

## **What is the Nature of the link between Students' Mathematical Qualification, Subject Knowledge and their Confidence to teach Primary Mathematics?**

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This study is an exploration of students' confidence in their mathematical subject knowledge and their ability to teach mathematics in the 3 – 11 age range. A survey of 78 students was carried out by questionnaire after the second placement in Year 2 of a three year degree course in primary teacher training. The study found a close match between students' confidence and their qualifications and a further link with perceived success in the classroom. The study raised the question of whether actions around improving subject knowledge in the training institution was raising or decreasing student's confidence.

**Keywords:** Maths; Teacher Training; Subject knowledge; Confidence

### **Introduction**

Primary initial teacher training students often express anxiety about their maths. This perception of themselves is derived very often from low grade passes at GCSE (entry qualification grade 'C' or equivalent) or struggles to gain this level of qualification. Poor international results for 11 year-olds (TIMSS 1995) was one of the reasons the government required students to have specific subject knowledge above primary curriculum level (DfEE 1998). This has reinforced the belief that students need to have detailed mathematical knowledge to at least key stage 3 to teach in the primary school. Meeting the standard was managed by most teacher training establishments by auditing and testing. Much of this was presented in a pure maths context rather than a primary teaching context which, for many students, must have seemed like more of the maths which was found to be hard before they arrived on the course, thus, for some raising anxiety again. The TTA regulations for teacher training in 2002 removed precise content from the Qualified Teacher Standards but indicated there would be gaps in knowledge that student teachers would need to address. Hence, most training institutions have continued some form of audit and evidence gathering.

For some trainee students the struggle to learn maths in their secondary schools and on access courses has established in them a deep belief that the subject is hard and that they are not any good at it. The context free presentation of similar maths on their training course probably deepens this belief and leads to a wariness and lack of confidence in their own abilities. Is this lack of confidence then transferred to their teaching, even though the maths is easier?

This research study was set up to look more closely at the link between students' subject knowledge and their professed confidence in teaching primary maths. This will be done through an examination of Year 2 undergraduate students' responses to a questionnaire about their qualifications, confidence and enjoyment of teaching maths.

## **Mathematical knowledge for teaching**

Shulman when discussing models of effective teaching, said,

No one asked how subject matter was transformed from the knowledge of the teacher into the content of instruction. Nor did they ask how particular formulations of that content related to what students came to know or misconstrue (even though the question had become the central query of cognitive research on learning). (1986, 4)

This observation led to his theory of the different types of knowledge required for teaching; content knowledge, pedagogic knowledge and curriculum knowledge. Whilst this moved thinking away from the need for a high level of personal content knowledge, it has always been difficult to tease out which one is in action at any one point in time when teaching. One study which has taken a close look at student teachers in action in the classroom is that of Huckstep et al (2003). Twenty-four video tapes of postgraduate students teaching maths on their final practice were studied. Using grounded theory, the tapes were analysed and eighteen categories of aspects of practice produced. These were later grouped into four themes; foundation, transformation, connection and contingency (Rowland et al 2003), which have been called the 'Knowledge Quartet'. The quartet provides a useful set of criteria with which to analyse classroom practice. The studies give insight into the nature of the knowledge required for teaching maths to primary children and it is clear from the categories that pedagogic, content and curriculum knowledge are closely intertwined. But are they intertwined in the students' mind or do their past school and initial teacher training experiences push them into keeping them in separate mental boxes?

## **Qualifications in relation to teaching**

Entry qualifications for teacher training require GCSE grade 'C' or equivalent in England. The Teacher Training Agency (TTA 1993) indicated that, despite this, there would be gaps in students' subject knowledge which would need to be addressed. In 1998 the Teacher Training Agency (TTA) indicated the nature of the subject knowledge required which went well beyond the knowledge of reasonably able eleven-year-olds. In 2002 the TTA produced a more generalised statement but there remained the question of what level of personal knowledge is required. Also, since the 1986 publication of Shulman's paper, questions have been asked about the actual nature of subject knowledge required in relation to teaching. Askew et al (1997) found little correlation between qualifications and effective teaching of primary maths. Rowland and Morgan (2002), on the other hand, found a significant correlation in primary PGCE students' low audit scores (subject knowledge) and weak teaching of number. The high or middle audit scorers were more likely to be assessed in school as strong teachers of number.

