

# numeracy

for what's in the news and  
Building an Expressway

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## Context

**M**y school is Quorn Area School, which is situated around 40 kms from a main town centre and approximately 400 kms north east of Adelaide. The school has approximately 280 students catering for Reception to Year 12 and is structured around a primary (Reception Year 5) and a middle years section (Years 6-10) on the same campus. A separate senior section houses the Seniors (Years 11-12 consisting of 24 students) in a building away from the main teaching areas but within the same grounds. In the middle school, there are approximately 100 students.

There is a sense of community about the school with parent brochures at the front desk and information about the town pinned to school noticeboards at the front entrance.

## Background

In my teacher education degree I specialised in Middle Years of Schooling, majoring in Science and Society and Environment. Before studying to become a teacher I had spent several years working in the retail industry. I had been at the school for one full year when the DECS Numeracy in the Learning Areas Project started. This was my second year of teaching and the beginning of my second year at the school. During the project year I taught Years 6-9 Science, Year 10 English, Year 9 Mathematics, and Years 8-9 Society and Environment.

My classroom is a small demountable building with a non-networked computer on one table and the students' desks arranged in various groupings (designed by the students themselves). My classroom is the only room within the middle years classrooms equipped with an interactive white board.

## School visit: Round 1

### Planning and preparation

My first focus on numeracy was through a Year 8/9 English unit that involved print newspapers. I wanted to integrate numeracy skills into lessons that typically were not seen to be numeracy friendly, so I decided English would be a good place to start. I planned to cover amongst other things: Golden ratios in advertising; costing calculations in classified advertisements; and co-ordinates in World news. Whilst constructing my weekly planning document, I added an extra column entitled “What is the numeracy?” so that this would be a specific focus during the English lessons.

In an earlier task completed before the researchers visit, students had explored golden rectangles (rectangles in the golden ratio of 1:1.618) and had then applied this learning to newspapers to determine whether any of the advertisements or photographs were golden rectangles. This activity generated discussion about whether golden rectangles may have been subversively used by newspaper designers to draw the reader's eye to particular parts of a newspaper.

I had also followed up the ratio aspect of the Newspapers unit when the students were on camp. In this case the students were mixing cordial with water in a dispenser while discussing the ratio of the two measures. I was pleased that the students had made a real connection to ratio from our earlier classroom discussion.

Another planned activity in the English unit (and also the lesson for the researchers' first visit) was for students to determine the percentage of different forms of news in a newspaper, that is, the component elements of a newspaper in terms of types of reports (sports, local news, world news, special interest, weather, and so on). The aim here was to develop a basis for students developing their own newspapers and thinking about the balance of material in a newspaper. I was using this context for teaching students about text types and intended that when the students created the class newspaper that it would contain a variety of text types. It was intended that this publication would take an authentic approach that required students to write within these different styles.

A further planned dimension to the unit was a lesson on coordinates as students read the world news stories and identified the place in which the news had occurred on a large map of the world. The intention was to link with the Society and Environment learning area.

As I was the students' classroom teacher for several subjects, they had become familiar with the integrated lessons across the four subject areas that I taught. However, during the English lesson on measuring and finding golden ratios, students were curious, some had commented and wondered why they were doing Maths in English but also let me know they enjoyed the lesson. In the Newspaper unit I was careful to keep the main focus on the English core learning outcomes towards which I was working.

A specific moment I remember was when the students were exploring ratios in the newspaper advertisements and one of my lower achieving year 8 boys said “this feels like maths”. It was just a passing comment at the time but it was not until the end of the year that I understood what he meant, something I will discuss later. I did spend some time with students asking them to consider the meaning of the word numeracy. Students' responses initially were predominantly related to the word mathematics or number but gradually, through discussion and via examples I provided, students expanded their

understanding of numeracy to include terms related to measurement, spatial concepts and data. A list of these terms was displayed on a wall of the classroom and students were encouraged to add to the list at any time.

