Lower attaining primary trainee teachers' choice of examples: the cases of Naomi and Victor.

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This paper reports on selected findings of a doctoral study exploring primary trainee teachers' choices of mathematical examples and the relationship between these and their mathematical subject knowledge. Through a combination of interviews and lesson plans gathered from the final school placement of one cohort of B.Ed trainees, and measures of mathematics attainment before and during their curse, the choice of examples by two lower attaining trainees, known as Naomi and Victor, are considered. This paper presents aspects of the data relating to Naomi and Victor and raises issues of concern about their approaches which will impact on pupil learning.

Keywords: primary, trainees, examples.

Introduction

Research into primary trainee teachers' choices of examples for teaching identified some differences between trainees who were regarded as being of higher mathematical attainment, middle attainment or lower attainment (Huntley 2011). The previous paper as well as Huntley (2008) set out the key literature underpinning the research. In this paper, the focus is to identify particular practices identified in the two trainees who were categorized as being of lower mathematical attainment on the basis of the data collected about their pre-university mathematics and their progress during the course. The trainees will be referred to as Naomi and Victor, and a profile of each will be outlined before analysing the data which each produced during the research.

Participant profiles

By considering a range of data for each trainee, including for example, GCSE grades, interview test scores and module assessment results, it was decided to give each trainee in the sample group an overall grade in the range A, B, C to indicate whether they were likely to be of higher attainment, middle attainment or lower attainment relative to the cohort. This grading was largely the researcher's subjective decision and was not arrived at by trying to calculate an overall result by any formulaic process, but sought to allow the selection of the case study students to form a purposive sample which, as fairly as possible, represented the range of students from two cohorts in terms of their past achievements, which informed the assessment of their potential for teaching mathematics.

Naomi

Naomi started her initial teacher education course immediately after leaving school with grade C at GCSE mathematics, making her amongst the lower attaining trainees in mathematics and in the most commonly represented demographic groups, namely females in the 18-25 year old category. As the course progressed, Naomi achieved marks of 40, 45 and 40% in each of the Year 1, 2 and 3 modules respectively. These figures indicate she is a student whose knowledge and attainment in mathematics were not applied well to her module assessments, demonstrating that she found it difficult to relate the subject knowledge to the pedagogic aspects which were assessed in the module assignments, although there is insufficient data to verify this speculation. Further evidence to support this hypothesis could come from close analysis of Naomi's lesson planning and her teaching, although the latter was not possible in this study. From pre-course data and results on the course, it was decided to consider Naomi as Grade C.

Naomi taught a Year 4 class for her final teaching placement and provided a total of 21 lesson plans from mathematics lessons. These covered the topics of addition and subtraction, multiplication and division, function machines, rounding and estimation, money and negative numbers. For the purpose of this study the lessons on addition, subtraction, multiplication and division were analysed to give a consistent approach to the topic of number across each of the cases.

Victor

Victor also started initial teacher education immediately after leaving school, although he had performed less well in school mathematics, achieving with grade C at GCSE. As a male, Victor represents a minority for primary trainees, in a poorly represented demographic group, namely males in the 18-25 year old category. In the university's interview test for mathematics, Victor only scored 15% at the first attempt, which represents just three questions on the 10-item test where he was awarded half a mark.

Victor was only able to score marks on questions involving calculation of a total price when a given percentage of a number of identical items are sold at normal price and the remainder at half price. Before being able to join the course, Victor re-took the interview test and on the second attempt at the same test he scored 55%, this time gaining a full mark on five of the questions and half a mark on one question. Of the three questions which gave Victor half marks at the first attempt, one was fully correct at the second attempt, one again scored half marks, but on one question he failed to score on the second attempt.

Once on the course, Victor completed the university's diagnostic numeracy test and as one of the lowest scoring trainees he was invited to take the additional mathematics module 'Confidence Counts' which covers a range of GCSE level topics to help improve mathematical subject knowledge. At the end of the module the trainees sit an exam and Victor scored 54%. During the 3-year course, Victor achieved marks of 53, 55 and 48% in each of the Year 1, 2 and 3 modules respectively.

These results suggest Victor's knowledge and attainment in mathematics did not appear to be strong in the module assessments, demonstrating a continuing issue with subject knowledge. However, in school placements, Victor was able to relate subject knowledge to pedagogic knowledge through high grades during the placements. From examining pre-course data and results from the course, Victor was considered as Grade C. Victor taught a Year 3/4 class for his second year and final teaching placements and provided 8 detailed plans from mathematics lessons. For this study the three lessons on addition, subtraction and multiplication were analysed.

