Secondary Teachers’ Use of Technology for Teaching Mathematics

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Abstract
In Victoria the use of technology in mathematics is strongly encouraged for years 7-10 (VCAA, 2008) and expected at year 11 and 12 (access to technology is assumed for some final secondary school assessment tasks, including examinations (VCAA, 2010)). The curriculum advice for teachers incorporates statements about use of technology for students’ learning of mathematics. This paper reports on responses of 92 secondary mathematics teachers from Victoria to a survey probing three issues: the mathematics software these teachers were using; the purpose of use; and teachers’ concerns related to using technology for teaching mathematics. Survey responses indicated that teachers made most use of technology with senior secondary classes and the use of graphing and spreadsheets or tables was dominant. Although the use of technology for mathematics is an accepted part of school culture in Victoria, and encouraged through curriculum documents, it seems the focus is still on functional opportunities afforded through efficient computation. A minority of teachers expressed concerns regarding time and access constraints. The findings in this Victorian study add to the evolving picture of the use of technology in Australasian secondary mathematics classrooms through providing extra details related to year level and purpose.

Information and communication technology, be it hand-held, lap-top or desk-top is an integral part of life in the 21st century. The place of such technologies in teaching secondary school mathematics has been widely discussed (for recent overviews see for example Heid & Blume, 2008a, 2008b; Thomas & Chinnappan, 2008; Goos et al, 2010). There is general agreement that technology may be used to advantage functionally (to do maths) and pedagogically (to support teaching and learning) (Pierce & Stacey, 2010). However the degree to which teachers use technology is varied even when there is institutional or systemic support. It is therefore important to monitor its use in classrooms over time.

Victorian mathematics curriculum documents have suggested incorporation of technology for more than two decades (see for example, Ministry of Education, Victoria, 1988) and graphics calculators have been allowed in year 12 examinations since the late nineties (Leigh-Lancaster, 2002). From 2001 there has been a phased introduction of Computer Algebra Systems (CAS) into VCE mathematics (see for example, Norton, Leigh-Lancaster, Jones & Evans, 2007) and increased teacher access to laptop computers. The phased systemic introduction of CAS into VCE mathematics from 2001-2009 indicates that schools will be expected to include sophisticated technology in mathematics teaching and learning.

In this paper we report on one section of the results from a 2007 study investigating Victorian secondary teachers’ use of technology for teaching mathematics. Results from the second section of this study, which probed teachers’ perceptions regarding
teaching mathematics with technology, are reported in detail in Pierce and Ball (2009). The snapshot of technology use reported in this study adds to our picture of the use of technology in Australasian secondary mathematics classrooms.

The following sections comprise a review of literature reporting five recent survey studies conducted in Australasia, a description of the study conducted using the Mathematics with Technology Usage Survey (MTUS), an outline of the results and finally discussion of the implications of these findings.

**Australian and New Zealand survey studies**

We have chosen to focus on Australasian studies here to place this current study in the context of recent findings on technology use in mathematics in Australasia. Five key survey studies on the use of technology in teaching mathematics conducted between 1995 and 2006 have been reported in the literature.

From Victoria, Tobin, Routitsky and Jones, (1999) report a study of over 1000 teachers’ use of graphics calculators andForgasz and Prince (2001) considered the computer software used by 80 year 7-10 mathematics teachers. Thomas (2006) reported on two studies conducted in New Zealand in 1995 (339 teachers) and 2005 (465 teachers). These studies included investigation of the purposes for which teachers chose to use technology. Goos and Bennison (2006) reported on 485 teachers in Queensland, using calculators or computers with students from years 7 to 12. Their study included the type of software used and the purpose for this use. From New South Wales, Hudson, Porter and Nelson (2008a) investigated the use of technology by 114 year 7-12 mathematics teachers.

