

We need to talk about mathematics: analysing conversations of PGCE primary mathematics specialists

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I am in the early stages of doctoral study and am researching what primary mathematics specialists talk about when they talk about mathematics. I have made a collection of conversations over the past year and some of the audio data indicates that these student teachers see ‘maths talk’ as a valuable part of their development in beginning to establish a deep understanding of the mathematics that they teach, what Ma (2010) might call ‘a profound understanding of fundamental mathematics’ (p.125). However some feel that they have different types of conversations about mathematics at school and at university. As we move towards PGCE courses which are primarily school based I question what this holds for the types of ‘maths talk’ that student teachers will have opportunities to engage in.

Keywords: content knowledge; subject-matter knowledge; pedagogical content knowledge; primary mathematics specialist; ‘maths talk’

Introduction

I currently teach on the Post Graduate Certificate in Education (PGCE) primary mathematics course at Bath Spa University and on the general primary with maths specialism route that is offered alongside the main PGCE route. This article focuses on the analysis of five semi-structured interviews conducted with individual mathematics specialist trainees as they came to the end of their PGCE year in July 2014; the aim of the interviews was for me to capture some insight into the trainees’ experiences of teaching and learning primary mathematics over their PGCE year. I chose to work from an inductive position throughout: learning more about the experiences of trainees is central to my current research interests and the analysis and discussion that follows is rooted in the reflections and stories that the trainees shared with me.

In order to qualify for the general primary with mathematics specialism route at that time applicants must have undertaken study in mathematics post-16 and demonstrated, in a written expression of interest, an enthusiasm for the teaching and learning of mathematics. The specialist route was centred on mathematics seminars on five university based days in addition to the university based days attended on the main PGCE route. A key aim of the specialism route was to offer opportunities which would help to develop potential for subject leadership of primary mathematics.

Data collection and summary of findings

Talking about experiences of teaching and learning mathematics was a fundamental component of the five mathematics specialism days over the course of the year. At the end of the year I asked each of the ten primary mathematics specialists if they would be happy for me to talk to them in more depth about their experiences and five

trainees agreed to be interviewed. I devised eight questions to act as a basis for semi-structured interviews. The questions picked up on themes that had come out of conversations that we had had over the year as a whole group. Each interview lasted for approximately half an hour, I recorded each one and used the process of thematic analysis described by Braun & Clarke (2010) to study the data.

Through transcribing and re-reading the interview data I generated some initial codes and gathered them under the four broad themes described below. These themes were pertinent as they were reflected across the five interviews and recurred within each individual interview too. I have selected excerpts from the interviews in order to exemplify each of the themes and to give voice to the trainees, their views and experiences. I made selections that I felt reflected the data set as a whole and which showed some of the overlap between the broad themes.

Culture of learning

The way of learning that trainees wanted to inculcate in their classrooms was talked about by all trainees. Their desire for their pupils to understand the mathematics that they were teaching was of particular importance as was the engagement and enjoyment of pupils.

Trainee A: I don't know what the point is if you don't understand it, what's the point in doing it because you're just going through the process and it doesn't have any meaning for you, so it's just learning that process and not actually doing it for any purpose, it's kind of a bit pointless if they don't get it

Trainee A: I want them to enjoy it, cos I really enjoy it, I want them to enjoy it as well

Trainee B: I want them to understand it, I want them to not sit on the carpet and just daze away or be scared or frightened or anything like that, I want them to know that actually if they don't know what I'm talking about it's safe for them to say 'I don't understand', that's ultimately what I want but at the same time I also want them to feel challenged as well, I don't want it to be easy for them, that sounds like a total contradiction but, I want them to feel safe but also feel challenged

Trainee E: we were able to do all the maths problem solving and different things and we did all the palindrome numbers and all that sort of thing and they were really excited about that, 'oh I've got his answer', when they start to see the pattern so they really loved that and to be able to do all those challenge ones and get their enthusiasm a bit more

Affective domain

Trainees used anecdotes to illustrate points that they wanted to make. These short stories sometimes described emotional experiences in the mathematics classroom and these events shaped the way in which trainees both thought about and engaged in teaching and learning processes.

Trainee B: there was an SEN boy who had severe maths anxiety last year in Year 2 and at the beginning of this year, if he didn't understand something he would just literally shut down and cry and so I found myself planning for him as opposed to the entire class because I was more concerned about him not breaking down in tears

Trainee C: if I find something boring then I have no right to tell the kids that they have to enjoy it... how can you teach something if you then are sort of in the back of your mind going, well this is horrendous?

