REALITY IN PRIMARY MATHEMATICAL LEARNING

Jon Wild looks at the issue of ‘context’ – the positives, and negatives for the learner.

Background

Educational research into teaching mathematics often champions the role of contextualised learning. Researchers have long suggested that engaging children in mathematical activities that have meaning for them is crucial – Hughes, 1986; Nunes & Bryant, 1986; Atkinson, 1992. Indeed the National Strategy talks about solving problems in a context – DCSF, 2010. Yet what is often evident when observing student teachers, if my own personal, anecdotal evidence as a visiting University tutor is replicated elsewhere, is that the contextualisation is often in the form of word problems. It could be argued – with some justification – that this will always occur while SATs continue to dominate the educational landscape of the English primary school as this is where assessment involving word problems reaches its zenith.

O’Sullivan et al (2005) discuss a range of mathematics problems couched in an intended realistic framework. Research from Cooper (1998), Cooper and Harries (2002) and Blinko (2004) is considered, drawing out issues related to pupil interpretation of such contexts. There are important issues pertaining to whether the context is in fact realistic from a child’s point of view; whether there is any ambiguity within these problems; the purpose of the contextualisation, and children’s perceptions of requiring a ‘right answer’. Blinko (2004) identifies contexts that aim to provide meaningful situations for children to interpret and the key differences within these contexts. It is clear from the reflection invited – O’Sullivan et al, 2005 – and the discussion of the questions considered that there are significant complications when mathematics is presented in the format of word problems. This is without even considering the issues raised by Newman (1977) involving being able to read, and understand the problem, as well as determine the mathematics required to calculate an answer, do the calculation, and then interpret any solution to make sure that it makes sense in the context. Along with these issues, O’Sullivan et al (2005) also discuss additional difficulties within the problem-solving process found by children attempting to solve word problems. These are related to how easy, or otherwise, children find it to create mathematical representations of the real life situation, drawing on findings from Askew (2003) and De Corte and Verschaffel (1987). The Dutch implementation of Realistic Mathematics Education (RME), developed initially by Freudenthal (1968) is also considered, with a focus away from the written word problem, creating pictorial opportunities for children to view mathematics in contexts, allowing the children to have fewer difficulties in engaging with the mathematics. Alongside this is the aim of providing problems that children can find some resonance with, whether this is because it reflects the situations children encounter in reality, or whether it is something altogether fictional, but that the children relate to. These problems aim to draw the child in, and enable them to engage with the immediate mathematics and then extend this to more generalised situations (O’Sullivan et al, 2005). In addition to this, Setler (1994) also illustrates the difficulties children often have when insufficient care or thought is evident.

Teachers should rightly consider all these issues. However, many of these situations do not mirror how children engage with mathematics outside of school, and it could be argued that these remain
rather contrived. Merttens (1997) suggests that children learn at home in a natural manner as a direct consequence of what they experience every day. There is no planned curriculum and the learning is initiated by the child; a direct consequence of their interests. This raises the issue of the role of the context itself; whether it is purely a vehicle for the learning objective, or whether it becomes the learning objective. This could also be allied to the practicalities of embedding elements of the Using and Applying strand within learning contexts. For this project, I wanted to draw upon the combination of natural realism to discover how practical it was to implement within the classroom. In essence I wanted to identify a real life event, and identify the scope for developing and extending children’s mathematical understanding from it. At the inception of the project it could be argued that the context became the learning objective itself; however, as planning for the project developed and crystallised, the context was seen as the vehicle for the key learning objectives.

**The project**

I worked with a class of Year 6 children as part of a wider project linked to the 2012 Olympics which aimed at engaging primary school children in activities linked to practical learning. The initial mathematical learning intention was to develop the children’s ability to use a protractor accurately within a realistic context.

To that end the children were taken out onto the games field to play a game of rounders. After a period of play the children were asked about their positioning when fielding and their reasons for fielding where they were. As expected, there were the usual answers that related to where the fielding side expected the batters to hit the ball. However, some children were closer to the batter than others. When these children were questioned about their reasons for their position, some indicated that because they couldn’t throw very far they fielded close in, while others were confident in their throwing prowess and fielded far away, waiting for the strong batsmen in order to nullify their effect.

This led to discussions about how far the children could throw, and how they could improve the distance of their throwing. Consequently the children engaged in measuring how far they could throw, and decided to find the average distance after a number of throws for fairness. During the discussion about how to improve the distance of their throwing, children mentioned looking at other ‘good’ throwers. This led to children discussing sports where throwing occurred, including Olympic events such as javelin, throwing, and handball, as well as cricket – not linked to the Olympics but included as several children played cricket for the school and local club sides. As the discussion developed into how we could compare the different styles the children decided to find photos of professional athletes and then compare them with photos of themselves. Finally, after some careful questioning, the children agreed that measuring the angles of the throwing arms would be valuable so that the children could make any changes to their own throwing action and then determine if it improved their throwing performance.

