OBJECTIVES DRIVEN LESSONS IN PRIMARY SCHOOLS: CART BEFORE THE HORSE?

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Advice to share learning outcomes with pupils may be based on sound theoretical and practical principles. However, in order to turn intended outcomes into classroom experiences teachers have to draw on their interpretations of objectives and their mathematical pedagogic content knowledge. In this paper I argue that this may place non-trivial demands on primary school teachers and requires a subtle understanding of the mathematics involved.

INTRODUCTION

The introduction of the National Numeracy Strategy into virtually all primary schools in England during 1999/2000 has impacted on many aspects of teaching mathematics. Not least amongst these has been the importance attached to sharing learning objectives with pupils. The introductory section to the 'Framework for Teaching Mathematics from Reception to Year 6' (Department for Education and Employment (DfEE), 1999) emphasises that within the main teaching part of the daily dedicated mathematics lesson, teachers need to:

- make clear to the class what they will learn (Section 1. p. 14).

Although not specified in such terms, this appears to have been interpreted by many teachers as sharing with the pupils the objective(s) from the framework that lessons address (even though these objectives are couched as teaching objectives rather than learning outcomes: 'Pupils should be taught to …).

Such advice assumes either that objectives have been presented in an unambiguous way or that teachers will have no difficulties in interpreting them. In this paper I question such assumptions by examining two lesson vignettes and the ways in which the teachers' interpreted the teaching objectives and associated classroom tasks. These examples raise questions about the nature of mathematical subject knowledge needed to turn objectives into meaningful learning experiences.

DATA SOURCES

I present data from two lesson observed over the course of five years of lesson observations undertaken as part of the Leverhulme Numeracy Research Programme. (For a more detailed account of the research from which this example is drawn see Brown, 2002). Given the level of detail that the analysis yields, restrictions of space prevent the reporting on the response of more lessons. However the two lessons chosen were not a-typical of the sorts of examples identified in many of the lessons that we observed and provide 'telling cases' of some the issues that objectives driven teaching raises.

The first is a Year 4 lesson on multiplication that the teacher had planned from the ‘Framework’ and after she had attended the five-day training. The second comes from a Year 4 lesson that the teacher was ‘delivering’ from down-loaded lesson plans. Both lessons demonstrate the demands placed on teachers’ subject knowledge in taking pre-specified objectives and turning them into meaningful experiences for the children.

MAXINE’S MULTIPLICATION LESSON

At the beginning of her lesson, Maxine wrote the day’s learning objective on the board and read it out to her class of 8 and 9-year-olds:

> ‘to understand multiplication as repeated addition’.

With the whole class sitting together on a carpetted area at the front of the class, Maxine encouraged them all to count on in tens from zero. In time with the chanting Maxine pointed to divisions on a counting stick (a metre rule marked in ten segments). She then worked with the class on recording calculations such as 10 x 4 as 10 + 10 + 10 + 10 = 40 and then recording 4 + 4 + …+ 4 = 40 and which in turn was expressed as 4 x 10.

The children went off to complete one of two worksheets with multiplication calculations that they had to express in these different ways. Both worksheets were entitled ‘ x as +’ and each had exactly the same structure: a list of multiplication calculations to be re-written in three other ways. For example given a multiplication sentence such as 4 x 5 = they had to write down three other ‘equivalences’:

5 + 5 + 5 + 5 =

4 + 4 + 4 + 4 + 4 =

5 x 4 =

The two sheets were differentiated for two levels of ‘ability’; the ‘harder’ worksheet had larger numbers. For example, the ‘easier’ sheet started with ‘2 x 3 = ‘ while the ‘harder’ started with ‘7 x 8 =‘

Finally Maxine brought the class back together to discuss the work and what they had learned

Commentary

Within the pedagogic parameters of the ‘three part lesson’ that is expected in English schools as part of the National Numeracy Strategy Maxine’s lesson was typical of the majority of lessons that we observed over the latter years of the Leverhulme Numeracy Programme. The lesson had many of the recommended pedagogic elements as set out in the ‘Framework’: a shared, explicit learning objective, a whole class oral and mental ‘starter’, a main teaching part that had differentiated follow-up work for the pupils and a summarising plenary.

