Library
planning and design:
Lessons in mathematics

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Introduction

A renovation of school buildings at Rosetta High School, in the northern suburbs of Hobart, Tasmania, has provided an opportunity for students to use a real life context to develop and apply mathematical understanding. This has led to students achieving educational outcomes for the Essential Learnings curriculum that affirm the role of mathematics as a critical element of education and its potential for assisting with the development of learning outcomes across the curriculum.

The Essential Learnings Framework [ELs] (Department of Education, Tasmania [DoE], 2002) is a values-based curriculum, which promotes the development of important ideas and skills for students through authentic learning experiences. The ELs place an emphasis on conceptual understanding rather than procedural understanding and provide opportunities for the development of knowledge and skills that will prepare students for future life. This is facilitated by learning experiences that draw upon real life situations. These learning experiences are predominately undertaken as integrated units of work and bring together knowledge and skills from a number of disciplines to achieve outcomes across the ELs (Skalicky, 2005). This has implications for the teaching of mathematics, the place of the discipline of mathematics within the new curriculum, and how the

integrity of the discipline can be maintained under the broader umbrella of the ELs. The Essential Learnings Framework is made up of five key elements with eighteen key element outcomes, as shown in Figure 1. Officially, it is recognised that mathematics fits within two of the ELs. These are communicating and thinking, with the key element outcomes specific to mathematics being 'being numerate' and 'inquiry'. The mathematics project described here illustrates that desired outcomes for other ELs can be facilitated by exploring mathematical concepts in a real life context. In this case, outcomes were also planned for the social responsibility key element outcome 'understanding the past and creating preferred futures'.

The library renovations unit

Rosetta High School is undergoing major renovations and is reconfiguring teaching areas to enable the provision of a progressive education for its students. The Manual Arts block and the new student kitchen area were completed late 2003, and the beginning of 2004 saw the addition of two classrooms to the gym. The next stage of the renovations is the relocation of the school's library and the canteen area. At present, the school is involved in a consultative process with the architects and the school community to establish the needs of the key stakeholders, which will inform the design of

ESSENTIAL LEARNINGS

Communicating
- Being literate
- Being numerate
- Being information literate
- Being art literate

Personal futures
- Building and maintaining identity and relationships
- Maintaining wellbeing
- Being ethical
- Creating and pursuing goals

Thinking
- Inquiry
- Reflective thinking

World futures
- Investigating the natural and constructed world
- Understanding systems
- Designing and evaluating technological solutions
- Creating sustainable futures

Social responsibility
- Building social capital
- Valuing diversity
- Acting democratically
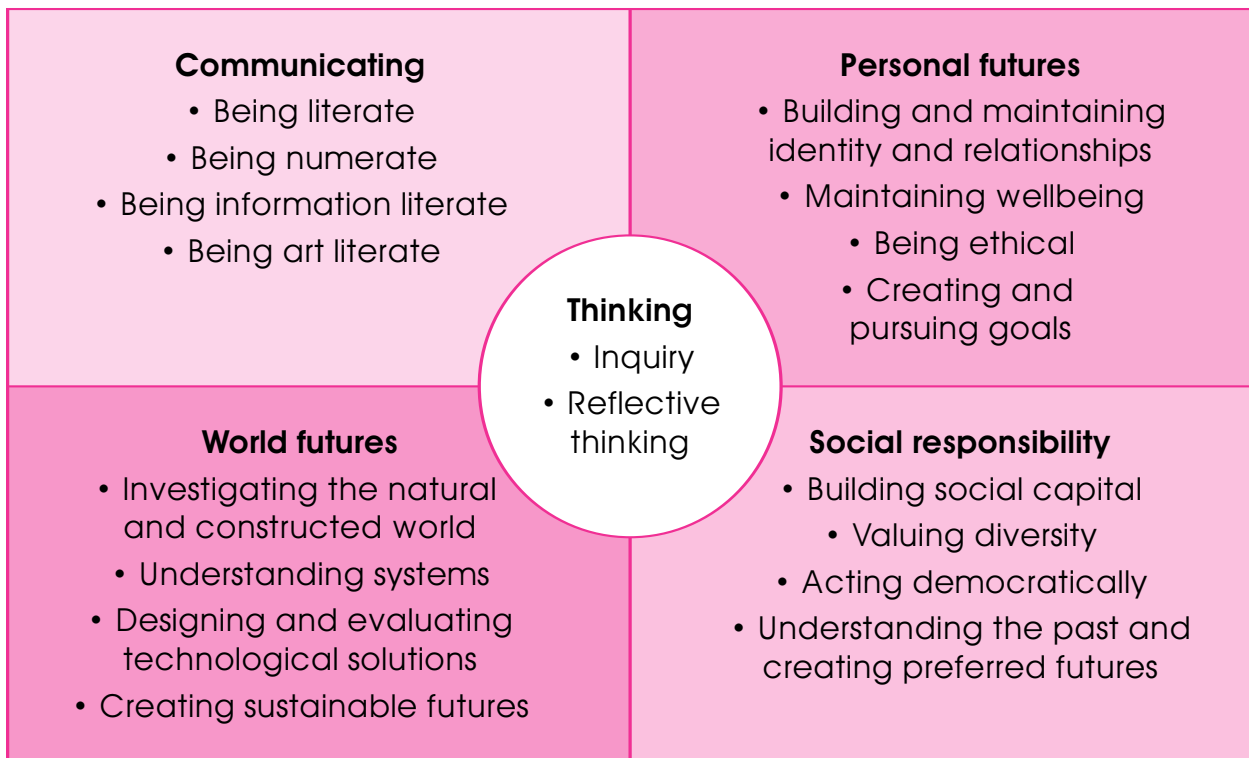- Understanding the past and creating preferred futures

