1. Introduction

The students taking Core Maths are likely to have studied maths already for 11 years. For much of that time, they have likely acquired understanding by listening to clear explanations by the teacher and watching as the teacher demonstrates how to solve certain types of problems. They have then consolidated their learning by solving similar problems.

This traditional transmission model of teaching and learning often does not value true understanding or encourage the creative thinking, flexibility or alternative approaches necessary to meet the challenges of tomorrow. Core Maths should give the students an opportunity to learn mathematics with a deeper understanding than is currently needed at GCSE level. We firmly believe that “things learned with understanding can be used flexibly, adapted to new situations, and used to learn new things” (Hiebert et al., 1997).

Building relationships and connections within mathematics is an effective methodology for students’ understanding of mathematical skills and fluency in applying their mathematical knowledge.

2. Teaching through problem solving

It is clear from the above that the chosen tasks are critical to the students’ learning. In this instance we define a challenging task as one for which the student has “no prescribed or memorised rules or methods” to follow and that “there is no perception by the students that there is a unique “correct” method (Van de Walle, 2007).

In other words a challenging task must offer the chance for alternative approaches to be considered and shared and so will encourage reflection and communication. It is important to understand that in this context the task is not simply an interesting mathematics problem but specifically chosen to drive the learning from what is known to what needs to be known.
For each task, the pedagogical context needs to be carefully articulated before the task is chosen. In this way learning is intentional rather than haphazard. In effect this is “teaching through problem solving” as opposed to the more traditional “teaching for problem solving”. The intention is that students learn mathematics as a result of solving problems. Mathematical ideas are the outcomes of the problem solving experience.

It is also important to stress that the task must be of interest to the student. The context needs to be considered carefully and it should be presented in a way, which piques their interest and arouses their curiosity.

3. Possible Lesson Structure

The lesson is likely to be centred around one or two problems with a suggested format in line with Japanese lessons (see, for example, Isoda et al., (2007).

**Phase One: Presentation of the problem**
- The teacher presents the problem so that students understand and know what is expected of them.
- The students figure out what the problem is about by reading, listening to the teacher’s instructions and discussing it amongst themselves. They check what they already know and what they need to learn and begin to develop ideas of how to tackle the problem.

**Phase Two: Developing a solution**
- The students think about the problem and try to find solutions on their own.
- The teacher purposefully walks around looking at the student’s work, making notes and deciding in which order to ask the students to present their ideas in phase three. The teacher in general does not guide the students apart from giving hints to students who cannot make progress. In this way the maths being created belongs to the students.

**Phase Three: Progress through discussion**
- The teacher asks three to five students who used different methods to explain their approaches to the rest of the class. The teacher remains neutral to the ideas.
- The students listen to the explanations and try to reach a common understanding of better solutions by discussing the strong and weak points of each approach proposed.

**Phase Four: Summarising**
- The teacher summarises the group findings and in particular emphasises the important points addressed in the lesson. The teacher will challenge the students with similar or developmental problems for homework.
- The students often write down what they have learned in their journals.

Whilst we are not expecting ALL lessons to follow such a pattern, we will be supporting and encouraging our Core Maths teachers to innovate in similar ways. We will provide a bank of initial problems with the planned learning goals articulated, and also provide model lesson plans and video clips of key moments in the lesson.
4. Assessment

Becker and Shimada (2005) explain though that although the Japanese approach to teaching through “open problems” was originally intended as a means of evaluating higher order thinking skills, it proved to be an effective method of teaching mathematics to students of all ages and abilities. Their findings suggested that students taught through problem solving did at least as well as students taught in a more traditional way. Consequently we do not feel a traditional style end of course examination will disadvantage our students although we anticipate that awarding organisations will be imaginative in their planned external assessment. We also expect that students will demonstrate other skills such as fluency, flexibility and originality when faced with unfamiliar problems.

5. Continuous Professional Development

The aim of our professional development programme is not only to provide teachers with new frameworks to use as they plan their students’ learning experiences but also to challenge the teacher’s own beliefs about effective teaching. Core Maths teachers will be encouraged to form lesson study groups either within their own institution or across institutions as they work together to research teaching materials, develop lesson plans and practise teaching lessons.

The underlying principal here is the idea that teachers learn from and improve their practice by watching other teachers teach (Isoda, 2007). In this way the teachers mirror their own students by becoming inquirers themselves and this will become key to sustainability of these approaches to teaching and learning. We will also encourage teachers involved in the Core Maths programme to enhance their professional development by engaging with relevant modules in our on-line MA course.

References