Although each study is different the reports all provide background on the place for, and proposed value of, using technology software for teaching and learning mathematics. Common emerging themes from across the studies were that a majority of teachers expected the use of technology to enhance students’ enjoyment of, or engagement with, mathematics but fewer teachers were confident that this will lead to students’ improved understanding. The positive perceptions were not without qualification. Tobin et al found teachers’ perceived value of calculators to be directly linked to level of access available to both teachers and students. Those with easy and ongoing access held more positive views. Tobin et al also reported that, even if teachers and students had ready access to calculators, teachers found the usefulness of such technology was not intrinsic, but dependent on effective teaching.

Forgasz and Prince’s study found a lower percentage of teachers with positive perceptions of the role of technology in teaching mathematics than was reported in the other 4 studies. These teachers’ responses may have been coloured by a difficulty with accessing computers, or by the fact that their responses were focused on year 7 to 10 and did not include senior classes. Only 80% of Forgasz and Prince’s responding teachers had used one or more pieces of software for teaching mathematics.

Thomas (2006) reported that in 1995 67.2%, and in 2005 68.4% of responding teachers said they used computers in their mathematics teaching. Thirty-two percent of the New Zealand teachers surveyed noted that using technology made working quicker and more efficient but only 8% believed that it aided understanding and 16% actually claimed that its use impeded learning and understanding. When Goos and Bennison (2006) analysed the responses from their Queensland teachers, they found a positive association between how often technology was used and the teachers'
perceptions that technology “helps students understand concepts”; “makes sophisticated concepts accessible”; and “helps students to explore unfamiliar problems” (p. 11). Hudson et al (2008a) reported that 85% of their New South Wales respondents thought that “The use of computer software can make understanding clearer through graphs, presentations and simulations”. This was a high percentage considering only 76% of respondents indicated that they used computers in their teaching.

Technology software used
Across the studies listed above those which reported on the particular use being made of technology noted statistics and graphical work as the curriculum areas where secondary teachers indicated that they made most use of technology. Spreadsheets clearly stood out as the most popular software used with computers (Forgasz and Prince, 2001) followed by graphing software (Thomas, 2006). In the study by Thomas (2006) the percentage of teachers using technology for either statistics or graphical work was more than twice the percentage using it in other curriculum areas such as algebra, geometry, trigonometry or calculus. Little detail is provided specifically about the choice of particular software applications used on calculators, however it was reported by Goos and Bennison (2006) that graphics calculators were used for graphs, calculus and statistics (Queensland Mathematics B and C). Teachers’ in the Goos and Bennison study suggested that they equally made use of technology for demonstrations and for student investigations so technology was used by both teachers and students for functional and pedagogical purposes.

Concerns expressed
Teachers expressed reservations about the expectation set by education authorities that technology should be used in their mathematics classes. Across all studies, the key areas of concern were access, cost, time and the need for professional development.

If students are expected to work with technology then access for all is essential for equity. Teachers’ and, particularly, students’ access to calculators or computers was a problem highlighted by Tobin et al in 1999. Ten years later access to hand held technology, namely calculators, has improved, but now more sophisticated hand held technology, with software offering more capabilities, is available at a further cost. In each of the other studies access to computers is noted as a problem. Typically, class access to computers requires booking a school computer laboratory and these are in high demand. Goos and Bennison report that “one third of teacher respondents stated that they could never or only rarely get access to computer laboratories for classes when they wanted to” (p.6). This has obvious consequences for usage of computer software in mathematics classes.

The time taken to learn to use technology as well as to learn mathematics is of concern to teachers. Tobin et al (1999) reported that teacher’s perceptions of the usefulness of technology were related to students’ level of access. This is in part because syntax and menu structures may be a distraction when students do not use a calculator or computer regularly enough so that such processes are automated. However Tobin et al report that even regular users did not necessarily find that the use of graphics calculators reduced the time required for teachers’ explanations (44.81% of those teachers reporting good access to graphics calculator indicated that this never or rarely reduced the time needed for explanations). This may be due to the relative novelty of graphics calculators for both teachers and students pre-1998 and hence the need to learn technical skills. Pierce (2002), who studied undergraduate students learning mathematics with CAS available, observed that
throughout the teaching of functions and calculus new technical skills were needed for each new topic, but the associated overheads of learning to use the technology progressively diminished over time.