## **Confidence or lack of confidence in maths?**

Students often express anxiety about their own maths and early on in courses they see this as closely linked to how they will be able to teach maths. (Even though all students' qualifications are probably higher than the level they are required to teach.) After two placement experiences and significant University input, is this lack of confidence still present and how does it link to personal performance levels? Bibby (2002) discusses how as a course progresses, students can suppress their fear of maths in a need to demonstrate professional progress. This indicates that students may be in

public denial about their own mathematical difficulties. Brown (2005) adds to this picture by exploring the historical experience of the student. This could involve several changes of philosophy which presents a confusing picture. How does a student make sense of the maths they have experienced at school, possibly a different way of teaching maths in the University and then on placements where different approaches may again be presented to them? From this range of experience each student must forge their own ideology of maths and must operate it within the confines of the settings they find themselves in. This requires a degree of meta-cognitive awareness of one's beliefs and style and a reasonable level of confidence in those beliefs. This view is endorsed by Walshaw (2004) who claims that student's identities are constantly being challenged and that a classroom is not a comfortable place to be but a setting where 'constant social negotiation' (p65) takes place between the class teacher and the student. Further, Walshaw describes this as a play of 'power relations' between the student's ideological University view and the actual practice and expectations of the class teacher. If this is so, the student teacher who finds themselves in agreement with the teacher's view and has a close match to their own ideology will have a more positive experience. This may also be true for those who can reflect positively on a range of practices or are skilful negotiators. Pepperell's (2007) study of one student's move to their first teaching post indicates that new learning from Initial Teacher Education (ITE) courses may not be as secure as hoped when moving into the school environment of their first teaching post. Possibly the easiest route, in such a new and intimidating environment is to continue current school practice. It appears that school settings on practice or in first posts can have a more powerful influence than previously recognised.

## Method

The method of data collection was by questionnaire. The survey group consisted of students in their second year of a degree course in Primary Education with recommendation for qualified teacher status. The students had just completed their second block placement in primary schools (3 – 11 age-range). The sample contained a cross-section of those on the course and included students who had been placed in the age-phase 3 – 7 years and students who had been placed in age-phase 5 -11years. Canterbury Christ Church has a holistic approach in Year 1 and then upper and lower teaching in Year 2. The students surveyed were mainly placed in Key stage 1 or Key Stage 2 for the placement immediately prior to the issue of the questionnaire.

The questionnaires were distributed during a maths session in which review of maths on placement was part of the session. 78 were issued and 78 were returned. The responses were anonymous. The tutors issuing the questionnaires had no connection with the research.

The questionnaire consisted of the following questions:

- What qualification have you gained in maths?
- Would you have continued studying maths if circumstances had been different?
- When you chose to study upper or lower primary, did the thought of teaching maths play any part in this decision?
- You have completed two weeks school experience in a school near home and two weeks in your first college term. At this stage what stands out for you about what you have seen or done in maths lessons. (Please state the age group you worked with.)
- How do you feel about your own subject knowledge in relation to teaching children?
- Do you feel confident about your own maths in general?
- When you taught maths how did you prepare your teaching? (Where did you go to get information? What resources did you use? Who did you speak to?)

The validity of the results is limited as the sample is relatively small and the questionnaire exploratory in nature. The profile of qualifications from institution to institution will vary although all should be meeting the minimum entry requirement. The reliability of the results may be tentative as questions have yet to be refined. To meet ethical the questionnaire was preceded with an explanation of its purpose and the opportunity to opt out.

### Results and discussion

Of the 78 students surveyed all but two said they enjoyed teaching maths on their placements (97.4%). This is remarkably high when you consider the general fears expressed by students about maths and the potential dynamics of the classroom pointed out by Walshaw (2004). Some of these fears were reflected in students' responses to other questions on the survey (see below). Within the sample of 78 the qualifications in maths held by the students was as follows:

Above GCSE		7
GCSE A + GCE 1		14
B + GCE B		31
C + CSE 1		26

Table 1 Student qualifications

When asked, 'How do you feel about your own subject knowledge in relation to teaching children?' 48 (61.5%) said they were confident, 14 (17.9%) were mainly confident, often in the age groups they had been teaching, 8 (10.3%) were confident about teaching key stage 1 but not key stage 2 and 8 (10.3%) were not confident about teaching maths, although they had enjoyed teaching it! If one considers enjoyment linked to confidence in the classroom, compared to the 97.4% who enjoyed teaching maths this may indicate that the 'confidence factor' has influences which lie outside the classroom and within maths in general.