### Lesson observation: Data organisation and representation

During the lesson that the project researchers observed, the class were looking at the amounts of different types of news in a newspaper and were asked to represent this data in the form of a graph.

At the beginning of the lesson I explained to my students the aim of the session and reminded them of the previous activities they had completed in relation to the newspaper unit. To simplify the calculations they were to carry out, I suggested that students work on the assumption that there were 100 pages in the newspaper and to make an estimate of the number of stories in the following categories: local news, world news, weather, sport, advertisements, other. I modelled how this would be done but intentionally did not remind students about percentages or how to calculate them. The requirement was for students to represent their data using a graph, and that this graph could take any form (bar, pie, line). I wanted to see how much the students knew about representing data so I did not go into detail on specific graphs and their purposes, rather allowing them to use their current understandings to make the decision.

After estimating the proportions that a newspaper devoted to different categories, the students then counted the number of pages that were assigned to each category in the newspaper, calculated the percentage for each category compared to the total number of pages, and compared this result to their original estimate. As students began working, it was evident that many of the newspaper articles were of interest to the students as they read the articles and discussed the content rather than focusing on the task at hand. Some students stated that they were unsure of percentages and how to calculate them. One student was seen to use a calculator to determine the difference  $100 - 30$ . At the end of the lesson, students had begun to rule the axes for their graphs. Curiously, almost all students had decided to do bar graphs rather than pie graphs. One male student started to construct a line graph and I questioned him on why he chose that particular style of graph. He could not really provide an answer, just stated that he knew what a line graph looked like and they were easier to do than pie graphs. This provided an opportunity to discuss with the students gathered at the same table when line graphs were commonly used, for example, to compare data over a period of time. After this discussion the student decided to start again on a new bar graph.

Although not all students completed the task, they were engaged in reading the newspaper and sharing ideas on the content of each story with their peers and creating the axes for their graphs.

Reflecting on the task after the lesson, I noted that all students had made some progress, but I knew that their final products were a measure of their understanding of graph construction and they had not shown me they were comfortable with constructing pie graphs. This might have been an opportunity to probe students about their knowledge in this area, that I missed at the time, so I decided to follow up this lesson with specific instructions for students on how to construct pie graphs both manually and using excel spreadsheets.

When thinking again about the numeracy flavour I included in this lesson and what an English teacher might think of this, I recalled the discussion at the initial professional development workshop on numeracy that I had attended: numeracy opportunities are everywhere and it is a teacher's job

to ensure that we take advantage of these situations. I believe this English unit on newspapers had been valuable to me in highlighting students lack of skills in reading a newspaper, particularly in terms of identifying main ideas in stories, the use of headlines and methods of scanning for information as well as the numeracy aspects that were explored. I was fairly pleased with the overall outcomes of the Newspaper unit of work but still felt like the numeracy tasks were token activities for the sake of the numeracy project rather than rich tasks embedded into the unit, a concern I deliberately addressed in the next unit of work.

## School visit: Round 2

### Planning and preparation

When it came time for the second unit of work to begin I was still lost for ideas and I think this was because I was still struggling with my own dispositions and comprehension of the term numeracy. I felt a little disappointed after the next project meeting where all teachers had presented the initial numeracy units they had developed in their schools. This was because I was not perfectly happy with my own initial unit and I was having difficulty thinking of ideas for the next unit. Fortunately, an opportunity arose that gave me a way forward within the numeracy project and which may have a lasting influence on my teaching career in general.

I had successfully applied for a Premier's Industry Award and as part of this award I spent two weeks with a civil engineering firm where I looked specifically at the mathematics and science used in this workplace. I believe this experience provided me with a light bulb moment because from this time onwards I knew what I wanted to do within the numeracy project.

While at the civil engineering firm, I noted the type of projects the firm was engaged in, for example, building bridges, making roads and studying environmental impact of future developments. I also noticed the way mathematics was embedded in the work life of the firm. I could see how numeracy was not just doing maths, it was a way of life for these employees. In particular, I saw that mathematical language permeated nearly all discussion about how to solve problems and the importance of estimation skills.