Discussion

The data collected from the trainees was analysed in terms of its correspondence with the dimensions of the Knowledge Quartet (Rowland et al. 2009). During the development of the Knowledge Quartet, a number of codes based on video-taped lessons were identified as part of the grounded theory approach taken. Two of the contributory codes which went towards the formation of the Foundation dimension were 'overt subject knowledge' and 'adherence to textbook'. The lesson plans and interview data from the lower attaining trainees were examined for evidence of the extent to which they use or demonstrate these aspects in their planning and teaching.

'Overt subject knowledge'

As a trainee identified as less able in mathematics, Victor's interview revealed not only that he had identified weaknesses in his level of mathematics, but also that he used this as a reason to adapt his teaching in a way which might be thought of as very worrying:

> 'I always struggled with maths to be honest… I think sometimes it can be limiting, 'cause sometimes you look at things and think I don't quite understand that fully, so I won't bother teaching… you know, I might leave that today'.

'Adherence to textbook'

The research identified that some trainees tend to rely on the Primary National Strategy (PNS) to ensure they have covered the relevant objectives and planned appropriate activities. However, in terms of using PNS materials or published schemes, all of the case study trainees showed evidence that they rarely change the examples they find. Most trainees prefer to 'adhere to the textbook', a facet of the Foundation dimension of the Knowledge Quartet. Looking firstly at Victor and then Naomi from the case study group, Victor reported that his plans are: '…always from some kind of framework, that the teacher has given us', implying that the plans are 'ready-made' for use and cannot or need not be changed. Naomi, whose school used the Hamilton Trust plans, described how easy they seemed in terms of use for planning, as they: '…used the Hamilton Trust website, and it was easy for them just to go and print and it comes off… with the average Year 4 work, then I could pitch it to different groups'.

Victor also found that his placement school were using the Abacus scheme but he felt they needed to check with the PNS to ensure appropriate coverage of objectives: 'We used Abacus Evolve, and it was the brand new one, and they pretty much do it all for you', and he later added: We did so much from Abacus, it was just a case of checking... with what was supposed to be going on with the PNS'.

The only trainee amongst those selected as case studies that had a different experience in terms of using PNS guidance was Naomi, whose placement school relied on the planning guidance from the Hamilton Trust. She described using plans from the Hamilton Trust as her main source, but was prepared to look at the PNS for further help:

> I was given plans from the Hamilton Trust and I adapted those into my own planning to suit the class, but if I wasn't given those then I would probably use the Primary Framework, probably the 'I can' statement or something like that and the suggested tasks they have, because all you need is something little to get your brain going.

'Transformation'

Victor was teaching a mixed Year 3/4 class, and his lessons on addition and subtraction are considered. This section considers Victor's third lesson from the perspective of theoretical frameworks. The lesson plan includes a 'Point for Action' as follows:

> Hopefully with the introduction of the column method the children will be able to do more working out on paper that will hopefully help them to meet the requirements outlined in the relevant statutory frameworks.

The first concern here is Victor's use of the word 'hopefully', suggesting he may have little confidence that his activities and examples will be effective for children's learning. Secondly he feels that by moving the children towards a column method, they will not necessarily understand the method, but should be able to achieve the statutory requirements, which he obviously regards as more important. In the introduction to the lesson, Victor works through the following examples:

34 + 50 =
245 + 40 =

These examples are similar to those he used in a previous lesson and it is not obvious which methods are required to calculate these. The earlier lessons made no use of number lines or particularly 100 squares, which would have made the first calculation straightforward. However, after these calculations, Victor begins to introduce the column method, by which it is assumed he means the standard algorithm for addition as set in the PNS. He then continues with the following examples:

43 + 30 =
367 + 70 =
965 + 80 =

The first of these is of a similar type to the first example in his introduction and could presumably be calculated in the same way, thus making the introduction of the column method unnecessary. The second and third examples, whilst extending into 3-digit numbers, have the additional challenge that the tens will add to more than 10 in each case, requiring the children to carry into the hundreds column. If the method was introduced to enable children to perform the carrying operation, then it is interesting that Victor chose as his first example two 2-digit numbers where no carrying was necessary. Given his apparent purpose for using the method, he should perhaps have chosen something like 68 + 50 to ensure the tens carried into the hundreds which in this example are empty. In trying to link the examples to the objectives for the lesson, Victor has seemed to be unaware of the discrepancy in the examples he used. When asked about the way Victor chooses the numbers for his examples, he seems to imply that the numbers are not significant, but it is the context that is very important:

> I think, … if you can make it… put it in an exciting context, I think you can do most… what some people would consider, most simplistic, maybe boring things, you know, I'm not saying they are, but erm… I think you can, you know, can teach that effectively in a practical context, 'cause I always think, you know, rather than just doing some subtractions on the board, if you, sort of, like I said, just for example like a shop context, or something like that, then… I've done that quite a few times before, and it's quite effective really.

