

How can I improve provision for mathematics on a primary PGCE Initial Teacher Education programme in a context of national change?

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ABSTRACT

In this study, which was the focus for an MA dissertation, I focused on my own practice as subject leader for mathematics on a university-based PGCE Initial Teacher Education (ITE) programme and the ways in which I could examine, critique and ultimately change my practice in a time of change within the ITE sector. By using a mixed methods paradigm and an action research methodology, I explored elements of my practice and placed them in the context of recent developments in the sector, notably the introduction of the revised national curriculum in 2014 and the Carter review in 2015. In particular, I identified how the national context impacted on my own pedagogy in relation to trainees' acquisition of mathematical subject knowledge, curriculum knowledge and pedagogical knowledge. The study demonstrates that by making small changes to ITE provision to implement national priorities, trainee satisfaction with the quality of their training experience can be improved.

KEYWORDS

PRIMARY INITIAL TEACHER
EDUCATION
MATHEMATICS
CARTER REVIEW
WILLIAMS REVIEW
MASTERY

INTRODUCTION

The setting for this study was a School of Education in a diverse, inner-city university. The trainee teachers on the Postgraduate Certificate in Education (PGCE) programme were drawn predominantly from London and the surrounding area and reflect the diverse social and ethnic characteristics of the local population. All trainees were graduates engaging on a one-year programme resulting in the award of Qualified Teacher Status (QTS) as well as the PGCE in Primary Education.

In conducting this study, I aimed to investigate ways in which I could improve my practice in my role as mathematics leader on a PGCE primary programme. I looked at ways in which my practice impacted on the development of trainee teachers and on their effectiveness in teaching mathematics. I considered this research important because, as mathematics leader on the PGCE programme, I was concerned that the responses on the national Newly Qualified Teacher (NQT) survey were

not as high as I would like and despite having made changes to the provision previously, these hadn't translated into improved survey results.

THE NATIONAL AND INTERNATIONAL CONTEXT

The study took place in the context of a changing national picture for teacher training and the way in which it is evaluated. In 2015, Ofsted revised the Initial Teacher Training Inspection Handbook (Ofsted 2015)

to state that ‘the key purpose of teaching and training observations is to evaluate the quality of teaching and training, and their contribution to the learning of children/pupils/learners. Inspectors should also identify ways in which teaching and training can be improved.’ This profoundly changed the focus of evaluation: Initial Teacher Education (ITE) provision moved from being evaluated primarily on trainee outcomes towards evaluation based on the effectiveness of trainees in raising pupil attainment. It was important, therefore, that I kept the focus of this study on outcomes that impact positively in the classrooms in which my trainees work.

The university in which this study took place has its own unpublished survey (UEL 2014, 2015), closely mirroring the questions in the NQT survey (NCTL 2015). The UEL survey is completed by current trainees at the end of each term to give staff an up-to-date understanding of trainee attitudes towards the aspects of their training identified in the NQT survey. Both these evaluation tools were used in part to evaluate the outcomes of this study, ensuring the study had validity in the wider professional context of the researcher.

The cultural shift required to move mathematics education in primary school towards a ‘mastery’-based curriculum based on ‘those found in high performing education systems internationally, particularly those of east and south-east Asian countries such as Singapore, Japan, South Korea and China’ (NCETM 2014: 14) was inevitably going to receive a strong critique from sections of the educational establishment. However, the justification for this development comes from OECD Programme for International Student Assessment (PISA) data (OECD 2012: 1) showing that, internationally, UK pupils perform ‘around the average in mathematics’ despite the fact that ‘the United Kingdom has a higher GDP and spends more on education than the average in OECD countries, as well

as higher levels of tertiary education and a lower share of the most socio-economically deprived groups’. Ofsted (2013: 7) reported that the most successful schools in teaching mathematics ‘focused on building pupils’ fluency with, and understanding of, mathematics. Pupils of all ages and abilities tackled varied questions and problems, showing a preparedness to grapple with challenges, and explaining their reasoning with confidence’: the skills underpinning the “mastery” approach’. It is for this reason that a focus on the ‘mastery’ approach was introduced into the provision offered to this researcher’s trainees prior to the commencement of this study, although not to the exclusion of more conventional approaches.

THE WILLIAMS AND CARTER REVIEWS

In this section I discuss the two major national reviews relevant to this study that have been published in the last ten years. The Williams review (DCSF, 2008) was an independent review published in 2008 set up to address the perceived underachievement of children in mathematics, partly as a result of a climate ‘where it is socially acceptable – fashionable, even – to profess an inability to cope with the subject’ (DCSF 2008: 3). It was important to understand the implications of the national picture to contextualise my local study.