Apart from Tobin et al, the other studies also reported teachers’ concerns over the time it takes students and teachers to learn to use the technology. Teachers were concerned that students would not have time to cover the course. Some teachers were also concerned by the time needed for professional development. In an additional paper, Hudson et al (2008b) reported 22% of teachers noting each of these concerns.

Technology available for use in school mathematics (both software and hardware) has been changing rapidly; so too are education policies regarding the use of such technology, especially in assessment. In Victoria a policy decision was taken to implement ‘technology active’ and ‘technology free’ Year 12 examinations (VCAA, 2010); this prompted a call for more professional development for teachers. Since Forgasz and Prince’s study was conducted prior to this policy change we decided to conduct a new survey (reported below and in Pierce & Ball, 2009).

The purpose of the MTUS reported in this paper was to take a ‘snapshot’ of the use of technology for teaching mathematics in Victorian secondary schools in 2007. With regard to teachers’ use of technology for teaching mathematics we wished to find the:

- software mathematics teachers chose to use
- purpose(s) for which the technology was used
- technology features that mathematics teachers value
- relationships between the above and teachers’ gender, location, years of teaching or year level taught

In addition to providing detail about the software being used and features which are valued, we also analyse whether technology is being used pedagogically (to support learning mathematics) or functionally (for finding answers); a distinction not made in the five studies reported earlier in this paper. In the surveys we asked teachers to think both generally about their perceptions regarding the use of technology (calculators or computers) for teaching mathematics (reported in Pierce and Ball, 2009) and quite specifically about the class, in the last year, where they made most use of technology. Some details of the MTUS are included and responses are given below.

**Methodology**

In our study data were sought from mathematics teachers at 200 secondary schools across the state of Victoria via email sent to each school’s mathematics coordinator. The details of the study were explained and mathematics teachers were invited to complete and return the survey. Respondents were asked to provide some basic demographic information regarding gender, years of teaching, geographical location and school system affiliation. The MTUS then asked teachers to answer a series of questions in relation to the class with which they had made *greatest use* of technology in the past year. In the MTUS the teachers were given a list of software and hardware commonly used in mathematics classes and asked to identify the technology they used and to indicate whether they used it for teaching or their students used it for ‘doing’ and/or ‘learning’ mathematics thus making the functional/pedagogical distinction discussed by Pierce and Stacey (2010).
The MTUS closed questions were followed by semi-structured items seeking information about: what teachers valued most about the technology they used; a lesson they had taught that made use of technology; and any other comments they wished to make.

For the purposes of data analysis ‘years of teaching’ was grouped to identify those who are likely to have trained since 2000 (Y<7), in an era when the use of graphics calculators in senior secondary mathematics has been assumed in this state; those who trained prior to 1980 before the advent of the ‘microcomputer’ (Y\geq27); and the middle group. Geographical locations were grouped as metropolitan (Greater Melbourne area) and non-metropolitan. School system affiliation was classified as Government and Non-Government. This distinction may be of importance because each is funded differently and accesses professional development in different ways.

Some exploratory data analysis was undertaken to look for patterns of responses and relationships between variables. This analysis was supported by results from the open response items.

**Results**

Ninety-two teachers responded to the survey from across the 200 schools contacted. To preserve anonymity teachers were not asked to disclose their name or their school; however we do know that the cohort who chose to respond to this survey was diverse in each of the demographics dimensions canvassed. The composition of this group is summarised in Table 1.

Non-government school teachers are slightly over represented but otherwise the numbers of teachers in each sub-category of the sample were reasonably reflective of the equivalent proportions in the population of mathematics teachers in Victoria. Accurate population data were not available however based on recent reports (Harris & Jenz, 2006; DEECD, 2007) it is estimated that two-thirds of mathematics teachers had more than 10 years experience; 60% of Victorian secondary teachers were female but more males tended to teach mathematics at senior level; 60% of Victorian secondary students attended government schools and 40% attended non-government schools; and finally, approximately 70% of the total Victorian population lived in the metropolitan area.