However, despite this fit of the lesson structure with the Strategy's prescription for 'effective teaching' our observations during the lesson of children in the class suggested that the fit between teaching and learning was less good. The children's work and their comments when questioned about it suggested that many of them engaged in activities during the course of the lesson that were not always close to leading to what the teacher might have intended as learning outcomes. For example, in the part of the lesson when the children were working individually, errors in their recording indicated that some had adopted a procedural stance towards the task. Typically, given 4 x 5 children were writing down things like:

4 + 4 + 4 + 4 + 4 + 5 + 5 + 5 + 5 =

or 4 + 5 + 5 + 5 + 5 =

The task seemed, for these children, to have become 'a guessing game that is empty of mathematical meaning' (Steinbring, 1998).

Two things to note about this. Firstly, there was no explicit support to help the children make meaning of the connection between, say, 4 + 4 + 4 and 3 + 3 + 3 + 3. The use of an artefact such as an array model for multiplication, setting out tiles or counters in a 4 by 3 arrangement might have been appropriate. As it was, the counting stick as an artefact is not helpful. Trying to establish such equivalences is not easy as the actions of making three jumps of four along the stick and then making four jumps of three do not result in arriving at the same position on the stick. While the pronounced result of 12 is the same in each case, the mismatch of this with the visual image is likely to confuse children.

Secondly, while it may take longer to write out 8 + 8 + 8 + 8 + 8 + 8 + 8 = ('harder' worksheet) than it does to write 2 + 2 + 2 = ('easier' worksheet) the understanding required to do each of these is no different. The worksheets may have been differentiated by the amount of 'work' required to complete them (as measured by the amount of writing involved), but they could hardly be considered to be differentiated in terms of the cognitive demand placed upon the children. This I suggest is linked to the teacher's subject knowledge and lack of explicit awareness of how the meaning making demands of a task may be modified, as opposed to simply altering the action demands. Even amongst those children who were correctly recording what Maxine expected, many replied 'no' or shook their heads when asked if they could explain what they were doing. At best, while children could write down the required strings of symbols, any conceptual understandings of the links between the different forms of representation appeared limited.

Locating Maxine's intentions for the lesson within policy

Maxine's stated objective for the lesson –'understand multiplication as repeated addition' – appears in the 'Framework' examples for 8-year-olds within the strand 'calculations' (understanding multiplication) and under the objective that

> ‘pupils should be taught to: understand the operation of multiplication and the associated vocabulary, and that multiplication can be carried out in any order’. (DfEE, 1999, Y123 example, p 46)

There is only one example later in the Framework that further elaborates this objective.

‘Understand multiplication as:

- repeated addition: for example,

5 added together 3 times is 5 + 5 + 5, or 3 lots of 5, or 3 times 5,
or 5 x 3 (or 3 x 5)’ (DfEE, 1999, Y123 example, p 47, original emphasis)

As this example compresses a repeated addition into a multiplication statement, it seems reasonable to interpret the intention behind the objective as helping children come to understand multiplication as a more efficient method of calculation than repeated addition.

I now turn to examine Maxine’s interpretation of this objective. Although we can surmise something of her intent from the lesson itself, here I draw on data from an interview carried out in the afternoon following the lesson observation.

Interview extract: Maxine’s interpretation of the lesson objective

Maxine: This morning was a bit different because it’s kind of a lead up to a culmination. So this week we started looking at different strategies and today we introduced the strategy and they were trying the strategy. Trying the strategy and how to use the strategy and then tomorrow we’ll look at another strategy and doing the same. Then on Wednesday we’ll be looking at another strategy and doing the same and then Thursday and Friday we’ll be exploring problems and deciding which strategy we want to use to work them out. So it’s a bit different, you’ve got different lessons really sometimes, sometimes it is more procedural. ….

MA: And I know you’ve talked about this a moment ago, but just to clarify, talk to me about repeated addition as a strategy.

Maxine: Because a lot of the children feel insecure. As soon as they see a multiplication sign it’s like, I can’t do multiplication. But all children generally are quite secure in what they have to do now. They can count on, especially when it’s quite small stuff so using repeated addition they find it a lot easier because it’s a method, it’s something that they are confident with so they already have their strategy developed to show them how they can use something that they are already secure about to help them work out some method they are less secure about.

Commentary

From this extract, it seems clear that Maxine’s interpretation was somewhat different to the one I argue above: that if a child did not know the answer to a multiplication then they might use repeated addition to calculate the answer. She repeatedly refers to what is being taught as a ‘strategy’, possibly then associating the objective with the part of the framework that deals with ‘mental calculation strategies’. Her clear intent is that children should use addition as a means of calculating multiplications. Interestingly, although in her account of the lesson she emphasises that this means the children have a strategy that they understand, at no point in the lesson itself were the children ever required to actually calculate the multiplication; they simply had to express it in different forms.

