Towards solving the recruitment crisis in maths teaching: the role of Subject Knowledge Enhancement courses

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ABSTRACT

Subject Knowledge Enhancement (SKE) courses aim to provide sufficient subject knowledge in 'shortage subject' areas, such as mathematics and science, to enable those who attend them to then undertake Initial Teacher Training and to go on to become teachers in secondary schools. This paper examines the learning experience of a group of SKE participants, and assesses whether this added significantly to their subject knowledge and helped prepare them for work in the classroom, comparing this outcome with conventional teacher trainees who had not undertaken such a course.

KEYWORDS

Subject Knowledge
Enhancement
mathematics
PGCE
Initial Teacher Training

INTRODUCTION

Although this article reports on a single-site evaluation, its findings have implications for how best nationally to meet the challenge of recruiting students onto Initial Teacher Training (ITT) Postgraduate Certificate in Education (PGCE) courses in so-called 'shortage subjects' like mathematics.

The evaluation, which was undertaken between June 2014 and March 2015, investigated the impact on knowledge and teaching experience of 19 students enrolled on a pre-ITT Mathematics Subject Knowledge Enhancement (SKE) course hosted by a university located in the northeast of England. Such courses, which were first introduced and rolled out across England in 2006 by the Training and Development Agency for Schools (TDA),[1] are a response to concerns that there is a declining number of students studying mathematics and physical sciences at degree level, and even fewer progressing onto Secondary ITT courses. Their chief objective accordingly is to bring the subject knowledge of those attending them up to a sufficient level so that they can commence training to be a teacher. This article is written in five parts. The first part runs over and comments on other research relevant to that discussed here. The second outlines the structure and nature of the SKE course I evaluated. The third describes how participants' involvement with the course was assessed. The fourth reports specifically on what they learnt. The concluding part reflects on these outcomes, offering some recommendations arising out of them.

1. LITERATURE REVIEW

There are a number of research studies on SKE courses whose findings sympathetically connect with my own. Atkins et al. (2008), for example, report that 'the importance of the SKE, as a stepping stone to teacher training, through supplying the maths subject knowledge necessary, was highly valued by the students' they surveyed. Similarly, Gibson et al., (2013) concluded that SKE courses provide a 'high level of subject knowledge and confidence'. Relatedly, Clarke (2011) notes that the students he surveyed 'acknowledged that the SKE course had helped them "build" their mathematical confidence' (p. 5). Atkins et al. (2008) stated too that a further benefit of completing a SKE course was found to be 'superior confidence, communication and organisational skills' (p.14).

While this literature details what is gained by completing a SKE course in terms of enhancing students' subject knowledge, it is useful to reflect on what this means. In this connection, Hyde & Edwards (2014) confirm what is broadly recognised to be true: that 'the relationship between the quality of mathematics teaching and the subject-related knowledge of the teacher is an important one'. On the other hand, almost counter-intuitively, Hyde & Edwards (2014) state that 'research shows that there is no relationship between teachers' level of formal qualifications in mathematics and their effectiveness in mathematics teaching' (p. 9). This point brings into sharp focus two important questions: is it enough to be simply good at mathematics in order to be good at teaching it? and what subject knowledge is required in order to be able to train to be a mathematics teacher?