Figure 1. Essential Learning Framework (DoE, 2003, p. iii).

the new library. The Grade 7 mathematics teachers took this opportunity to involve their students in the process and designed a mathematics unit, *The Library Renovations*, which used the context of the renovations to provide a rich learning experience. The students were given a design brief for the new library and had to draw up plans that reflected their ideas for the new library design, as well as their understanding of the mathematical concepts used to develop the plans.

Teaching for understanding

The Library Renovations unit was designed using the Teaching for Understanding framework (Perkins & Blythe, 1994). The framework involved using a generative topic to develop a guiding question to stimulate the learning process. The guiding question was then used to generate understanding goals and establish opportunities for ongoing assessment to be made throughout the unit. The final aspect of the planning process was the development of a performance of understanding that would be a demonstration of the learning outcomes.

Generative topic and guiding question

The generative topic, *The Library Renovations*, was relatively easy to introduce to the students as renovations under way in other parts of the school made the building renewal process obvious. It did, however, take a great deal of preparation to ensure students understood and saw the relevance of the guiding question. At the beginning of the project students completed tuning-in activities that explored the traditional aspects of libraries. The use and purpose of library buildings were discussed to give students an understanding of why, in the past, libraries were constructed as they were. Students quickly identified that libraries had moved from being a place where you worked in silence, which provided access to depositories of books, to a place where you can investigate ideas and concepts, globally through the internet, as well as through the traditional access to books. The way they use the internet, email, mobile phones, and chat rooms to communicate became an important part of the conversation. This was then extended to considering how video and movies

influence their lives and reflect behaviour in society. The students acknowledged that these elements of communication and entertainment should be a part of the new library. Other activities saw the students identifying that a modern library should not only uphold the traditional aspect of libraries but also facilitate the use of contemporary technologies in their learning experiences. This set the scene for asking the students the guiding question, 'What should our new library look like and how can we use mathematics to describe it?'

Ongoing assessment

Throughout the activities planned for the unit a number of opportunities were taken to determine the learning achieved by students. The process began with an assessment of the prior learning and understandings of the students and continued throughout the implementation of the unit. The early activities of the unit were assessed by teacher observation, with more formal assessment of other activities being assisted by the use of rubrics. Additionally, students used proformas to conduct peer and self assessment. A feature of the assessment of the unit was the continual feedback teachers were able to give to individual students and their groups about their progress, when they worked in small groups.

Performance of understanding

A major aspect of the Teaching for Understanding framework is the development of an activity that provides an authentic experience, which requires students to go beyond displaying knowledge, extending to the demonstration of their understanding. As Perkins and Blythe (1994, p. 7) state: 'Understanding is being able to carry out a number of performances that show one's understanding of a topic, and at the same time, advance it.' With this in mind, the final project for *The Library Renovations* unit was the construction of a poster to display the students' work. To complement this, the students had to make a formal presentation to the class about their work, not only showing the display but also articulating their ideas,

and justifying the choices they made. For one class this included presenting their work to a number of teachers from within the school.