Trainee D: one of the reasons I came into teaching was because I wasn't content with, I don't know, some of my peers at secondary school would get there and they can't add numbers or do these things that I thought were quite simple that was kind of, there's, education's kind of failed them

Challenges

Trainees identified a range of issues that made aspects of teaching and learning mathematics difficult. Differentiating effectively and meeting the needs of all pupils were recurring themes. The pressures of limited time and the requirement to keep moving through the curriculum meaning that children might not fully understand a concept before having to move on to another learning objective or topic were also mentioned. Contrasting beliefs and values about the teaching and learning of mathematics among colleagues alongside the amount of freedom given for trainees to teach in the ways that they felt were right for them and the children were evident too.

Trainee A: I always feel like I've never got enough time. There's always a limit and when the children come in late and then you've got to reteach it and it's just time constraints. And what my mentor said, well they don't all have to understand it, that goes completely against my views so that was difficult... and also there's only kind of, when you go into school, there's expectations that you've got a week or three days to teach this topic but what if they don't get it and then you've got to try and go onto something else, you're expected to move onto something else

Trainee C: in my first placement it was quite rigid and they were like year 6 going towards the SATs and it just meant it's sort of, just come the end they hadn't done as well in their practice papers as they wanted and they were just teaching to the paper... on placement two I was allowed loads of freedom

Trainee E: you got that child to really understand it but actually then there were other people who didn't understand it or if you've marked their books and you've thought they've said 'yes, I totally get this' and then you look at their book and you think 'oh no, you have completely missed the point' but you feel like oh I should have, if I'd have noticed that in the lesson you could have intervened

The future

Four of the five trainees mentioned the positive impact that a one-day mathematics conference had on their development and saw engaging in such professional development activities in the future as desirable. Having the opportunity to continue observing other practitioners was also viewed as important. Some apprehension about what was ahead in their teaching posts was expressed too.

Trainee A: I'd quite like just to observe sessions, I've already spoken to [a colleague], she works at a school in H and she's spoken to the maths specialist in there and she's like, come in whenever you want so I'm going to do that but, the conference was really good and I'd like to do more like that, you kind of get exposed to things that you don't get to do very much if you're just in school

Trainee B: one thing that stuck out from the conference was if, with this growth mind-set that I really want all my children to sort of work towards is, when you ability group a child it becomes a fixed mind-set, it limits it, it says this is what you are so therefore you are going to do this, it's something that I really want to avoid but then I wonder if some children like it like that, am I doing it because it's what I want or am I doing it because it's best for the children

Trainee D: I've got my timetable through for next year and it seems like it could be quite rigid like I have, this is when I do this, this is when I do this... I will only have 15 children every morning, if I want to, in the afternoon oh we are just

quickly going to finish that maths earlier I'm not going to be able to because the other 15 aren't going to have that to do as well so actually I've got to stick quite well within those blocks that have been laid out

Discussion

Overall I was struck by how much these trainee teachers, on the verge of becoming qualified teachers, were able to talk about what was important for them in the teaching and learning of mathematics. They had clear ideas about the learning culture that they wanted in their classrooms and the types of learning experiences that they valued. The experience of the child was central to their reflections and their views were founded on some of the theoretical ideas presented at university, their experiences as classroom practitioners on school placements and their own experiences as learners of mathematics. They were aware that there was more to learn and had clear ideas about how they could continue learning.

Taking a broad overview of the data set I noticed that throughout the interviews we were talking about three different things: sometimes our talk was about teaching, often it was about teaching mathematics and very occasionally it was about mathematics in its own right.

I studied the transcripts again for evidence of what I consider to be 'maths talk' by which I mean talk which indicates that trainees are grappling with the mathematical content that they are teaching in order to establish a more secure understanding for themselves but I found limited evidence. The extract that follows is the clearest and most sustained example:

Trainee A: yes, it's trying to find other ways to explain it, other than how I understand it as well because I think there are different ways to understand things and I've got my own ways of understanding

CO: so have you had thoughts about that, about how will you find out about those different ways of understanding?