Data were self-reported by teachers and this may impact on results. The school context, in particular the extent of technology use by colleagues, may also impact on a teacher’s perception of their own use of technology. This study does not provide data on the broader context of each school.

| Table 1 |
| Percentage of teachers in key demographic dimensions. |
|---------|------------|------------|
| Gender  | Male 45    | Female 55  |
| School Type | Government 44 | Non-Government 56 |
| Location | Metropolitan 75 | Regional 25 |
| Likely trained since | Y<7 | Y \geq 27 |
|              | 7 \leq Y < 27 | Likely trained pre |
Class level at which respondents made most use of technology for teaching mathematics

Of the 92 teachers who responded, 82 provided information about the classes they were teaching in 2007: 34 taught a year 7 or 8 class, 47 a year 9 or 10 class and 53 a year 11 or 12 class. The bias towards teaching experience at years 11 and 12 was not surprising as the survey made first contact with mathematics coordinators and such teachers commonly teach senior classes. With regard to the year level at which teachers made most use of technology there was diversity. Technology use was strongest at year 11 or 12 and this is not surprising in a system where technology is assumed in senior assessment. Most respondents taught students at different year levels. Half of those teachers who taught a year 7 or 8 class and senior classes made most use of technology with a year 11 or 12 class and this result was similar for those who taught at the year 9 or 10 levels. Forty teachers said they taught at least one year 11 or 12 class and 35 teachers said they made most use of technology at this level i.e. if they had a class at this level then this was where most use was made of technology.

Technology software used

Teachers were asked to complete ‘tick the box’ items focused on software use in relation to the class with whom they made most use of technology. Individual teacher’s use varied from those who only used the CD that accompanied the set text book, or only used graphs or only spreadsheets, through to a few who made use of a wide range of software and hardware including the use of digital images and data loggers. The most popular technologies are listed in Table 2. Teachers were asked to rate their software use as “none”, “a little” or “a lot” against their intended purpose for this use: ‘teaching maths’; students ‘doing maths/finding answers’; or students ‘learning maths/exploring concepts’. In Table 2 dark shading is used to emphasise the software/purpose most commonly used ‘a lot’ and light shading indicates the next most common use.

It is clear from Table 2 that a ‘scientific calculator’ (calculator or computer hardware) is the technology used extensively across all year levels. This is followed by graphing software and then tables/spreadsheets. This result is different to the emphasis on spreadsheets reported in the five studies outlined above.

Other options for software, listed in the survey were: interactive simulations, micro-worlds, analyse digital images, analyse video, drill and practice and data logging. The data on the use of software from these categories is not included in Table 2 because little use was made of them for any purpose at any level. Approximately one third of teachers at each year level made ‘a little’ use of interactive simulations but this was the highest usage for these other software categories. There were no statistically significant differences in the use of the software categories omitted from Table 2 according to year level, gender, region or years of teaching.

Table 2
Most used software: by year level and purpose.

<table>
<thead>
<tr>
<th>Year 7 or 8 (n=14)</th>
<th>Year 9 or 10 (n=23)</th>
<th>Year 11 or 12 (n=37)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Pierce and Ball, 2009)
From the data in Table 2 it can be seen that the purpose for the use of technology software varies according to class level. While fewest teachers made use of technology with year 7 and 8, those who did made use of a range of software for a variety of purposes. These teachers may be seen as technology enthusiasts. The most common purpose was for students to make use of the software to ‘do mathematics’ i.e. functional use, making use of technology to ‘find answers’. At year 9 or 10 the primary use was, again, for students ‘doing’ mathematics. At year 11 or 12 the use of technology software was closely aligned to the VCE curriculum. Hence the lack of use of dynamic geometry and symbolic algebra; these were not permitted in examinations. The ‘purpose of us’ at this level was highest for teachers ‘teaching’, then students ‘doing’ and lastly for students ‘learning’.