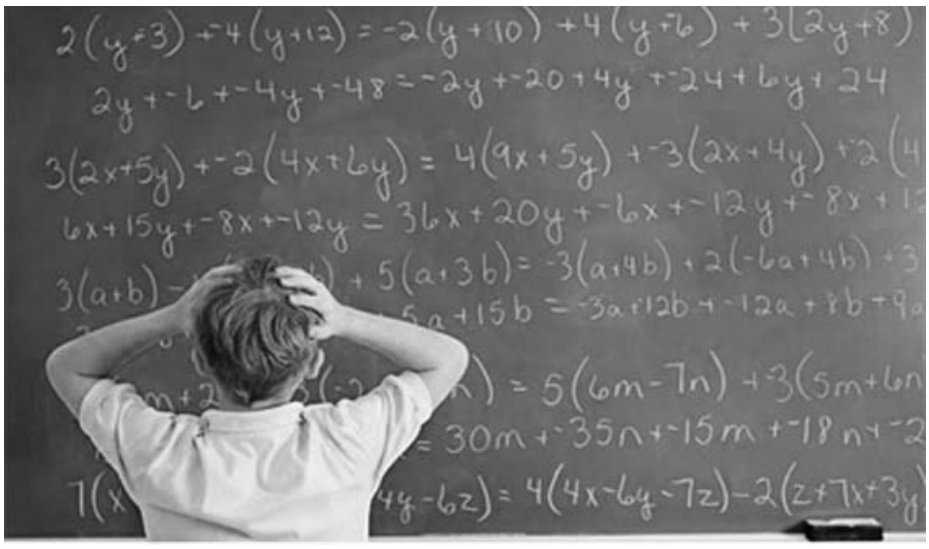
Answers to these questions are not unequivocal. On the contrary, Ball's US-based Teacher Education and Learning to Teach (TELT)[2] project, which examined what mathematics content knowledge should be required for teaching, concluded that 'majoring in an academic subject in college does not guarantee that teachers have the specific kind of subject matter knowledge needed for teaching' (Ball et al, 2008). Prestage & Perks (2001), in the light of such findings, which proliferate, consider therefore that definitions of subject content knowledge should take into account not only what is acquired from attending a relevant course of study prior to becoming a teacher, but also the knowledge which is accumulated in the mind of the teacher through successful practice in the classroom subsequently. Watson (2008) seems to agree, considering that mathematical subject knowledge is strengthened as teacher trainees prepare mathematics lessons and teach them. In fact, she queries the need explicitly to define what mathematical subject knowledge is in this context, arguing that 'the deepening of [such] knowledge takes place through doing mathematics and being mathematical in social contexts in which mathematical habits of mind are embedded, recognised and valued'. What all of this suggests is that we should be cautious in being over-prescriptive about what sort and amount of subject knowledge is needed in order for a trainee teacher to function effectively in the classroom. For the truth is we do not know.

2. THE STRUCTURE AND NATURE OF THE COURSE

Nine female and ten male graduates attended the SKE course which is the focus of this article. While each had some prior mathematical knowledge, as measured by qualifications achieved at school, none possessed a pure or specialist mathematics degree, though the ones they had acquired often included some mathematical content, such as economics, marketing and engineering. Well over one-half of the students were good honours graduates. All but two attending the course achieved the necessary standard to be able to commence to a relevant ITT course.

While SKE courses are required to take into account the mathematics GCSE and AS-level subject content and the assessment objectives produced by the Department for Education (DfE) in 2013, there is no standard template for their design. This means their form and content differ somewhat between providers, a variability that makes strict comparative evaluation problematic and generalisations therefore difficult to arrive at, though it is reasonable to anticipate some overlaps and continuities, given the common focus. Indeed, as will be highlighted, this is confirmed by the evaluation reported here.

The SKE course discussed in this article lasted eight weeks and had three aspects: an online component delivered over one month; a face-to-face element lasting a fortnight; and a final two-week period during which students worked on individual projects designed to strengthen previously identified personal mathematical weaknesses. The online component included five modules covering the content of the Mathematics



Higher GCSE specification, requiring each student to complete a pre- and post-test in each of number, algebra, geometry, statistics and probability. The face-to-face element bridged the gap between GCSE and A-level mathematics.

3. HOW STUDENTS' INVOLVEMENT WAS EVALUATED

The evaluation of the course was organised around four questions: (1) what did those attending think they had gained from the experience?; (2) to what extent did the course in actual fact impact positively on students' subject knowledge of mathematics?; (3) were there any indicators that attending the course affected positively participants' classroom practice during their first teaching placement?; and (4) how did their assessed mathematical knowledge compare with that of conventional PGCE students who are not required to attend such courses?