The children then embarked upon this investigation armed with digital cameras, and recently developed skills of importing photos into a document template created with a translucent protractor ready for them to manipulate so that they could make the required measurements. The emphasis was on being really accurate when using the protractor. Once the measurements were taken, and the comparisons made, children were required to draw some conclusions about their own throwing styles to see if any changes made would affect the distance they could throw.

**The children’s learning – mathematics**

Prior to undertaking the project children had experienced using protractors in measuring static angles of shapes – Haylock, 2010 – in worksheet and textbook contexts. What was interesting in this project was that there was no confusion about exactly what pupils were investigating, building on their use of protractors to focus on greater accuracy of measurement, and also on interpreting their results. There was no issue with interpreting a written word problem or even interpreting the context. In many ways the immediacy of the context and the reality of it, something that the pupils had experienced rather than read about and tried to relate to, enabled the children to apply their understanding without any confusion.

As expected the most able children were able to access the task with ease, although through using this context the immediacy gave rise to a desire to measure with increased accuracy, and then interpret these readings with some maturity. This was typified by one child claiming that although they had measured accurately, and made the decision to change their throwing action, it would be impossible to replicate the exact angle to the nearest degree in their new throwing action, but rounding this to the nearest 10 degrees would probably suffice. Others, notably the keen cricketers who...
received throwing coaching in out-of-school clubs, made comparisons between their throwing styles and those of professional cricketers and concluded there was little difference in their action, or the angles of their throwing arms and therefore there was no reason to alter their action. This was strengthened by their reasoning that they were the best throwers in the class — as indicated by their average distance thrown. Others made changes to their actions and were rewarded by an increase in the distance thrown. These instances indicate a real engagement with both the context and the mathematics, enabling learners to become emotionally engaged, to reflect, and to evaluate with a real purpose. In addition, there was no noticeable focus on ‘getting it right’ which often occurs within the classroom.

The less able mathematicians again responded very positively, with no confusion about what they were doing, as there was no reading requirement — Newman, 1977. Indeed their accuracy in measuring was very good with real clarity about accurate alignment and rotation of the protractor before measuring, along with clarity about which scale to use when measuring with the protractor. Part way through the series of lessons in the project, one child exclaimed, with surprise, that he was actually doing maths! Such were the levels of engagement and the immediacy of the task in hand this came as a surprise to him along with several others. As with the more able mathematicians, the children were able to interpret their findings effectively making clear changes to their throwing action with positive results. Again, other learners made the decision that no change was necessary.

It seemed that this particular context was real enough to enable children to access and interpret it without difficulty. The mathematics within it did not appear to be obscured by the context and the children’s responses to the context appeared very positive.

The children’s learning — ICT

Obviously, ICT was used extensively within the project. Given the resources available netbooks for use outside — if required, digital cameras and the school computer suite, the children needed to use ICT skills. While the learners were very familiar with using ICT, some skills and processes that were required for this project needed to be taught. These included importing photos on the school network and being able to find them again; resizing and rotating objects — photos and protractor, and layering objects in a document — enabling the translucent protractor to be seen on top of the photo. Given that I was a visitor to the school and that these pupils were not my class, this meant that the focus of the sessions sometimes moved to ICT skills rather than mathematics, which could not have been helped. However, for a class teacher, careful planning would be required to ensure the skills required could be developed in ICT sessions prior to the mathematics focus.

The contextual chicken or egg?

I was given the theme of the Olympics as a starting point and then added the focused ‘Learning Objectives’ orientation. However, in approaching a project such as this, some teachers might find it easier to find the real life event, and then find the mathematics in it. For some, there are possible dangers to this approach particularly at a time where teaching is very much expected by the current inspection regime to be objective-lead, focused on achieving age appropriate expectations and beyond. It would be quite easy to see a curriculum dominated by ‘real events’ becoming reminiscent of the ‘topic work’ much criticised in the 1960s to the 1980s as being vague and unfocused. However, it is possible to reverse the process; to consider what specific learning the children need to be engaged in, and then consider real events in which this mathematics might develop. In my own experience, to some extent this process becomes circular as the more you consider different mathematical concepts alongside specific real situations it becomes difficult to distinguish which thought came first.

Another question also raises its head, that of whether I should always, and only, teach mathematics in real contexts? May it never be! I believe there is also a compelling argument to teach what could be construed as ‘pure mathematics’, for example the Fibonacci series because mathematics is, for some, intrinsically interesting and has an intrinsic value. However, that is another discussion.

What is clear is that in the decision making process of whether to choose a real event from which to develop children’s mathematical understanding, it is crucial to have a very clear appreciation of exactly what mathematics pupils need to learn, and how well the real event can support this process. Again speaking personally, I believe that your outlook upon real life can be altered, so that often the mathematical opportunities available can be recognised, even when doing very mundane things such as walking down the High Street.

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