While Williams’s recommendations go beyond ITE provision for mathematics teachers, his recommendations regarding the nature of trainee competence in mathematics were of particular interest in providing a context for this study as this was also identified as a key area by Carter: ‘Evidence suggests that a high level of subject expertise is a characteristic of good teaching (Coe and others, 2014). We have found that the most effective courses address gaps and misconceptions in trainees’ core subject knowledge’ (DfE 2015: 7). Weaknesses in subject knowledge could be evidenced in a range

of ways, perhaps most significantly in the trainees’ teaching practice.

Williams acknowledges that subject knowledge alone is not a determining factor in whether or not a trainee will be a successful teacher of mathematics, citing Askew et al.’s study (1997) which found that ‘having an A-level in mathematics was not strongly correlated with effective teaching of numeracy’. Instead, he says that ‘a combination of deep subject knowledge and pedagogical skill is required to promote effective learning’; so trainee teachers not only need to understand what to teach, they also need to understand how to teach it (DCSF 2008: 7).

Ofsted (2010), cited in Hansen & Vaukins (2012), reporting on the reasons Finnish children were successful in mathematics stated that one reason was that teachers are confident in their subject knowledge and pedagogical knowledge of mathematics and therefore convey confidence in their own and their children’s ability to learn mathematics. It is clear, then, that developing strong mathematical subject knowledge in trainee teachers is valuable in equipping them with the skills required to become effective teachers of mathematics.

Carter (DfE 2015: 8) also identifies strong pedagogical understanding as a cornerstone of effective teaching and learning: ‘Teachers who understand the way pupils approach different subjects, understand the thinking behind pupils’ methods and can identify common



https://en.wikipedia.org/wiki/Mathematics_education

misconceptions are more likely to have a positive impact on pupil outcomes (Sadler & others, 2013; Hill & others, 2005). Carter also proposes that one of the key aims of ITE is to 'prepare teachers to be able to cope effectively in the classroom in terms of both the knowledge and the practical skills that they will require', and for this reason it is necessary that my students are prepared for teaching the national curriculum for mathematics, a necessity that, in part, contributed to the inclusion of 'mastery' in the ITE provision in my institution (DfE 2015: 7).

DEVELOPING THE SUBJECT KNOWLEDGE AND PEDAGOGY OF TRAINEES

In this section I discuss the importance of strong mathematical subject knowledge, curriculum knowledge and pedagogical knowledge in trainee teachers and the way in which it impacts on their pedagogy in the classroom.

Williams, however, found that 'for primary PGCE students, mathematical subject knowledge alone is not necessarily the overriding issue'. He suggests that obvious 'gaps' in subject knowledge are often addressed within the PGCE when topics are revisited. An equally important, if not more important, issue is how to ensure students acquire the requisite pedagogical subject knowledge and skills for mathematics teaching (DCSF 2008: 9). This is contested by Carter whose report concludes that 'across all subjects and phases we have found variability in the way subject knowledge is addressed'. Carter goes on to say that there 'are some particular challenges for subject knowledge development – the breadth of the subject knowledge primary teachers need to teach the new curriculum, for example, may be difficult to cover, especially within a one year programme' like the one discussed in this study (DfE 2015: 7).

Simply getting to know the requirements of the curriculum at each year group or key stage may be challenging for some trainees, but strong curriculum knowledge requires more than that. Haylock (2014: 4) writes that 'the key processes of mathematical reasoning, applying mathematics and problem solving must always be at the heart of learning the subject', so it is not only important that trainees are competent at mathematics themselves, it is also essential that they understand what the 'key processes' are in pupil acquisition of mathematical knowledge and skills, and how to apply them in the classroom. Even those trainees who have developed an understanding of these processes will still be able to develop a stronger pedagogy through the creative teaching of mathematics.

Just as trainees may be at different stages in their mathematical subject knowledge, so they may be at different stages in their pedagogical content knowledge.

RESEARCH APPROACH

A mixed methods approach seemed to be most appropriate in addressing the needs of this study, largely due to the need for 'transferability' (Cohen et al. 2011: 186) of the findings to my broader working context. The research question this study sought to answer was based on statistical data from the National College for Teaching and Leadership (NCTL 2015), and one of the key indicators for success was to be an improvement in the satisfaction of trainees with the provision on offer based on this data, which might also be shared with colleagues and as part of an Ofsted inspection. This necessitated data collection and analysis which was, at least in part, quantitative. However, to understand and evaluate the effectiveness of the changes made in addressing this aim, it was also important to collect data that was more qualitative in nature. Since neither paradigm alone seemed to offer the possibility to do both,

a mixed methods approach was chosen, albeit with some caveats.