Demographic associations with technology use
Cross tabulation of technology use responses (summarised in Table 2) against gender, region, system affiliation and years of teaching (summarised in Table 1) and Fisher’s Exact tests indicated statistically significant associations in three areas. These are detailed below (Fisher’s exact test was used because the assumptions of the more commonly used Chi-square test were violated. Due to a combination of the sample size and the distribution of the data, too many cells had very low expected frequencies.).

First, the results showed that in ‘metropolitan’ teachers’ classes technology was less likely to be used by students for ‘learning’ symbolic algebra than in ‘regional’ teachers’ classes. (Student learning: Fisher’s exact test statistic 7.235, p-value 0.028). This result was of interest because we had expected that relative ease of access to professional development in the metropolitan area would mean that a greater proportion of metropolitan teachers than regional teachers would be making use of technology for symbolic algebra. However this finding was not part of a pattern of results and so is not seen as being of practical importance.
Second, it is interesting to note that there is only one statistically significant association with gender. Fewer female teachers than expected reported use of technology for statistics, while more male teachers than expected reported making a lot of use of technology for statistics (Teaching: Fisher’s exact test statistic 8.426, p-value 0.017; Students doing: Fisher’s exact test statistic 6.625, p-value 0.039; Students learning: Fisher’s exact test statistic 9.110, p-value 0.010). While there was no obvious explanation for this finding in terms of the other data collected, this finding is noted for further investigation.

Third, the data indicates a statistical association between years of teaching and use of dynamic geometry environments. Teachers who have been teaching between 17 and 27 years – who probably trained during the 1980’s – are least likely to use dynamic geometry (Teaching: Fisher’s exact 12.057 p-value 0.028; Students doing: Fisher’s exact 13.521 p-value 0.012; Students’ learning: Fisher’s exact 13.123 p-value 0.015).

**Perceived value of technology software for students’ mathematical learning**

In relation to the class with whom they used most technology, teachers were asked to “List the three technologies/features/etc that you have found to be most valuable for this level and briefly explain why.” Table 3 provides a summary of these responses. Access to graphics calculators is assumed in most Victorian year 12 assessments tasks so it is not surprising that at year 11 or 12 the software most valued by teachers was that offered by graphics calculators: graphs, statistics and scientific calculations. At year 7 or 8 it seems that value was perceived in software, such as applets, that is likely to engage students through interactivity.
Table 3
*Software teachers found most valuable.*

<table>
<thead>
<tr>
<th>Software</th>
<th>Year 7&amp;8 (n=10)</th>
<th>Year 9&amp;10 (n=14)</th>
<th>Year 11&amp;12 (n=38)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spreadsheets/ tables</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>(Excel, GC, CAS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphs (GC, CAS,</td>
<td>0</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>Graphmatica)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistics (GC, Excel,</td>
<td>0</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>CAS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symbolic algebra</td>
<td>0</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific Calculator</td>
<td>3</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Geometry</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD accompanying textbook</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interactive white board</td>
<td>3</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning objects/Applets/ simulations</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill and practice</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other: programs,</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>data-logger, internet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Concerns expressed**

Key concerns, like those raised in the earlier studies discussed above, related to time taken to learn technical skills and cost. These issues were emphasised in the teachers’ ‘further comments’. Teachers’ noted four main issues: first the lack of access and cost of technology for their students (Figure 1: Teachers 3, 4, 5 & 10); second, the time required, in a rapidly changing environment, for both students and teachers to learn to use technologies effectively (Figure 1: Teachers 2, 5 & 10); third, students becoming over reliant on technology or using it in an unthinking manner (Figure 1: Teachers 4 & 8); and fourth, the relevance of the predominant calculator technologies for students’ future study or work (Figure 1: Teachers 6 & 7). This last concern is not mentioned in the other 5 studies and is worth consideration in future studies.

