

## **How primary trainee teachers' beliefs change about mathematics education during their first term of a PGCE course**

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Within the UK, it is widely acknowledged that there are not enough good teachers of mathematics and that this is having an impact on different facets of society. Reasons behind this need to be explored so that this trend can be reversed. This paper will explore the experiences of three Primary Trainee Teachers within the world of mathematics education. Their perceptions, confidence and attitude towards mathematics education are explored at different points during their PGCE Primary teaching course to discover whether university led subject knowledge/pedagogy sessions and teaching children on placement can change these views in a positive way. Using the framework of the 'Knowledge Quartet', I analyse whether the beliefs of the trainees have changed and why, in order to use this knowledge to inform future practice for the successful teaching and development of future trainees. From this, further issues are exposed which are worthy of future research.

**Keywords: Primary; trainees; beliefs; mathematics education**

### **Rationale**

As a Senior Lecturer in Primary Mathematics Education I feel that the issue of perceptions towards mathematics is very important as I believe that the way somebody thinks about a subject affects the way they teach it. As a primary school teacher I had met people who had disliked mathematics intensely until they had taught children, and often these were the people now championing the subject within their school. Conversely, the teachers who had excelled in mathematics at school now found teaching the subject difficult. I decided to undertake this study to try and discover what may affect trainee teachers' perceptions of mathematics and whether what was done in university sessions and on school placement would change their thinking about mathematics education. Any findings could be used to influence future PGCE programmes to enable trainees to have a more positive attitude towards mathematics and therefore influence the children they teach.

### **Literature review**

Whilst it is socially embarrassing to profess to be unable to read or write the same cannot be said about the ability to do mathematics, to the extent that people openly admit that they cannot do it (Hodgen & Marks, 2013). National Numeracy (nd) state that this negative attitude, rather than a lack of ability in mathematics, is at the root of a crisis within the UK. According to a report commissioned by National Numeracy (Pro Bono Economics, 2014) around half of the adult population in England and Wales have the mathematical ability of a primary school child or below. The Campaign for Science and Engineering (CaSE, 2016) has suggested that each year there is a shortfall of 40,000

STEM workers within the UK and that this skills shortage issue starts at school (ATKearney, 2016), an issue which is important in this study because of the question of how a trainee teacher's perception of mathematics may influence the children that they are teaching. Recent studies have concluded that many children do not enjoy mathematics as it makes them feel helpless and stupid (Brown, Brown & Bibby, 2008). Numerous people think that mathematics is difficult (Brown et al. 2008) and is viewed culturally to be the domain of highly intelligent people (Boaler 2015). Brown et al. (2008) citing Osborne et al (1997) reports that the main reasons why children discontinued their study of mathematics were that it is perceived to be 'hard', 'boring' and 'useless'. From their study, Brown et al. (2008) state that expressions of boredom were not only due to a lack of stimulation, but also a lack of challenge, a loss of control over tasks and direction, and a felt inability to be seen and acknowledged as successful in a subject. Ahmed (1987) cited in Ahmed (2014) discusses his report where he found that children failed to connect mathematics with other subjects or with life outside school, therefore finding it irrelevant. Educators have tried to address the issue of the relevancy of mathematics by renewing the emphasis on presenting maths in the form of real life situations. This has often been accomplished by inserting children's names into problems or asking children to make up their own problems rather than schools providing problems relevant to the students themselves. Boaler (2015) believes that these unrealistic contexts lead to the mystery of mathematics which switches people off the subject. So the issue for teacher educators is whether what is done in universities can enable trainee teachers to be confident enough to teach mathematics in a manner that makes it appealing and relevant to people, whilst still retaining enough challenge to engage students (Brown et.al, 2008).

