Opportunities and Challenges for Teachers and Students Provided by Tasks Built Around "Real" Contexts

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Following professional learning sessions which focused on developing and using tasks in middle years classrooms which began with "real" contexts, teachers trialled such tasks in their classes, and then completed a survey, the results of which are reported here. Teachers were able to articulate the features of such tasks, see potential benefits, and articulate opportunities and constraints in their use. Secondary teachers saw greater constraints in using such tasks than did primary teachers.

Introduction

There is a strong consensus in the research literature that the nature of student learning is determined by the type of task and the way it is used (Kilpatrick, Swafford, & Findell, 2001). "Instructional tasks and classroom discourse moderate the relationship between teaching and learning" (Hiebert & Wearne, 1997, p. 420).

When teachers pose higher order tasks, students give longer responses and demonstrate higher levels of performance on mathematical assessments (Hiebert & Wearne, 1997). The greatest gains on performance assessments, including questions that required high levels of mathematical thinking and reasoning, are related to the use of instructional tasks that engage students in "doing mathematics or using procedures with connection to meaning" (Stein & Lane, 1996, p. 50).

The provision of meaningful and challenging mathematical tasks remains an issue in middle years' mathematics in Australia. For example, the Executive Summary of *Beyond the Middle* (Luke et al., 2003), a report commissioned by the Australian Commonwealth Department of Education, Science and Training, and involving a literature review, a curriculum/policy mapping exercise, and system, school and classroom visits, claimed:

> There needs to be a more systematic emphasis on intellectual demand and student engagement in mainstream pedagogy. … This will require a much stronger emphasis on quality and diversity of pedagogy, on the spread of mainstreaming of approaches to teaching and learning that stress higher order thinking and critical literacy, greater depth of knowledge and understanding and increases in overall intellectual demand and expectations of middle years students. (p. 5)

What are Type 2 Tasks?

When using Type 2 tasks, teachers situate mathematics within a contextualised practical problem where the motive is explicitly mathematics. This task type has a particular mathematical focus as the starting point and the context exemplifies this. The context serves the twin purposes of showing how mathematics is used to make sense of the world and motivating students to solve the task. It is intended that the context provide a motivation for what follows and dictates the mathematical decisions that the students make in finding a solution. Although the contexts are in some cases contrived, it is important to distinguish Type 2 tasks from *word problems* (e.g., Fennema, Franke, Carpenter & Carey, 1993), which are only contextualised in a very basic way.

In R. Hunter, B. Bicknell, & T. Burgess (Eds.), *Crossing divides: Proceedings of the 32nd annual conference of the Mathematics Education Research Group of Australasia* (Vol. 1). Palmerston North, NZ: MERGA.

Hodge, Visnovska, Zhao, and Cobb (2007) studied the use of a range of contextualised tasks with seventh-grade students in the United States, with a focus on the extent to which these tasks supported students' mathematical engagement and their developing mathematical competence. Most tasks involved comparing two data sets in order to make a decision or judgement (e.g., deciding whether the installation of airbags in cars impacts on car safety, exploring the impact of a treatment program for AIDS patients). During the design experiments, the authors found that issues, which were of a personal or societal relevance, were the most effective in engaging students. They attributed this to "adolescents' growing interest in their place in society and their sense of power in affecting [sic] change on society and their immediate community" (p. 398).

Peter-Koop (2004) summarised many of the difficulties which students face when solving context-based problems, including comprehension of the text, and the identification of the mathematical core of the problem. We need to be careful about the use of problems which have little in common with those faced in life, Maier (1991) describing them as school problems coated with a thin veneer of "real world" associations.

Boaler (1993) was also critical of these kinds of problems, particularly those extracted from the adult world (e.g., wage slips and household bills) with an assumption that students could identify with these. She also criticised the misconception held by some that "mathematics in an 'everyday' context is easier than its abstract equivalent" (p. 13). Boaler also noted that "one difficulty in creating perceptions of reality occurs when students are required to engage partly as though a task were real while simultaneously ignoring factors that would be pertinent in the 'real life version' of the task" (p. 14).