The methodology selected for this study was action research. The two data collection methods selected were questionnaires and structured interviews: questionnaires because a questionnaire is a 'versatile tool... [which] can be tightly structured, but can also allow the opportunity for a more open and discursive response if required' (Thomas 2009: 174), and interviews because they 'provide useful information when you cannot directly observe participants' (Creswell 2008: 226), as was the case in this study.

The interview schedule was devised in response to the themes that emerged from the analysis of the questionnaires. I decided on group interviews as there is 'the potential for discussions to develop, thus yielding a wide range of responses' (Cohen et al. 2011: 432). I hoped that the trainees would feel more comfortable discussing the issues with their peers rather than in a one-to-one interview with the tutor responsible for the provision under discussion.

ANALYSIS

The questionnaire identified enhanced subject knowledge teaching as one of the top four things that trainees requested for future sessions in each of the four questionnaires presented; although the percentages varied significantly over the four weeks in which trainees were questioned, they always remained at around 50% of all respondents.

The interview schedule offered me the chance to identify whether there were any emergent themes using a qualitative approach. I memoed and coded the interview transcripts (Mertens 2015) and drew together common themes and instances. Several of the respondents identified the subject knowledge audits they had completed at university as being useful in helping them identify areas

of maths in which they were weaker, although none said that they had helped them identify areas of relative strength.

The coding of the transcript helped identify that the respondents placed a value on the audits despite (and possibly as a result of) finding them quite challenging at times. This wasn't what I had expected to find; I had anticipated that my findings would inform my future mathematics teaching rather than the assessment cycle.

Since action research 'is about improvement... [and facilitating] changes through enquiry' (Koshy 2005: 10) the final step was to change my practice. I again used Survey Monkey to design a questionnaire on which trainees could enter their audit scores. This enabled me to track individual trainees, groups of trainees and the whole cohort, as well as enabling me to do question level analysis to identify particular concepts and mathematical areas in which trainees may require further support. These areas became the focus for additional, optional mathematics support sessions which took place each Thursday afternoon, as well as enhanced support within sessions. This enabled me to 'rigorously audit, track and systematically improve trainees' subject knowledge throughout the programme' (DfE: 2015) and respond to trainee needs more appropriately.

The issues shaping the national context identified in the literature review also shaped the questions in the questionnaire and interview schedule around curricular knowledge. Trainees' understanding of the national curriculum was a particular focus in the questioning as the new curriculum was launched at the same time as the respondents started their training programme, and 65.79% had indicated on the pilot questionnaire that they would value 'opportunities to improve [their] curriculum knowledge' (UEL 2014).

I altered the content of the next taught session to include greater curriculum knowledge content and evaluated it

in subsequent questionnaires. This identified that, while a significant number of trainees felt quite confident following the session input, there remained a significant number who considered their curriculum knowledge insecure, indicating that further, ongoing input would be required as the programme progressed.

Again, I used the interviews with trainees to investigate further. In 'memoing' and coding the interview transcripts (Mertens 2015: 438), a number of common features emerged over the two interviews, not all of which I had anticipated. I had expected that a lack of familiarity, a lack of confidence, a lack of subject knowledge and a lack of prior experience, for example, would have emerged as significant factors among trainees midway through their first placement (which they did), but I hadn't anticipated that the language of the national curriculum and mathematical 'jargon' would be significant barriers.

Another surprising theme to emerge was that trainees didn't always gain much experience of planning from the national curriculum as their planning was often based on school planning or on directions from their school-based mentor. Because trainees at the institution in which I work spend their first placement as part of a group working at small group rather than at whole class level, many will adapt plans from the setting in the early stages of their training.

It seemed, then, to be important to introduce trainees to the national curriculum for mathematics in a practical (school-based) context earlier to enable them to familiarise themselves with the language, content and concepts the curriculum contains and to build their ability to use this as a means to 'plan and teach well structured lessons' (DfE 2011: 11). I also revised the assessment for the mathematics module to enable trainees to build a portfolio to include their mathematics planning against national curriculum objectives, evaluating and reflecting on their impact. This was then

formally assessed and trainees received feedback from their tutors.