Maths anxiety is a feeling of helplessness, tension or panic when asked to perform mathematics operations or problems which then leads to a negative view of the subject (Haylock & Thangata, 2007). This can affect everyday life and inhibit the ability of individuals to reach their full potential because they avoid anything that involves mathematics (Jameson, 2014). Maths anxiety can start to manifest itself in young children (Jameson, 2014) which means it is important that the causes of anxiety need to be studied in order to eliminate them. Harari, Vukovic and Bailey, (2013) state that accumulated negative experiences in school – failure to do well in maths, hostile teachers and anxiety in teachers - is one of the factors that lead to maths anxiety in children. In their study, Uusimaki and Nason (2004) looked at the causes of negative beliefs and anxieties about mathematics with pre-service teachers. They found that the origin of maths anxiety in most of their participants was because of prior school experiences (in primary and secondary) and were mainly due to their teacher rather than specific mathematical content or to social factors such as family or peers. Furthermore, a study by Beilock, Gunderson, Ramirez and Levine (2010) has concluded that many girls had a significantly worse grasp of mathematics if taught by a female teacher who suffers from maths anxiety – this is particularly significant in the UK as approximately 90% of primary teachers are female (Paton, 2010). It could therefore be concluded that the manifestation of maths anxiety is cyclical – somebody becomes a primary school teacher who is anxious about mathematics and this anxiety is passed on to the next generation of primary school teachers.

In order to avoid the cycle of negative perceptions of mathematics that is being passed on at school, it is important to ensure that trainee teachers have the best possible experience of

mathematics education whilst on their PGCE course in order for them to become successful teachers of mathematics.

## **Discussion and analysis of data**

### *The start of the course*

Three trainee teachers agreed to take part in the study. Oscar was a mature student with a family, who had been in employment before embarking on the PGCE, Jane and John had both just completed undergraduate degrees. The initial group interview took place at the end of October, approximately two months after the trainees had started the course. This meant that they had already attended ten university sessions on mathematical subject knowledge so I was unable to capture perceptions and attitudes towards mathematics at the start of the course, before any influence from university. However, the trainees had not been on placement yet, so it was still easy to gain attitudes and perceptions from before the course. In the first session attitudes towards mathematics are explored. All three trainees felt confident and had a positive attitude towards mathematics.

During the focus group discussion I asked them what had influenced them to make them feel confident and have a positive attitude towards mathematics. It emerged that both Jane and John had been positive until the end of their GCSEs but had found the transition to A level difficult. At this point their confidence fell, mainly because of the attitudes of the teacher. It affected Jane so much that she avoided mathematical modules within her science degree. Both Jane and John perceived that the A level teacher only liked the pupils who were successful with their work, but did not have a strategy to work with the pupils who struggled, which relates to the study by Henderson and Rodrigues (2008) who discuss the fact that although someone has an excellent subject knowledge of mathematics it does not mean that this person will have the pedagogical knowledge to be able to teach it successfully. This possible lack of pedagogical knowledge would also have affected the engagement of the pupils which could be the reason why John noted that the teacher could not control the class properly.

Oscar also enjoyed mathematics but did not go on to take A level.

... I think it was the case that they were worried that the rest of us were perhaps on the B, C cusp. If they put us in for the higher paper and we didn't get it then I could have come away with nothing, so it was kind of a gamble that I assume the teachers must have taken on our behalf... (Oscar)

His teacher had essentially cut off his route to further mathematics education by not allowing him to take the higher paper. This 'control' of the teacher with regard to GCSEs was also mentioned by Jane who noted that at her school everyone was put in for the 'higher' paper, but those who were not as talented at mathematics were trained in how to answer specific types of questions, 'teaching to the test' rather than for understanding.

Regardless of this, the trainees were still positive about mathematics, with the main reason being that there is always a right or wrong answer, but as the trainees had already had university sessions their perceptions about how mathematics worked were starting to change.

... we were taught that it was one way of doing something and that's how you did it. Now we're in sessions and you sort of see the others and they are saying like, 'Well I did it this

way', it's kind of like, 'Aah,' and you ... realise there are different ways of doing things...  
(Oscar)

When they looked back over their mathematics education they realized that they were all taught a set method of solving a particular calculation, but the sessions in university were encouraging them to notice the different methods that people use. The trainees were also encouraged to use the enactive – iconic – symbolic theory to teach the children – this is in contrast to how they were taught.

... I don't remember half of this stuff and resources. I remember those Dienes blocks we had those in year 2. That's all I can remember. I never saw a bead string. (Jane)

The trainees realized the importance of this in education as everybody works and needs support in different ways.

The conclusions from this session were that all of the trainee teachers were happy and confident with mathematics despite there being some negative aspects of their mathematics education. They had all started to reflect on the way university sessions were encouraging them to teach mathematics and were willing to revise anything they were unsure of.

