INCREASING LEVELS OF TECHNOLOGY USAGE IN THE MATHEMATICS DEPARTMENT AT ORMISTON COLLEGE

Ian Thomson

Ormiston College

This paper describes the process of planning to upgrade the use of technology in the mathematics department at Ormiston College. A variety of options were evaluated taking into account factors associated with finance, professional development, and pedagogy.

Experiences of others in the field were drawn upon to aid the decision-making process. Opinions found in contemporary mathematics education literature also proved to be helpful. After consideration, a compromise was selected that would provide a consistent level of access across the faculty for students and teachers. It was decided that a computer and a digital projector would be installed in each of the five mathematics classrooms. Increased student access to graphics calculators and other more advanced calculators would also be provided along with software that would allow the teacher to demonstrate the use of the calculators. Internet access would also be available to the teacher in the classroom. Resources would be made available to the teacher using an online portal. The resources would be directly related to the curriculum. Care was taken in the planning process to avoid overburdening the teachers with too much change whilst at the same time ensuring that the technology did not serve teacher directed methods only.

Background

There are many ways that the internet and other forms of technology can be integrated into contemporary secondary mathematics education and there are growing indications that mathematics teachers are generally supportive of the use of computer technology in the classroom (Forgassi, 2006, p.90). There are several key factors however, that determine whether computer use is encouraged or inhibited. For a successful outcome, mathematics teachers require sufficient access to hardware, adequate levels of technical support, quality software and appropriate professional development (Forgassi, 2006, p.90).

Ormiston College is a coeducational private school located between Brisbane and the Gold Coast in Queensland. The school has approximately 1250 students from reception to year 12. Ormiston is an example of a school that seeks to upgrade the use of technology in its teaching and learning programmes. In particular, the mathematics faculty at Ormiston devised a plan in late 2006 to integrate technology into the mathematics curriculum and everyday classroom practices. The mathematics team in the senior school (years 8 to 12) comprised of six teachers who taught mathematics exclusively and four teachers who taught mathematics along with other responsibilities (Year 12 Coordinator, Dean of Studies, Head of Technology, Year 8 Class Teacher).

The mathematics department at that time made limited use of technology. Graphics calculators were available for use in some Year 11 and 12 courses. Year 9 students received a timetabled spreadsheet lesson. Students of financial and applied mathematics courses in Years 11 and 12 had access to a computer room for one lesson a week. There were five rooms that were used predominantly for mathematics teaching. Two of these rooms had computers and digital projectors which were rarely used. A Classroom Management System had been installed on the school network but had been virtually unused.

There was, however, a clearly expressed desire to upgrade the use of technology in the school. The intention to make better use of technology was documented in the school's achievement plan for 2007. In keeping with this policy, the mathematics department had to carefully consider how to use technology more effectively.

Following discussions between the Head of Technology and the school administration, it became clear that the school was willing to make a significant investment in technology for teaching and learning. In my capacity as Head of Mathematics, I needed to assess the best configuration of technology for the mathematics department. Factors that needed to be taken into account in this situation included finances, the technology skill levels of teachers, and implications for pedagogy.

Drawing on the experience of others and ideas in mathematics education literature

In this planning stage, there was an opportunity to make use of the experience of others and to interpret theories from contemporary mathematics education literature. The approach taken by the Brewster Academy in New Hampshire involved substantial investment in hardware which was beyond the financial commitment that Ormiston College would have been prepared to make. The changes that were made at Brewster, however, were based upon two main principles, universal access and connectivity, and curricular embedding. Even with a less expensive solution, these principles were borne in mind.

It is important to consider the attitudes of teachers towards the use of technology and their skills in this area. Depending on the skills and attitudes of the staff involved, the technology may take on a variety of roles as outlined by Goos, Galbraith, Renshaw and Geiger (2006, p.307). The technology may be a master. This is an undesirable role which results from the technology being forced onto the staff. The technology may be a servant. In this role, the technology is embraced and used in an informed knowledgeable way. As a servant, however, the technology is used in ways that perpetuate existing ways of producing knowledge.

The technology may be a partner. In this role, the technology can be used to do more than transmit prescribed knowledge and procedures using a firmly teacher directed approach: the technology may be used, for example, as a means to explore conjectures. Finally, the teacher may use the technology as an extension of self. In this role, the technology becomes an integral part of the teacher's teaching style and complements high levels of pedagogical and mathematical skill.

Professional development would be a determining influence on the role that the new technology would take. As Goos et al. point out:

Introducing new mathematical and communication technologies into classrooms can change the ways that knowledge is produced. Implicit in these changes are a number of challenges for teachers, the most obvious of which involves becoming familiar with the technology itself.

Goos et al. (2006, p.318)

Apart from the challenge of using the new technology itself, the teacher may experience challenges related to teaching and learning methods. In a general sense, technology is being embedded into a human system. This can alter the behaviour of the system and new properties may emerge from the system. In the context of the mathematics classroom, these emergent properties arise through changes in the communication structure. The patterns of social interaction that exist in the classroom may be altered. This may lead to knowledge being produced in more student centred ways. It may also allow less vocal students the opportunity to contribute.