Where Was This Photo Taken? An Example of a Type 2 Task

A number of teachers in the TTML project used what we have come to call the Signpost Task. In using the task, the teacher asked students whether, during family travels, they had ever seen a sign at lookouts or at other tourist places which showed how far and in which direction a number of key places were from their current location.

Figure 1. The sign presented to students in the Signpost Task

The teacher then explained that today's lesson would involve the students working, in pairs, on trying to find out the location of the signpost. A number of teachers reported that several students needed what Sullivan, Mousley, and Zevenbergen (2004) termed *enabling prompts*—appropriate variations on the task or suggestions to students, which might help those who are having trouble making a start. One helpful enabling prompt was to suggest to students that they pick a city named on the sign and find out how far on the map it would be from the sign's location and therefore which "mystery city" might contain this signpost.

A number of writers (e.g., Brown & Walter, 1993) have stressed the importance of problem posing by students. Several teachers extended the work on the task, by encouraging students in groups to create their own signposts with cities of their own choice, and then to pose their problems to another group. Incidentally, the photograph above was taken inside Auckland International Airport in New Zealand.

Teachers were encouraged to use the tasks provided by the project team as models for developing their own tasks. The two below were rated most highly by teachers:

Maps for the commander (Downton, Knight, Clarke, & Lewis, 2006). Here, students are presented with two views drawn by spies of a city surrounded by a circular wall—one drawing from the West, one from the South. The students are challenged to draw the view, which the third (missing) spy would have drawn from the North-east.

Land proportions. Students are presented with a copy of a real email sent to the authors by a person seeking some help. The letter read as follows: "If, on paper, a block of land is 2 cm x 5.8 cm, and the overall dimensions are 4768 square metres, how do I work out the actual length and width of the block?"

Project Teachers' Descriptions of Type 2 Tasks

Teachers were asked to describe Type 2 tasks as they would if they were explaining them to another teacher. The prompt was "If you were explaining to a group of teachers about to use tasks of this type, how would you describe this type of task?" Their explanations included the following:

- A mathematical problem embedded in a real situation.
- Questions which allow/require investigation through use of materials data gathering, testing and calculation. The tasks are based in authenticity.
- The mathematical problem is contextualised, but with an explicit maths focus.
- Contextualised maths investigations with explicit mathematical focus.
- Application tasks involving situate mathematics within a contextualised practical problem where the focus is explicitly mathematics.

Teachers' Views on Advantages and Difficulties in Using Type 2 Tasks

After at least one school term of trialling a range of Type 2 tasks, teachers were asked to list "advantages of using this task type in your teaching." Typical comments were:

- More hands on.
- Some were good for the student who struggles with mathematics.
- The mathematical skills and strategies are made purposeful and meaningful by being situated in a "real world" context.
- Increases the students' ability to think.
- Allows the students to draw on a variety of understandings and topics – engaging and relevant to what they are doing.
- Engages advanced students. Combines knowledge and skills, e.g., a task may need measurement, calculation, logic.
- Each task can be taken in various directions by the students. There are different ways to solve the puzzle and are very engaging.

Teachers were also asked, “What makes teaching this task type difficult.” In the comments below, “support students” refers to those students in the classes in which students of “lower ability” were grouped. Typical responses were the following:

- Some of the tasks were too challenging for support students and too long!
- The different learning needs and abilities of the students; at times some students arrived at their conclusions more quickly then others.
- Students who are less confident have very little idea of where to start if left to their own devices rather than assisted. These tasks can compound their negative feelings about themselves and maths.
- Not all the real situations are relevant to middle years students and may not fit neatly into the existing curriculum.
- You need to do some preparation with the students. Students are more interested in the answer than the process.

It is worth noting that teachers in secondary schools found using the Type 2 tasks more challenging to use generally than did those in primary schools.

Boaler (1993) provides an insight into the potential transfer of mathematical understanding when she notes that “it also seems likely that an activity which engages a student and enables her to attain some personal meaning *will* enhance transfer to the extent that it allows deeper understanding of the mathematics involved” (p. 15). She notes that “school mathematics remains school mathematics for students when they are not encouraged to analyse mathematical situations and understand which aspects are central” (p. 17).

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