### *After university sessions and placement*

Individual interviews took place after the completion of the first school placement. John and Oscar stated that their confidence and attitude towards mathematics had become more positive. The reason for this was because they had used mathematics every day in their teaching, incorporating the ideas that had been advocated in university, such as making the work practical and relevant, and becoming more confident when they were successful which led to a cycle of growing confidence. They also felt a responsibility to teach mathematics in a positive and understandable way. Both had moved away from how they had been taught mathematics as they were using concrete apparatus and encouraging children to use different methods to solve problems. However, they believed that in order to teach the written calculation strategies they still needed to have more formal lessons. Mentors of the trainees were confident in mathematics teaching and encouraged them to take risks. However, school policies made them feel restricted because of the need to have evidence in books and because there was an expectation for certain methods and procedures that needed to be taught for the KS2 SATs.

Jane had a different experience on placement, stating that her confidence and attitude had remained the same. She had voiced anxieties about teaching the younger children as she was good at mathematics but thought she would find it difficult to teach concepts she knew instinctively.

'... I ... struggled with kids that didn't get it. I couldn't see why they couldn't get it...'

The mentor did not enjoy mathematics which was evident when she was teaching; Jane mentioned that children were not engaged and that there were behavioural issues during lessons. As Jane was confident in her knowledge of mathematics she decided that she was going to use concrete apparatus, relevant contexts and other ideas from university. This had a positive effect on the children.

... [The children] got quite excited ... even higher ability ... were like, are we allowed to use that? I found that it stopped the ... hand putting up ... they were a lot more independent, and I had less of a trail of children following me around the classroom.

It also had a positive effect on the mentor, as she could see how the children were much more engaged with the subject but also the progress of the children was evident in their work and test scores.

The mathematics subject leader was also a source of inspiration for Jane. She found that she enjoyed watching him teach mathematics the Year 6 children, as he was always enthusiastic and taught in ways that encouraged understanding, allowing the

children to make mistakes in order for them to learn from them. Jane was surprised to discover that he had always been bad at mathematics at school.

He was very engaging ... he'd always been quite bad at maths in school, ... I assumed that he'd always been good at maths, so he had real empathy for them when they couldn't see it ... [he would] help them with strategies ... whereas I was ... the opposite, and was like why can't you see this staring you in the face, I think he was quite good for me personally.

Despite thinking that her confidence/attitude had not changed, it can be seen that Jane had become more empathetic towards children who struggled with mathematics and used successful strategies to engage them in their learning. She had the confidence to try these ideas despite the mentor having a dislike of mathematics. This in turn had an effect on her mentor who had started to see the benefit of the way in which Jane taught mathematics.

## Findings and implications for the future

Using the 'Knowledge Quartet' as a framework (Rowland, Turner, Thwaites & Huckstep, 2009), this section will reflect some of the themes that emerged during the interviews and discuss why these issues brought about change.

The first dimension from the framework is *foundation*, which relates to a person's background and beliefs about mathematics. It is evident that the trainees all had a positive foundation because of their mathematics education and the support they had from home, but that the university sessions and time in placement had started to *transform* their knowledge into successful teaching of mathematics. The trainees were taking what they had learnt in university into their practice and noticing that it was valuable in helping children to understand and make connections within mathematics. The ideas they were using were aspects of mathematics education that the trainees had not experienced when they were in school.

Another important aspect in the changing attitudes and perceptions of the trainees was how the mentor supported them by allowing them to take risks – even the mentor who disliked mathematics allowed this. This enabled the trainees to move on in their transformation towards becoming excellent mathematics teachers.

It is evident that university sessions and time on placement can positively influence the confidence and attitude of trainee teachers, but there are caveats to this. The trainees were lucky to have a university tutor who was engaging, knowledgeable and enthusiastic about what she was teaching, which enabled the trainees to have the confidence to try the ideas in school. They also had school mentors who were supportive and allowed the trainees to try these ideas which meant that their confidence grew. For all of this to happen the trainees also had to have an open mind to the ideas advocated in university and school. Therefore, the best case scenario for a university is to have enthusiastic and knowledgeable tutors and mentors who, despite their feelings towards the subject, will allow trainees to try ideas to see if they are indeed the best way of teaching children mathematics. If this can be done it might be that one day we will start to see a cycle of positive attitudes towards mathematics coming through the school system.

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