Victor appears to be certain that context is a more significant choice than numbers in the examples, even if that has meant his examples did not help children meet the objective. To compare Victor's examples with theoretical definitions, it seems that his first example (43 + 30) is an example used to illustrate one procedure when another procedure would be better, a method identified by Rowland et al. (2009).

His second and third examples are being used to teach a general procedure by demonstrating particular instances, but the procedure could be developed more progressively by using examples with fewer digits in the first instance and moving on to three or more digits at a later stage, suggesting that Victor's pedagogical knowledge lacks awareness in terms of planning sequences of examples that match the lesson criteria.

Naomi

The final trainee to consider is Naomi, also a lower attaining trainee, who taught a Year 4 class for her final teaching placement and provided lesson plans on addition, subtraction, multiplication and division which were analysed. This section will look at some of Naomi's lessons and consider the examples from the perspective of Naomi's choices. The first lesson starts with Naomi asking the children to identify the multiple of a hundred that lies between 789 and 874, then finding the difference between the numbers by calculating the difference of each from the multiple of 100, that is:

$874 – 789 = (874 – 800) + (800 – 789)$.

The example selected here seems appropriate to the objective, given that the minuend is 800 + 74 and the subtrahend is 800 – 11. The required multiple of a hundred is therefore 800 and the children can use this as a bridging point to help with calculating the difference between 789 and 874.

It appears from the lesson plan that Naomi requires the children to carry out the calculation in numerical form either mentally or using a written algorithm, when possibly the best choice from a pedagogical point of view could have been to use an empty number line. The children are then asked to work out a number of subtraction problems finding the difference between 3-digit numbers. Two worksheets of examples were provided; the first was designed for the lower attainers and used pairs of 3-digit numbers whose difference was always a multiple of 10 or 5.

At the top of the sheet the following advice was written: 'For each question use your knowledge of multiples of 50 to help you answer the question'. The opening example was 550 – 400 which could be completed by subtracting the hundreds to leave 150. The second example extended to requiring subtraction of all three columns: 755 – 550 = 205. Example 6 on the sheet did not match the objective since it asked for the difference between 250 and 55, which are not both 3-digit numbers but which are still multiples of 5 or 10. After six examples of this type, a change was introduced with 458 – 158. This example is the first to appear which does not contain numbers that are multiples of 5 or 10, but whose difference is still a multiple of 10; in this case it is exactly a multiple of 100, being 300. Example 9 extends beyond the objective by introducing a 4-digit number and changes the pattern of differences by not being a multiple of 5 or 10. The example is given as 1054 – 452 which has a difference of 602.

In her interview, Naomi explained how she set out her example for the top of the worksheet and the ones that followed:

> I was usually putting an example at the top of the worksheet and then the questions underneath… it would be quite random, in a way it's just the first question that comes into my head, or it's something we've covered in the lesson that I've put in at the beginning of the lesson, but then I've decided to maybe change one digit or something, just so they recognize the concept.

It seems apparent from the examples on the worksheet as described above that in changing digits for some of the children's questions, Naomi inadvertently changed the examples so that they no longer matched the objective or her earlier guidance in terms of using multiples of 50 as helpful bridging points, since multiples of 50 did not always appear in some of the questions.

The second worksheet, which was designed for higher attainers, includes the visual representation of a number line marked in 100s from 0 to 1000 at the top of the sheet, with the advice to use it to help solve the calculations. Each example used two 3-digit numbers either side of a multiple of 100 and the instruction was given to write down the multiple of 100 that comes between the pair of numbers before calculating the difference.

The first example was 523 – 489 which could be solved by recognizing that 500 comes between the two numbers and then finding the difference between 523 and 500, then the difference between 500 and 489 and finally combining the differences for the solution. In this case the calculation becomes:

$$(523 - 500) + (500 - 489) = 23 + 11 = 34,$$

although the children were recording this pictorially on the number line rather than setting out the numerical calculation as done here. The pattern of examples continues in a similar way for the entire sheet, with a total of ten examples, all of 3-digit numbers either side of a multiple of 100. With these examples it is noticeable that Naomi has included use of the number line to assist with the calculation.

Summary

This study provided an insight into subject knowledge and choice of examples of two lower attaining primary trainees. There is evidence that awareness of theoretical influences is weak, subject knowledge is a cause for anxiety and choice of examples for teaching and learning mathematics is random, not pedagogically planned. The lesson evidence suggests that the examples used are largely sequential, moving from 'simple' to 'difficult', although weak subject knowledge often prevents the examples being suitable for learners to develop their understanding of the intended concepts.

References

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