SANDRA’S ADDITION AND SUBTRACTION LESSON

After some introductory work on multiplying by nine, Sandra began the main part of her lesson by writing up on the whiteboard the objective for the lesson.

Sandra: Now, your learning intention for today is (writing on board) add or subtract the nearest multiple of ten, then adjust.

Immediately after writing up the lesson objective and reading it with the class, Sandra asked for explication:

Sandra: What do we mean by nearest multiple of ten?

Child: To the nearest ten.

Sandra: Nearest to nine?

Child: Ten

Child: Add or subtract to xxx, then adjust

Sandra: Add or subtract nearest multiple of ten. It does make sense, you’ll see.

Sandra wrote on the board

48 + 20 =

Sandra: Forty-eight plus twenty?

Girl: Sixty eight

Sandra: Good girl. How did you work it out?

Girl: I took off the eight from the forty then added on the 20 and added the eight on again

Sandra: Good, forty plus twenty is sixty and add eight back on.

Sandra then wrote up

58 – 30 =

which also was explained by ‘taking away’ 30 from 50 and then adding back the 8.

Sandra wrote on the board

46 + 17 =

Children's hands went up more slowly than for the previous two examples. Sandra asked for the answer from a boy whose hand was one of the first to go up.

Boy: Sixty two

Sandra: How did you do it so quickly

Boy: I added ten to forty six, then added seven

Child: Fifty six plus seven

Sandra wrote on the board

56 + 7 =

Sandra: (to boy giving 62 as answer) How did you know it was …?

Children call out that the answer should be sixty-three before he has a chance to answer.

Commentary

To understand Sandra's examples and approach here, I need to explicate the lesson plan from which she was working.

As part of the support material for the implementation of the National Numeracy Strategy, the policy makers produced a series of 'down-loadable' lesson plans that took the Strategies' objectives and provided tasks through which they might be taught. Sandra was working from one such lesson plan. The section of the plan that she was working from is in table 1

Objectives and Vocabulary	Teaching Activities
Add or subtract the nearest multiple of 10, then adjust	• Write on the board: 46 + 20 58 – 30 Collect answers and discuss methods. Amend to: 46 + 20 – 3 58 – 30 + 5 Collect answers Remind children of work in previous lesson and use of number line. Q. What single addition and subtraction do these statements represent? Establish the single calculations 46 + 17, 58 – 25. Repeat and discuss methods.

TABLE 1

Unless the reader already has a clear sense of what is expected in terms of methods of calculating here, considerable effort is required to make the connection between the teaching examples provided and the lesson objective. Firstly, the task does not start with a number that is near to a multiple of ten and then use a rounding method to carry out the addition or subtraction. It starts with adding an exact multiple of ten and then 'amends' this calculation so that, implicitly, a number that is near to the multiple of ten is added.

Secondly, the way in which this 'amending' is supposed to be developed is neither clear nor unambiguous. Given '46 + 20 – 3 and 58 – 30 + 5' which the teacher is supposed to have arrived at by amending '46 + 20 and 58 – 30' asking 'which single addition or subtraction do these statements represent?' does not produce unique answers. 46 + 20 – 3 could be expressed as 66 – 3, 43 + 20 or 46 + 17. Only in the light of the stated teaching objective of 'add or subtract the nearest multiple of 10, then adjust' does the answer of 46 + 17 best fit. The lesson plan then goes on to advise the teacher to 'repeat and discuss methods'. But what exactly is to be repeated?

In the case of Sandra's lesson, it would seem that these connections were not available to her. Note that she starts with 48 + 20 rather than 46 + 20 so the potential to link the later calculation of 46 + 17 with the one previously carried out is lost. Sandra's interpretation of what it means to 'establish the single calculation' 46 + 17 is simply to present this to the children as the next one to carry out. The interplay between the tasks and the learning objective did not appear to be clearly established for Sandra

DISCUSSION

How do teachers make sense of the relationship between the specific and the general, between particular lesson tasks and intended learning outcomes? Do examples help clarify the objective or does the objective help you sort out how to interpret the examples? It is not simply a case of understanding the meaning of an objective and then selecting suitable examples. There is an interplay between the two – objectives and examples – and teachers subject matter knowledge for teaching will be central in mediating between these.

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