After completing my placement, one of my responsibilities, as an award winner, was to develop a series of teaching units to be available for other teachers to use in schools. I decided to use this as a basis for my work in the numeracy project as well. As a result, I was using activities with an engineering or design flavour in which I emphasised the use of estimation skills and appropriate mathematical language. For example, I insisted my students used the term trundle wheel for a device used to measure distance rather than a clicky wheel, which is how students were referring to the tool.

One of the other things I had learned from my placement was the importance of estimation skills. In order to support the development of estimation skills, I had tried a number of approaches for helping students develop an appreciation for the magnitude of measures in real life contexts. For example, I tried to help students understand how much money was involved in a \$526 million road building project by asking them to work out how many of one particular item from a catalogue could be purchased for this amount of money. This approach re-quantified the amount of money in terms of a unit with which students were familiar and led to a discussion of the significance

and use of the decimal point and the effects of rounding where large numbers are involved.

I had noticed that when working on real life-related tasks such as these, students generally worked happily without concern for whatever school subject they were studying. This was different from my initial numeracy project experience where students often wanted to know what subject they were studying and also why they would be studying mathematics within another subject, for example, English. What I also found was that the extra 'what is the numeracy?' column on my unit plans was not needed, as it was up to the students to determine what skills and tools they required to complete any task. It then became apparent that we were not 'doing maths' anymore but we were all being numerate.

In the observed lesson I set students the task of finding the best path for a new expressway to be built between a nearby regional centre and Adelaide. The purpose of the activity was for students to gain an appreciation of the complexities associated with designing public infrastructure and to put into practice mathematical skills they had studied earlier in the year. This approach provided an opportunity for students to consolidate and revisit work covered earlier in the school program. I also believed, that it was important for students to see that the mathematics they studied was used in an integrated way in the real world and so had relevance and purpose.

### Lesson observation: Measurement and number

Students were provided with two adjacent maps of the area between the two centres that were to be connected by the expressway. They were required to start on a predetermined grid reference in one centre and finish on a grid reference in the other centre. Grid references formed a 1 cm square grid pattern across both maps. The task also involved the following constraints:

- The route must only cross one river because of cost limitations.
- The route must cross Gawler One Tree Hill Road at some point and then rejoin Main North Road.
- Bends in the expressway must be equal to or exceed 110°.
- The expressway must not pass nearer than one grid reference to a quarry.
- Residents were to be compensated \$150 000 per grid reference square for any land that it was necessary to resume.
- Crossing the region of Uleybury was to be kept to a minimum as compensation to residents in this district is \$500 000 per grid reference square as it is a vineyard area.

The expressway was to be designed for minimum possible cost and marked on the two maps with a length of woollen yarn.

Once the introduction to the lesson was over, students formed pairs or small groups to work on the task. They asked for little input from the teacher; however, a common problem occurred related to the scale of the map (1:19 000). Once I realised this was a widespread problem I stopped the class, reminded students of the work they had completed recently in mathematics and of the general strategy of looking for information they knew and recognised within a task. I then guided students through the process of maintaining the same ratio when altering units related to the scale as below.

$$\begin{aligned}1 & : 19\,000 \\1\text{ cm} & : 19\,000\text{ cm} \\1\text{ cm} & : 190\text{ m}\end{aligned}$$

Students then resumed the work of designing and costing their version of the expressway for the remainder of the lesson.

I also supported students who tried to use approximation skills to assist them to compare distances on the map developed from the scale with distances they were more familiar with or more comfortable with using. For example:

1 cm : 19 000 cm is approximately 1cm : 20 000 cm and then  
100 mm : 2 000 000 mm  
5 mm : 100 000 mm  
5 mm : 100 m

Students therefore deduced that 5 mm on the map was approximately equal to 100 m—or the length of a football field.