Implementing the project

The unit was designed for the students to work in groups of three with each student having a specific role and responsibility that contributed to the performance of understanding (see Figure 2). All roles shared equal responsibility for the completion of the project. The roles involved were the *architect*, the *interior decorator*, and the *resource manager*. An important purpose of the design of the unit was to ensure that all students had an opportunity to develop an understanding of the mathematical concepts involved with planning and design. As a result, a brief for each role was written outlining the contribution students had to make. This included the presentation of their work as well as the content demands. All roles included the same core elements of mathematics in their brief and used the genre of their roles for presentation of ideas.

The architect was responsible for drawing up floor plans of the entire library area, including measurements and calculations of the area of spaces. The interior decorator was to utilise a colour board to present design ideas related to the project. This was to be supported with calculations of areas of carpeting and painting requirements, and floor plans with furniture layouts. The resource manager was to provide an inventory list of computing and electrical equipment, along with the costs. This role also required
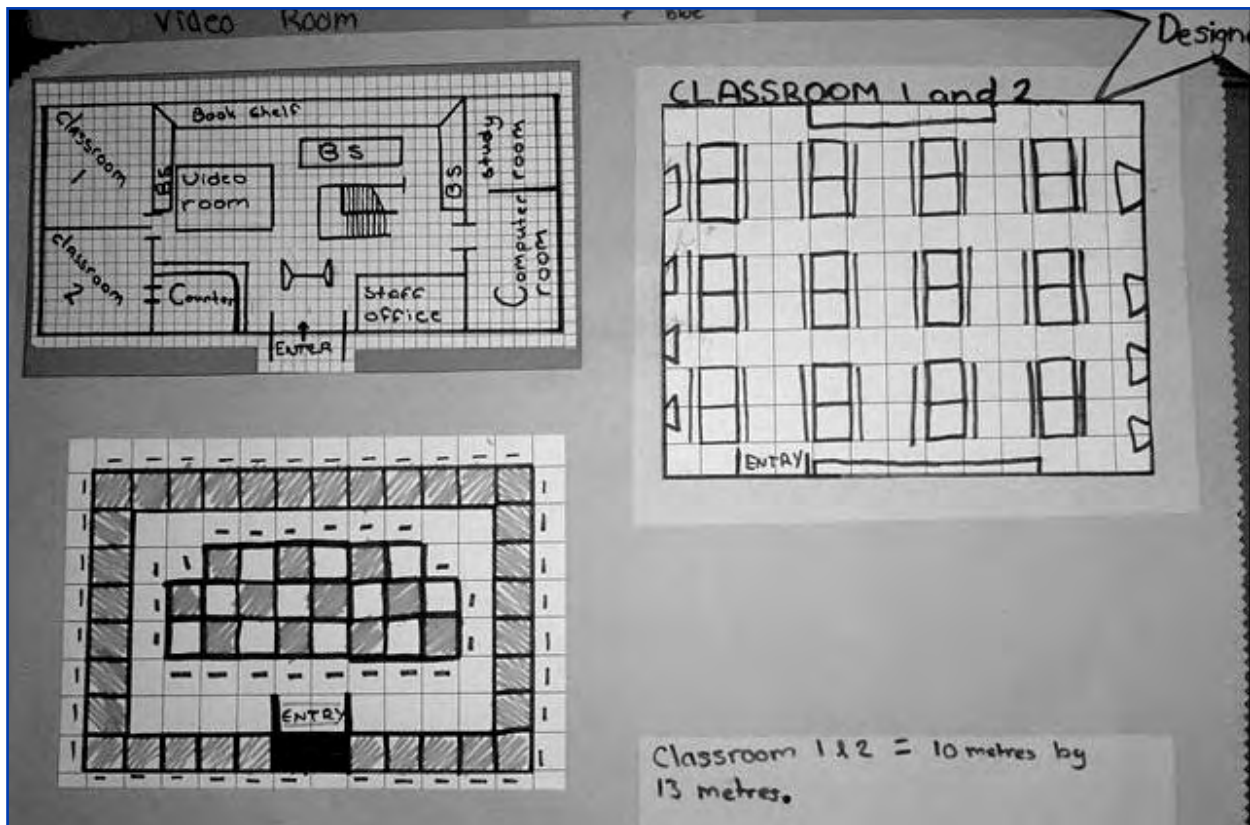

Figure 2. Planning team.