**Teachers 1 and 2 made most use of technology at year 7 & 8:**

*Teacher 1:* Every maths teacher should be demanding an IWB [interactive white board] in their classes. They are the most effective way I’ve seen to motivate kids to ‘have a go’ at the mathematics… Teaching Year 8’s is becoming fun using an IWB.  
*Teacher 2:* Interactive white board is brilliant for access to programs, but useless for usual written notes. Too much time required to type-up notes in advance.

**Teachers 3, 4 and 5 made most use of technology at year 9 & 10:**

*Teacher 3:* The main difficulty in using technology in schools is availability of computer rooms, technology reliability (server always down) and cost of software. Most would use more technology if it was more accessible and drama free.  
*Teacher 4:* The main difficulty I find with using technology in class is that students will use the computer or calculator but have not truly grasped the concept being taught. It is also difficult to afford a new set of CAS or TI83 calculators for each class. I am worried that students are too reliant on technology to work things out. Most of my students seem to have no idea when their answers are not correct- reasonable answers.  
[I am] worried CAS calculators are going to take the light bulb moment out of understanding linear equation steps etc.  
*Teacher 5:* Using technology is great. BUT it is getting access to the technology that is a major problem. The time it takes to write up the unit is another problem – e.g. a two period session can take 5-6 periods to write. You need to teach the kids the skills – it is assumed that kids have these skills.... Teachers do not have the skills –
where is the time for PD for this – we do not want to miss any VCE classes – are we to use our personal time again.

**Teachers 6 to 10 made most use of technology with year 11 & 12:**

**Teacher 6:** …[I have] spent many years in industry and business before transition to teaching. While much technology is great, eg, computers in general, scientific calculators, I am very cynical about the use of graphical/CAS calculators and the like, because I have NEVER seen them in use in the many places I have worked. Some of these have been quite technically oriented places.) From my perspective the skills developed using computers and simple and scientific calculators are valuable because of the ubiquitous nature of those tools, but the more advanced calculators require too much learning and have minimal relevance to the world outside school. Another concern I have with the use of technology is that it takes students in the opposite direction from that demanded by VCAA, which is the submission of most of their assessable work in handwritten form…

**Teacher 7:** I am very happy with the introduction of technology and really enjoy using it in the classroom and playing with it myself. I am also very interested in the CAS calculators and have enjoyed learning to use them. My major concern is the lack of communication between the school system and the universities. … Students adapt quickly to using technology when it is incorporated into the lessons. They enjoy learning about the different functions of their CAS calculators. Technology is an essential part of the secondary maths curriculum and should remain so. It should be viewed as a tool and used accordingly to enhance understanding and facilitate solution process.

**Teacher 8:** Too much calculator use at primary school. They should concentrate on making sure the students know the mathematics basics, and can do them mentally or by hand. Technology (specifically calculators) should not be introduced into the classroom until secondary school, where they can be used to build on a students’ knowledge, not be the basis of it.

**Teacher 9:** I find it sad that after 30 years as a maths teacher, I still hear the same, sad arguments trotted out against the use of modern technologies. Currently, there is the debate (?) on the use of CAS systems, particularly in Maths Methods. Any technology can be used poorly - that is not the point. We should concentrate on whether or not the technology can be used to improve student understanding. In the case of CAS, it is clear that many algebraic processes become clearer to students if they are not always spending large amounts of time and effort on the minutiae of a nasty expansion or simplification. Of course, they need to be able to perform these processes without a calculator, but shouldn’t have to always perform them…

**Teacher 10:** The use of IWB [interactive white board] has been invaluable. It is an excellent demonstration tool and the record and playback components mean that students can learn at their own pace.