Measurement (measuring distance and angles, estimation and converting units) and Number (calculations with money and ratio) was the mathematical knowledge used in this lesson. Learning was situated in an authentic context in which students wrestled with the complexities of balancing costs against the best route of a new expressway. In determining a solution to the task, students made use of measuring tools in the form of rulers and protractors and representational tools through maps. My attempt to make students learning more authentic and relevant appeared to encourage positive dispositions towards numeracy learning among my students. The chosen context demanded that students adopted a critical orientation to the way they were using numeracy skills. While completing the task, they had to make decisions about the path of the expressway, balancing cost against the directness of the route.

## Final reflections

After the lesson I thought about how my understanding of good teaching had changed. I believe I now devote a great deal more effort to developing integrated approaches to teaching and learning. In the initial stages of the project I tried creating an extra column in my unit planning template to record opportunities for numeracy teaching within existing units. Now, I am always looking for numeracy opportunities in all learning areas for which I am responsible. I feel more comfortable within my teaching of numeracy and feel this is because I have a real purpose for teaching mathematical knowledge and skills. At the same time, I am careful to faithfully represent South Australian Curriculum Standards and Accountability Framework learning area requirements in my programs.

I believe my teaching is relevant because my students can see relevance in the activities I design for their learning. Also, I know I have developed professionally and personally through the project. During the initial project meeting, where the numeracy model was described, exemplar activities were provided that helped me with *knowing* about numeracy. Returning to school and trying out initial ideas was part of me *doing* in relation to numeracy. Eventually, though, the continued interaction of my developing *knowing* and *doing* led to my present state where my approach to teaching numeracy had become part of my *being*. I feel that my involvement in the project has changed who I am, both professionally and personally.

This is just part of my teaching now; it is part of who I am now.

I also believe the numeracy model is a powerful tool when thinking about designing units and activities, because it provides a means of looking at numeracy from different perspectives. In particular, it has broadened my

view beyond numeracy as mathematical skills alone. In some way, the model gave me permission to incorporate personal and social aspects into numeracy learning. I saw this as a way to help my students gain confidence in the use of numeracy skills and give relevance to their learning. This meant my entry into the model was through students' dispositions, which were not that dissimilar to my own initial disposition toward numeracy. I attempted to improve students' dispositions by designing units and activities set within authentic contexts. The engineering and design contexts I eventually chose for my units demanded that students make use of mathematical knowledge they had previously studied or necessitated the introduction of new knowledge. The type of task also demanded the use of tools, for example, to measure distances or angles in the expressway project.

The contexts I chose naturally aligned with a critical orientation to making judgements about the accuracy and appropriateness of solutions students found to real world problems. One of my favourite catch phrases that I borrowed from the researchers was the 'critical eye' idea. They helped me to give a title to what I was trying to instil in the students – an extension to essential estimating skills and the ability to look at something and think, 'Is that what I was expecting? Does it look or feel right?'

By reflecting on and reviewing my practice I have found a way to incorporate all aspects of the numeracy model. I now feel very confident in my approach to teaching numeracy and believe the changes to my practice are not temporary, as they have become a part of my identity as a teacher.

From Helen Prochazka's

## Scrapbook

In the Australian Curriculum, students become numerate as they develop the knowledge and skills to use mathematics confidently across all learning areas at school and in their lives more broadly. Numeracy involves students in recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully.

Australian Curriculum Assessment and Reporting Authority (n.d.). The Australian Curriculum. Accessed February 2012 at <http://www.australiancurriculum.edu.au/GeneralCapabilities/Numeracy/Introduction/Introduction>

Mathematics and the capacity to be numerate, that is, the ability to effectively apply mathematics in everyday, recreational, work and civic life, is vital to the quality of participation in society.

Curriculum Corporation (2006). Statements of learning for mathematics [PDF]. Retrieved February 2012 from [http://www.mceetya.edu.au/mceecdya/statements\\_of\\_learning,22835.html](http://www.mceetya.edu.au/mceecdya/statements_of_learning,22835.html)