To answer Question 1, qualitative and quantitative data were collected in the form of responses to an online questionnaire completed by each student both before starting and after completing the course. The questionnaire constrained respondents to evaluate on a numerical scale their mathematical knowledge, teaching knowledge, curriculum knowledge and mathematical confidence. Respondents were also asked to provide written accounts of what they expected the course to deliver and their perceptions of its different components.

To quantify the extent to which attending the course affected students' subject knowledge of mathematics (Question 2), collated scores were collected from their performance in the online pre- and post-module test already mentioned, to which were added data derived from a further test administered during the two-week teaching element of the course.

To find out if completing the course had affected classroom practice during students' first teaching placement (Question 3), a focus group interview was conducted with a sub-sample of seven students, towards the end of their PGCE programme, when they were asked to speculate how much attending the course had helped them better initially to cope with the demands of teaching.

Comparing the performance on the maths PGCE course, in particular the mathematical knowledge component, of SKE and conventional PGCE students (Question 4) was achieved by analysing the results of outcome codes assessed against Teacher Standards after they had completed their first teaching placement.

4. HOW DID THE STUDENTS DO?

All students considered they were more mathematically confident following attendance at the SKE course[3]. Comments about this included: 'My subject knowledge had been significantly improved and enhanced'; 'I now have a good understanding of GCSE and A-level and feel more prepared and confident.' Relatedly, backing up such impressions, all students improved their scores on the online subject module tests, with the largest increase in average mark from pre- to post-test being in the one dedicated to number (from 67% to 82%). Many of the students commented that they 'liked the independent learning of the online approach', as it allowed them 'to focus on areas of weaknesses and complete the work in their own time'.

The two-week summer school, delivered as taught sessions, which followed the online part of the course, was deemed to be 'well structured, with relevant material and contained a nice split between teaching and answering questions'. The students also felt there were real benefits for enhancing subject knowledge by learning socially as a group. All participants, except one, remarked how peer group discussions allowed them to explain the solutions to problems to one another, which enhanced their understanding and 'provided a safety net to compare answers and assist each other with gaps in understanding'. It was noted that the course refreshed knowledge at GCSE and enhanced knowledge of A-level.

Two members of the cohort remarked that the 'pace of the summer school course had been too fast'. Interestingly, these two candidates scored significantly below the mean mark and, maybe not surprisingly, were from the group of five candidates who did not have an A-level in mathematics. Further analysis confirmed, again not surprisingly, that those who performed better had previously enjoyed access to a high percentage of mathematics content in their degree courses.

Even after a lapse of six months, understanding of how best practically to teach mathematics was considered a major benefit of the course by those attending it, trumping easily any increases in mathematical subject knowledge acquired, which were also positively acknowledged. During their first school placement, it appears the students had sought to emulate the pedagogical aspects of the SKE course itself, internalising and reproducing in their own practice some of its teaching techniques, explanations and evidence. They considered depth of subject knowledge chiefly therefore as an aid to efficient lesson planning rather than as an end in itself. One member of the focus group commented that she now knew the 'whys behind the maths', and since the course had updated her subject knowledge, she did 'not have to go over the topics as she was teaching them and therefore her lesson planning was more efficient'. Some students felt the SKE course had put them in the position of being the pupil, which had 'really helped me when I was teaching because I sort of understood what the pupils might have been thinking. It raised some misconceptions, which would have been raised in school and therefore it allowed you to think more deeply about the subject content.' These sorts of findings articulate with ones highlighted by Prestage & Perks (2001) in their earlier evaluation of a similar SKE course, which underscores the extent to which students easily transform newly acquired subject knowledge into strategies for the effective teaching of mathematics in the classroom.