... I believe there are ENORMOUS problems associated with technology in mathematics. Most of these problems come down to two issues, accessibility and experience. There exists an enormous disparity between schools in relation to accessibility to technology, … [some] teachers lack of experience, and subsequent confidence, means they are still very reluctant users of technology, which in turn means the students still have limited exposure. [Following some professional development] feedback from the teachers was extremely positive and some of the teachers now use the activities. This illustrates that such events can have a positive impact. …

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**Figure 1.** ‘Other comments’ from 10 teachers

**Discussion**

The MTUS items on use of technology target not only what software is used but whether the purpose of use is functional or pedagogical. Teachers are asked whether
the use is for teachers’ teaching, students’ doing or students’ learning mathematics. These items, along with others asking teachers about the class where they made most use of technology, give an alternative perspective to the 5 earlier studies. The MTUS data gives some impression of what ‘maximum’ use involves for a teacher in terms of year level, type of software used and the purpose for the technology use. It indicates that most use of technology is made in the senior secondary classes with focus on the calculation capabilities of technology to do mathematics. Few teachers make most use of technology with their junior classes but those who do are more likely to have students using technology for doing mathematics. These results are not surprising in terms of the teaching styles typically seen at these different year levels but they do suggest that teachers are not actualising many of the potential affordances of technology and not capitalising on the ability to use technology for pedagogical purposes.

Handheld technology today is more sophisticated than the available computer technology a few years ago. There has been a fast evolution of technology available in mathematics classrooms but there has been a slower evolution of pedagogical practices. This slow evolution of pedagogy is not necessarily negative as it takes time for teachers to develop personal philosophies about how best to teach mathematics in classrooms where technology is available.

Across all 6 studies, i.e. including the study reported in this paper, most use is made of graphing software (calculator or computer), spreadsheets and tables (often used for statistics). It is likely that this software dominates because it is available on both calculators and computers. In addition such software offers functional capabilities of speed and accuracy that are especially valued at the senior secondary level where the use of technology is greatest. This is especially so in locations such as Victoria where it is assumed that students will have access to graphics calculators for their senior secondary examinations and so teachers need to prepare students to make good use of technology for doing/solving mathematics problems. In addition the advent of graphics calculators makes a variety of features accessible in the secondary mathematics classrooms. This may also contribute to the move from spreadsheets as the main technology used in classes.

Across the year levels the most common use of technology is to do mathematics i.e. to access the functional capabilities of the software in order to perform harder, more complicated calculations quickly and correctly. Less emphasis is placed on accessing the pedagogical opportunities afforded. While most teachers in the current study recognised the potential of technology software to promote deeper learning, data related to their actual use of such technology suggests that software was not being purposefully used to this end.

In terms of teachers’ concerns two themes dominate across the studies: time constraints and access. Teachers are concerned about the time it takes them and their students to learn to use new technology. This problem is exacerbated when students do not have ready access to the technology so that they can practice basic usage. It is possible that access to hand held calculators with sophisticated features may work towards overcoming access difficulties. Using computer laboratories is problematic since there is competition for access and many teachers are concerned about the cost of handheld alternatives. While Forgasz (2006) raised issues of gender differences in the response of students to the use of computers in mathematics such concerns were not expressed in the teachers’ free responses to the MTUS but neither was there any item directly targeting this topic.
Conclusions
This study adds to our knowledge of teachers’ use of technology for teaching mathematics. Teachers who responded to this Victorian survey were generally positive about the use of technology for teaching mathematics. Greatest use of technology is being made in the senior years, with a focus on teaching and doing mathematics rather than students learning to use technology to support their own learning. A shift towards increased use of features other than spreadsheets suggests that hand held technology, which is increasingly available in Victorian schools may have impacted on the nature of technology use in classrooms. The impact of such changes on students’ solution strategies and understanding of mathematical concepts is an avenue for further research.

In this study, as in earlier studies, time and cost need to be addressed if the potential benefits of technology are to be realised. While the place of technology in the mathematics classroom is now accepted by school communities in Victoria the potential to use the software not only to do mathematics more efficiently but also to learn mathematics more effectively is still to be realised.

References