Figure 3. Part of one group's planning poster.

the production of floor plans to show where the equipment was to be positioned in the spaces provided. The students were assigned one of the roles and had to work collaboratively with the other group members to ensure each of the roles took into consideration decisions made by the whole group.

When implementing the Teaching for Understanding framework, Tina Blythe (2002) discussed student activity in terms of being 'all at sea' and 'back in port'. These were the principles used for the management of *The Library Renovations* unit. When, 'all at sea' students moved freely around the room. This enabled them to change from working individually to working with other members of the team, without direct instruction from the teacher. The students worked on their individual contributions to the final group project by searching on the internet for information, sketching plans, or developing their colour boards. During this time the teacher moved from table to table, checking on the work of each group, getting updates on the group's progress and giving guidance for the next stage of the project.

To support the students in developing the

mathematical skills required to complete the project it was necessary to have the students 'back in port' directed by the teacher. On these occasions all students worked on the same activities, developing process skills and an understanding of how these skills would contribute to their project. Instruction and activities explored calculation of the area of regular shapes, the relationship between area and perimeter, measurement of perimeter and lengths, applying ratio to maps and plans, and converting units of measurement.

Evaluation of the project

One outstanding feature of running this unit was the engagement of the students. This was noted by all teachers. Some students went to hardware stores and collected paint swatches. Carpet samples emerged and became part of the displays produced. Magazine articles and brochures from newspapers became a source of information for electrical equipment and furniture. The Dulux website was used to select colours, and online stores were accessed to determine the cost of many of the

items. It became obvious that the students felt the project was very much part of their lives and could see their place in contributing to the library design (see Figure 3). As a result of this enthusiasm, a number of students were selected to meet with the school architect and give him their ideas for the library. This not only gave voice to the students' ideas but also gave these students an opportunity to engage with a professional, to see how his job impacted on their daily lives, and to discuss the opportunities such a career has to offer. One aspect of the library designs the students were keen to impart was the need for comfortable furniture for them to be able to 'lounge about in' when reading.

Toward the end of the unit, for one teacher, it became difficult to get the students to finalise their projects. All the students had collected the information relevant to their particular role but the groups were having difficulty bringing it all together as a single piece of work. To facilitate this the students were instructed that the work had to be finished as the principal and other teachers from within the school were visiting the classroom to view their work. On the day, this particular class had not completed their projects. At the beginning of the lesson there was a great frenzy of activity and surprisingly all projects were completed and on the wall by the end of the lesson. Had this public display of their work not been organised, many of the projects may not have been completed.

Another important factor that arose from running the unit was that the teachers involved became aware that learning outcomes other than the ones targeted in the planning process were being facilitated by the activities of the unit. It became apparent through the assessment process that, initially, students' predictions of equipment requirements for the library and the space available were very low. It was difficult for them to visualise the amount of equipment needed for a classroom. It did, however, become obvious to them when they started to draw the plans that they had underestimated what they should include. The construction of the plans gave students concrete activities that led to an improved sense of spatial awareness and perspective. These were not targeted learning outcomes for the unit but important mathematical concepts

for students to understand.

This prompted the teachers to consider what Essential Learnings outcomes other than the ones targeted in the planning process could have been assessed throughout the unit. It was determined that the students' work applied not only to the Essential Learnings Communication key element outcome 'being numerate' but also to 'being literate', and 'being information literate' through the research and presentation of the information gathered. World Futures key element outcome 'designing and evaluating technological solutions' was another outcome evident in the decisions made by students, regarding the use of contemporary technologies in libraries.

Conclusion

The Library Renovations unit proved to be an exciting experience for teachers and students alike. The positioning of students' learning within experiences directly related to their lives provided learning outcomes across the curriculum through an engaging and motivating approach. The project enhanced the learning of mathematical concepts but it is important to note that the opportunity for the unit to assist in developing additional outcomes was extensive. Taking advantage of this aspect of such projects could facilitate collaborative planning and teaching opportunities that would deliver learning outcomes for a range of subject areas.

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