As to measured competence in the classroom, no significant difference could be identified between students who had accessed a PGCE course immediately after graduating and those who had enrolled on theirs following the SKE course. For sure, the former achieved a higher percentage of 'Outstanding' and 'Good' outcome codes for their teaching practice; but this proportion was not noteworthy in either a statistical or qualitative sense.[5] On the other hand, and maybe of some importance, is the fact that, while no SKE participants achieved an 'Unsatisfactory' grade for teaching practice, several of their counterparts on the PGCE programme did.[6] This counter-intuitive finding lines up well with a similar one reported by Stevenson (2008) who analysed classroom competence levels on another SKE course which 'yielded a mean grade of 1.9 for SKE students against a mean of 1.8 for the group as a whole' (p.16).[7]

However, further analysis of the outcome codes awarded for the individual subject and curriculum knowledge reveals a lower outcome code for SKE students compared to non-SKE students.[8] This indicates that though, overall, both cohorts performed similarly in their teaching practice, the level of subject knowledge demonstrated while on teaching placement was still not quite at the same level as the other non-SKE members of the PGCE cohort. This confirms findings by the DfE (2013) 'that SKE students considered their subject knowledge to be at a lower level (level 5) than traditional route trainees' as they progressed through the PGCE course (p. 11). This perhaps also renders problematic Hyde et al.'s (2014) findings that there is 'no relationship between teachers' level of formal qualifications in mathematics and their effectiveness in mathematics teaching' (p. 9).

5. OUTCOMES AND RECOMMENDATIONS

Prestage & Perks (2001), in their study to which I referred earlier, concluded that 'learner knowledge transforms into teacher knowledge over time' (p.107). This finding anticipates one of those reported here, which highlights the fact that trainees, when reflecting on the effectiveness of the SKE course at a later date, found that the pedagogy skills gained from it were more useful to them in the classroom than the new subject knowledge they had acquired. But the operative word here is 'appears', as it might be argued that they would not have been able fully to utilise these skills if their subject knowledge had not been at a certain and improved standard, which the course clearly had helped them to achieve. In other words, it may be impossible to identify with precision in this matter where one outcome begins and the other ends.

But, having said that, my evaluation does suggest that an eight-week mathematics SKE course is capable of producing PGCE trainees who perform just as well on their teaching placement as trainees who have a stronger prior mathematical background. However, further analysis of such performance data shows that subject knowledge is still a relatively weaker area for SKE trainees. The question thus remains: how far does this ultimately matter when it comes to being a successful PGCE trainee and a competent teacher of mathematics in schools subsequently? And the answer seems to be: it does matter, but not in any straightforward way. As this evaluation suggests, students who have studied mathematics up to Advanced level, and irrespective of any related degree specialism they may acquire afterwards, appear to be sufficiently numerate to be trained to be mathematics teachers, certainly up to Key Stage 4 in an English secondary school. And students, even without an Advanced level in mathematics, but possessing a degree qualification that contains a strong numeracy element, seem equally capable of successfully being trained as mathematics teachers having first attended a SKE course. Without such a background in mathematics, on the other hand, it is highly unlikely that attendance on an SKE course would bring individuals taking part up to a level of mathematical knowledge which would enable them successfully to take advantage of the training offered on a PGCE.

As the long-term provision of applicants entering mathematics ITT worsens, with an additional 5,500 secondary teachers required in the UK over the next few years (ACME 2015), it is arguably crucial that mathematics SKE courses continue. The training of less mathematical qualified graduates appears to be one solution to the shortage subject problem, on condition that a SKE course is completed prior to commencing ITT. This also suggests a real need for good quality mathematics professional development to be made available in school, for newly qualified teachers, and beyond, whose subject knowledge is weaker. ■

1. Part of the Department for Education, it has since become the National College for Teaching and Leadership (NCTL).

2. A five-year longitudinal study managed by the National Center for Research on Teacher Learning in the United States

3. An increase from pre-course mean rank of 7.2 to a post-course mean rank of 8.8. .

4. The mean mark for the test undertaken at summer school which examined the A-level content of core 1 and core 2 was 77%.

5. These outcome codes are based on those used by Ofsted to assess the quality of teaching during its regular inspections of schools and uses the Teaching Standards, produced by the DfE.

6. 5% of non SKE participants attained an overall mean outcome code of unsatisfactory.

7. Outcome codes were awarded as follows: 1=Outstanding, 2=Good, 3=Satisfactory and 4=Unsatisfactory.

8. A mean code of 1.7 for SKE students against a mean code of 157 for non-SKE students.

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