The possibility of confidence being influenced by past factors, (Brown 2005), is explored further in combining the data about qualifications with confidence to teach. From Table 1 it can be seen that there is a positive correlation between confidence to teach maths and the student's level of qualification.

Confidence in teaching maths (5)				
	No	mainly	Confident	in KS1
Above GCSE			6	
GCSE A + GCE A		1	12	1
B + GCE B		8	20	4
C + CSE 1	8	5	10	3

Table 2 Confidence in teaching maths

There is no lack of confidence with those who have pursued their studies beyond GCSE. The evidence of feeling reasonably comfortable teaching maths is strong for those who have GCSE grade B or above in this sample (66.7%). Problems emerge for a small group of 8 (10.3%) who gained GCSE grade C and are clearly indicating they feel lacking in confidence about their maths. Neither of these statistics indicates whether the student is an effective teacher of maths in the eyes of their class

teacher, mentor or link tutor. This is where the work of Rowlands et al (2003) becomes important as they examine effectiveness in teaching maths through the criteria of their knowledge quartet.

To explore the idea of confidence further, students were asked about their confidence in their own subject knowledge as opposed to teaching knowledge. Some students may interpret this as the same as teaching knowledge but many see it as able to do the maths themselves and not needing to revise topics heavily before teaching them.

Confident about own subject knowledge (6)		
	Not confident	Confident
Above GCSE		7
GCSE A+GCE 1	1	13
B + GCE B	5	26
C + CSE 1	17	9

Table 3 Confident about your own maths?

Once student teachers realise that gaining an award in maths which provides access to the teacher training course is not the end point, it would be interesting to see how they respond to further expectations. Will they recognize weakness and then have strategies to build up the knowledge or will they hope that they will not need that maths in school? This may be a line of thinking adopted by students training to teach in the 3-7 age phase, particularly if the perception of mathematical knowledge is knowing how to do some maths rather than how to teach it. What strategies do students employ to strengthen knowledge and is it teaching knowledge or personal knowledge that they address? And is their lack of confidence an inhibitor which prevents them taking action (Bibby 2002)?

A similar pattern emerges when asked about their confidence to teach, with 70 (89%) expressing confidence (11% not confident). But from the same group 23 (29.5%) declaring a lack of confidence in their own maths. Considering the two aspects together shows that the students had more confidence in their teaching of maths than in doing their own maths (a difference of 18.5%). This suggests there are students who felt they could teach primary maths despite not feeling confident about their own performance. A positive correlation can be seen in a particular group of 8 students who qualified with GCSE grade C saying they were neither confident about their personal maths nor about teaching it 8 (10.3%).

## Conclusion

The survey results show that there are a number of students who lack confidence in their personal maths even after a year on a training course. The data indicates that there are students who report that they lack confidence in personal maths, which they perceive as difficult, but are confident in their teaching of maths. It is possible this is due to the student having taught in an age-group and with maths they know and feel comfortable with. Alternatively it may have its roots in messages and expectations in past experiences and messages promoted by audit work in the Training Institution. Despite the surprisingly high level of students who are mainly confident or confident in teaching maths across the group (70 out of 78) there is still a tail of students (8)

who have the lowest qualification and an expressed lack of confidence. There appears to be a need to focus more individual attention on these students.

The mixed messages which pure knowledge audits give students may need to be reviewed as it could be lowering some students' confidence. This may be a supportive activity for others who recognize and want to 'fill in' the gaps in mathematical knowledge. To encourage growth of confidence it may be possible to review the style of audits so that they are related more closely to the curriculum and pedagogic knowledge which students see more clearly as a professional need and dovetail with the messages they receive on placement. There are also factors at play within school settings which may strongly influence students' perceptions of themselves as 'teachers of maths'.

It may also be worth exploring further how personal attitudes influence students' ability to take action to strengthen their mathematical understanding in personal, pedagogic and curriculum maths.

This paper begins to explore students' confidence in their own maths and their teaching of maths. It raises issues of student's perceptions being deeply seated in their past experience but also in the messages students receive about maths teaching in training institution and school settings. How do they respond to these messages? It would be useful to pursue confidence to teach related to year groups (each age) and to see if confidence relates to the quality of maths teaching in the classroom.

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