical identity' work which goes on in practice. One might imagine that this is largely because a) they are not trained to address the psychology of identity and b) there is little time and space in the delivery of the curriculum to do so.

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