Trainee A: I think through discussion, my friend did the BEd course in G and we went on a day trip and I was planning my lessons on the coach and we were doing, it was when you came in and saw me doing the time bit, and we were discussing how I see it and how she sees it and through that, it was just another way to view it, and she was saying about how she didn't get it when she was learning time, and so she knows the misconceptions are this this and this whereas I was just like I can't even remember, I always knew it, it was just one of those things that I could do but from discussion with other people you, there's only so much you can get from a book but personal experience is more valuable in teaching I think

For me this is a good example of a trainee working to establish what Shulman (1987) calls content knowledge and Rowland, Turner, Thwaites, & Huckstep (2009) refer to as subject-matter knowledge. Through discussion with a peer the trainee is establishing their own understanding of time more clearly and they see having the opportunity for such 'maths talk' as important in being able to develop their understanding. The value of such 'maths talk' is acknowledged by Ma (2010) in her description of how Chinese teachers learn from each other and she illustrates this point with an extract from an interview with a teacher:

I have learned so much math from other teachers... I liked to listen to [colleagues] discussing how to solve a problem. They usually had various ways to solve a problem...It was from them that I started to see the beauty and power of mathematics. (p.137)

Shulman (1987) recognises the importance of teacher understanding:

To teach is first to understand. We ask that the teacher comprehend critically a set of ideas to be taught. We expect teachers to understand what they teach and, when possible, to understand it in several ways. (p.14)

However the majority of our dialogue was concerned with talk about the teaching of maths, what Shulman (1987) and Rowland et al. (2009) call pedagogical content knowledge, as demonstrated by the interview extracts presented earlier. Studying the transcripts again also made me aware that I had not included specific questions about content knowledge and that trainees did not identify having secure content or subject-matter knowledge as being important in being able to teach for pupil understanding or list developing this knowledge base as a requirement for their future professional development.

If a difference exists between content or subject-matter knowledge and pedagogical content knowledge is a debated idea. Shulman talks of an intersection between the two, Ma (2010) explains that “in the investigation of “what it is,” concern for “how to teach it” is always implied and included” (p.133) and Brown & McNamara (1999) question whether a distinction can and should be made. However I suggest that there is an argument to be made for the importance of talk which helps to establish content or subject-matter knowledge. Williams (2008) recognises that: “Opportunities for open-ended discussions of solutions, exploration of reasoning and mathematical logic” (p.37) is a distinctive feature of high quality mathematical learning. While this statement is directed at children as learners of mathematics I propose that the same applies for teachers who are also learners of mathematics. In addition some trainees will become subject leaders of mathematics; being able to support other teachers in the development of their content knowledge will be an important part of their role.

Allen (2010) found that the cohort of trainee teachers she worked with did not regard the development of their subject knowledge as the highest priority in their growth as effective classroom practitioners and Brown & McNamara (1999) document a movement from affective responses to a pedagogical focus over time. Such findings may help to explain the observed focus on pedagogical content knowledge and perhaps suggest that a focus on content or subject-matter knowledge will come with time. In line with this suggestion Ma (2010) found that teachers established their understanding of mathematics as teachers, rather than as trainees, and Williams (2008) suggests that professional development opportunities after qualifying might be the most appropriate time to focus on the development of subject knowledge.

This raises two contemporary issues. Firstly there is a conflict with policy. Trainee teachers are currently required to meet the teacher standards (DfE, 2013) in order to attain qualified teacher status and the standards require that trainees “have a secure knowledge of the relevant subject area” (p.11). New guidance on the expectations of primary mathematics specialism routes recently released (AMET & NCETM, 2014) states that “all trainees need good content knowledge” (p.4). While I know that opportunities for ‘maths talk’ are created and built into our university sessions I cannot be sure of the impact of them and neither do I know if such conversations are happening at school but they seem important for the development of the good content knowledge required.

Secondly PGCE courses are becoming increasingly school, rather than university, based which could mean that, due to the pressures of time, the good content knowledge base expected of trainees as they become practicing teachers may

need to be developed at school yet my analysis suggests that the focus at school is on developing pedagogical content knowledge rather than content or subject-matter knowledge. Moreover the progression from a focus on affective issues in teaching and learning to pedagogical issues and then to issues of content or subject-matter knowledge that earlier research and opinion has perhaps indicated may begin to look different with more time at school and less at university.

Conclusions

While I must consider that the five conversations analysed were situated in many discourses, the way that mathematics is talked about at school and university, the way that trainees have talked about mathematics in the past and the construction of my interview questions themselves, the observations made have led me to wonder when and how trainees and teachers develop their mathematical content knowledge. It seems that 'maths talk' with peers and colleagues is an important part of this development and I hope to research conversations about mathematics further.

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