Several of the questions on the questionnaire addressed aspects of trainees' pedagogy in their teaching of mathematics. The needs of respondents in this area seemed to decrease as the study progressed, which was consistent with my working hypothesis. This could be because of respondents' growing knowledge, skills and confidence as the programme progressed; for example there was a sharp drop in the number of trainees requesting further input on planning after it was addressed directly in the taught mathematics session. Equally, perhaps as they became more familiar with mathematics resources in the weekly sessions, and with the national curriculum as a whole, their wish for increased session time for resources and links with other subjects diminished.

Coding of the interview transcripts revealed frequent references to behaviour management as well as lack of confidence, modelling, explaining concepts, questioning and planning. Trainees identified the relationship between behaviour management and purposeful learning: three trainees reported that they had initially experienced problems with children engaging with the learning; two reporting that once they had given more thought to the pupils' learning experiences, the behaviour had improved. This was a sign that they were beginning to 'recognise the importance of the social and emotional elements of learning, in addition to cognitive aspects of learning, thinking and problem solving' (Hewitt 2008: 10) which was encouraging.

In analysing the interviews, I realised that the most frequently recurring codes were also linked either directly or indirectly to effective planning. Reflecting on the provision offered during the early mathematics sessions, I realised that the time devoted to planning may have been insufficient for some. Although the percentage of trainees requesting additional planning support had dropped

significantly following the planning support included in session four, there remained a significant proportion of trainees (23.53%) who still identified planning as something they would value further support with.

CONCLUSION

The findings on mathematical subject knowledge were revealing as I had not previously understood the importance trainees placed on subject knowledge audits as a way of identifying and acting to mitigate weaknesses in their subject knowledge. But this needs to be more than just another test: Cotton (2013: 13) states, 'It is clearly important that trainee teachers are confident in their mathematical subject knowledge... however... it is also important that you can see, and make explicit, the connections between your own subject knowledge and your teaching.' By strengthening both the identification of trainees' subject knowledge gaps and the means by which they could be addressed, I could enable them to develop this area of their practice while on the programme.

The work concerned with both curriculum subject knowledge and pedagogical subject knowledge identified themes around planning. Trainees often did not get the opportunity to plan and teach from the national curriculum directly, meaning they were unable to practise what Shulman (cited in Burn et al. 2014: 23) describes as, "'engagement in practical action"... "the importance of experience" in developing practice, hence the need to learn by reflecting on one's practice and its outcomes'. The language of the national curriculum programmes of study for mathematics (DfE 2013) was also problematic for some.

Findings relating to my own pedagogical practice identified a lack of clarity around the subject knowledge and pedagogical knowledge elements of taught sessions, with a lack of balance leading to insufficient time spent on the different areas emerging as a particular focus. Trainees found the

pedagogical elements useful but still left sessions lacking confidence in key areas of pedagogy. In response to this, more effort was taken in balancing the different element in sessions; this was identified by coded symbols in the corners of slides demonstrating that different elements were being used in sessions (this was primarily for my use at the planning stage but was shared with trainees).

Having analysed and evaluated the data against the relevant literature and research questions I conclude that it is possible to embed statutory and non-statutory requirements and recommendations from recent national initiatives. To achieve this the learning opportunities I design for trainees should be varied, challenging and inspiring rather than simply a means of preparing them to evidence progress against a narrow set of measures. This can be achieved by designing a pedagogical model that enables trainee teachers to identify and address their own learning needs with the support of tutors.

An example of how this can be achieved resulted from my mathematical subject knowledge analysis. Through my analysis of respondents' mathematical subject knowledge I identified that they valued the subject knowledge audits as a means of understanding their own areas of relative strength and weakness in mathematics. By strengthening the ways in which the results of these assessments were recorded and analysed, I was able to enhance my ability to respond to the learning needs they uncovered among individual trainees and groups, providing targeted mathematical subject knowledge support to those who needed it.

Since embarking on this study, the effects of the changes in mathematics provision have already been seen to have a strong impact. The UEL (2015) Primary ITT Programme Evaluation 2014–15 results indicate a strong rise in grading 'How NQTs rated their training in: preparing you to teach primary mathematics'.

This survey indicates a 12% rise in the percentage of trainees grading the provision Good or Very Good (91%, up from 79% in 2014; this is now slightly above the average in the ITE sector in 2014), and a corresponding rise of 12% in the percentage grading the provision Very Good (25%, up from 13% in 2014).

These initiatives respond to the training needs identified in national initiatives without becoming an end in themselves: in short, they impact directly on trainees' abilities to plan and teach effectively from the national curriculum, their teaching underpinned by strong mathematical and pedagogical subject knowledge. This, in turn, will enable trainees to have an enhanced impact on the learning and attainment of the pupils they teach. ■

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