Identifying options

The mathematics department at Ormiston had a variety of affordable options to choose from in seeking to upgrade the use of technology. The deliberations above led to a more informed evaluation of these options. The options were outlined as follows:

Option 1:

- Computers and digital projectors would be installed in all five mathematics classrooms
- Teachers would have access to the internet and curriculum resources packaged together and available through an online portal.
- A tablet would be attached to each computer to allow teachers to write and draw freehand.
- Students would have access to graphics calculators and occasionally have individual access to a "ClassPad 300" calculator that not only operates as a graphics calculator but also incorporates a computer algebra system and an interactive geometry system.
- Teachers would be able to use a graphics calculator emulator that would display a working graphics calculator through the digital projector. Teachers would also have a geometry calculator emulator.

Option 2:

- As for option 1 above but in addition teachers would have eight computers in the classroom for student use.

Option 3:

- As for option 1 above but in addition an extra computer lab would be available to the maths department.

Evaluating the options

Each option was considered carefully and informal consultations took place with all the teachers individually. In considering these options, there was no doubt that Option 2 was very attractive. This option carried the opportunity for students to interact with computer technology in the classroom. With suitable classroom management methods, students would be able to share access by way of a rota system. This option would have been adaptable and lent itself to a more student centred approach to learning. This option however, required the highest level of change in practice from the teachers. The teachers

would have had to learn to use the new technology for themselves and they would also have to cope with significant changes in teaching methods.

The danger with Option 2 was that busy teachers would have found themselves hard pressed to take on multiple dimensions of professional development at the same time, and the computers would have been left idle. This would have engendered a negative perception of technology usage in the school community and would have been a waste of school resources. Any attempts to coerce the teachers into using the technology more fully would have led to a "technology as a master" situation. This option would have been too much too soon.

Option 1 would have involved the least amount of change for the teachers. Writing freehand on the tablet is straightforward. Accessing resources by way of a few clicks on the school website would also have been managed easily. The teachers were already used to working with graphics calculators and the use of the emulator would have made the task of instructing the students easier. For a relatively small amount of professional development, technology could have been introduced into the classroom that would engage the interest of the students and enhance the image of the department.

The danger with Option 1 is that it could have been used to perpetuate intense teacher directed methods. With technology being used as a servant of outmoded teaching methods, Option 1 could have become a serious "weapon of maths instruction". Care would have to be exercised in the way that this option was implemented to ensure that the students were meaningfully engaged. The students would have access to electronic technology that interfaces with the technology available to the teacher. This would allow scope for exploratory methods and collaborative inquiry to take place. If implemented appropriately, this option could have made technology a partner to teaching and learning.

Option 3 provided similar benefits and required similar care in implementation as Option 1. The only difference would have been that there would be increased access to computer laboratory time. This would mainly be given to financial and application mathematics classes to work on spreadsheets. This would not have involved any radical changes to teaching methods.

Taking into account the capacity of teachers to change methods and learn new technology, Option 3 appeared to be the best compromise. It provided the opportunity to move ahead with new technology and increase the amount of student interaction with technology without overburdening the teachers. This option was also perceived to be extensible. It had the potential to be a first step that could later lead to the implementation of Option 2 and possibly, in the fullness of time, a system along the lines of the School Design Model at Brewster Academy.

Ensuring access, connectivity and relevance to the curriculum

In the meantime, the main principles of the Brewster model (i.e. universal access and connectivity along with curricular embedding) were examined more closely in relation to technology development at Ormiston. Universal access would be addressed since the technology would be installed at a consistent level throughout the department and from the students perspective there would be equity. Connectivity could be achieved by making use of the Classroom Management System. Teachers and students would be able to access resources from this system in or out of the classroom. My previous experience with a Classroom Management System would be helpful here.

The CMS installed at Ormiston is called MOODLE (Modular Object-Oriented Dynamic Learning Environment). The experience of Oak Ridge High School with this software suggests that it enhances connectivity in the educational community and even includes parental access (Perkins and Pfaffman, 2006, p.35).

The second principle of the Brewster method is curricular embedding (Bain, 1996, p.5). Ormiston would do well to address this aspect also. If new technology is to be introduced then it must be relevant to the curriculum rather than an extra that is tacked on. The mathematics curriculum at Ormiston was being reviewed prior to the start of the 2007. Integrating technology into the curriculum could take place at the same time and ensure that the new technology was used in meaningful ways in relation to the curriculum.

Outcomes of the plan three years later

Three years later, the development of technology in the mathematics faculty at Ormiston College has proven to be a resounding success. The use of tablet technology in the classroom has become the norm. In addition, almost all of the mathematics staff members have taken advantage of a subsidised lease scheme to purchase their own tablet laptops so that they can prepare lessons from home. Microsoft OneNote has become the main software used by teachers in the classroom. The CMS is now used extensively by students and staff. Teachers regularly post resources onto the CMS including handwritten classroom notes. Student use of the CMS has risen dramatically. In 2009, ClassPad calculators were distributed to Year 10 students and these calculators are now the main calculator used by senior students. The focus of the department is now shifting towards finding ways to enhance pedagogy in a technology-rich environment.

References

Bain, A. (1996). The School Design Model at Brewster Academy: Technology Serving Teaching & Learning. *THE Journal, May 1996.*

Forgassi, H. (2006). Factors that Encourage or Inhibit Computer Use for Secondary Mathematics Teaching. *Journal of Computers in Mathematics and Science Teaching*, 25(1), p.77-93

Goos, M., Galbraith, P., Renshaw, P. and Geiger,V. (2006). Reshaping Teacher and Student Roles in Technology-Enriched Classrooms. *Mathematics Education Research Journal*, 12(3).

Perkins, M. and Pfaffman, J. (2006). Using a Course Management System to Improve Classroom Communication. *The Science Teacher*, 73(7), p. 33-37