GRAPHICS CALCULATORS IN VICTORIAN SECONDARY SCHOOLS: TEACHER PERCEPTIONS OF USE

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Since Victoria permitted the use of graphics calculators in final external examinations, their use has become quite widespread. A survey of secondary schools, undertaken to gauge the response of teachers to these tools, provides information on how teachers view graphics calculator use in secondary mathematics courses.

INTRODUCTION

As a follow-up to the decision in Victoria (Board of Studies, 1995) to remove the ban on graphics calculator use in Victorian secondary schools from 1997 in all external examinations, a statewide survey of schools was conducted in late 1997 to assess the impact of the decision on schools. The survey had two aims - the first to determine from school mathematics coordinators the level of ownership or access of calculators by students and the second to determine teacher attitudes and use of the calculators in various subjects or topics (Routitsky and Tobin, 1998; Routitsky, Tobin and Stephens, 1998). Information on effective use of graphics calculators in mathematics classes at all levels has generally been based on small group or case work previously and this was an opportunity to examine a larger group. A review of previous research on all aspects of teaching and learning with graphics calculators is provided by (Penglase and Arnold, 1996).

THE SURVEY

The survey was initially sent in September 1997 with two follow ups to non-responding schools, some by mail and others by telephone, in March 1998. The information discussed in this paper arose from the full survey data set. Some preliminary results on the earlier part of the survey have been presented elsewhere (Tobin, Routitsky and Jones, 1998).

The main target group of the survey was teachers of mathematics subjects in the Victorian Certificate of Education (VCE). This spans years 11 and 12 and includes the five subjects, Mathematical Methods 1 & 2, General Mathematics Units 1 & 2, Mathematical Methods Units 3 & 4, Further Mathematics Units 3 & 4 and Specialist Mathematics Units 3 & 4. It is only the unit 3 & 4 subjects which have external examinations affected by the new policy - these are ninety minute papers involving multiple choice, short answer and analysis tasks called Common Assessment Tasks or CATs.

The survey was sent to approximately 480 educational providers screened on the basis of whether they taught Mathematical Methods. The number of responses from school coordinators was high (about 73%). The brief Coordinator Questionnaire included information on school size (indirectly) calculator models, booklisting policies, class sets, student access and estimations of student calculator ownership. The focus of this questionnaire was depth of penetration of the graphics calculators in schools.

The more detailed teacher surveys were completed by over 1000 teachers, although not all teachers completed all sections. The focus of the teacher survey was on attitudes to the Board's calculator policy and attitudes to the graphics calculators themselves. This Teacher Survey enabled us to assess any variations in responses between school regions, types or sectors as information on these was gathered also. In Victoria there are seven educational

regions classified by the Ministry: Eastern Metropolitan, Western Metropolitan, Barwon South Western, Central Highland, Gippsland, Goulburn-North Eastern and Loddon-Campaspe-Mallee.

The four sectors were Government Secondary, Catholic, Independent and TAFE. The three types of educational providers classified were boys, girls and co-educational. Most respondents in the first group were schools - only two TAFE colleges out of a possible ten TAFE VCE providers gave any feedback.

RESULTS

The methodology of data collection and results of the survey relevant to market penetration of the graphics calculators and teacher perceptions of equity issues have been discussed in a previous paper (Routitsky and Tobin, 1998). In that paper, regional, sector and school type variations were examined. The paper raised the issue of teacher support for the decision to use graphics calculators and found that there was broad agreement for the policy across all sectors, regions and school types. This support level ranged from 64% to 70%, depending on the VCE subject, and this occurred, despite there being a similarly common perception (about 73% of respondents) that the use of calculators raised serious equity issues in terms of student access.

Taking up this theme, Routitsky, Tobin and Stephens (1998) analysed further the data on teachers who disagreed with the Board's policy. The purpose of this investigation was to determine if this were linked to their personal level of access to graphics calculators, or whether it related to the level of access which their students had, either through ownership or school access. The results of that analysis demonstrated, perhaps unsurprisingly, that teachers who disagreed with the Board policy tended to come from schools where they and/or their students had limited access to a graphics calculator. This is consistent with a previous study on teacher attitudes to use of graphics calculators in a college algebra course in the USA, where it was found that the only significant variable on level of teacher support was degree of familiarity of the user (Chamblee, 1995). Reduced familiarity is an immediate consequence of limited access.

The issue of teacher perceptions of the usefulness of the calculator in teaching mathematics remains to be considered and in particular its relationship to calculator access.

Because information was gathered on both teacher and student access to graphics calculators, for the purpose of this study it was found useful to create a single three level access variable which classifies access as poor, basic or good. This required recoding of the data as shown in the appendix and was justified on the basis of the strong correlation between the teacher access and their students access (see Table 1).

Table 1
Cross Tabulation of Student and Teacher Access to Graphics Calculators

	Students can use graphics calculators in class			
Teacher can use graphics calculators in class	Never / rarely	Sometimes	Often / always	Total
Never / rarely	47	8	0	55
Sometimes	15	42	8	65
Often / always	139	75	591	805
Total	201	125	599	925

The data reported in the following tables looks at teachers responses to several statements related to the graphics calculator and teaching mathematics.

The Graphics Calculator is Useful in your Teaching

The first aspect examined was on usefulness of graphics calculators in teaching. The exact statement is given following and teachers rated a level of agreement with the statement. Results are shown in Table 2.

Table 2
Perception on Whether the Graphics Calculator is Useful in the Classroom

	Graphics Calculator Access in the Classroom % (count)			
	Poor	Basic	Good	Total
Never/rarely	22.49 (74)	10.86 (24)	6.79 (25)	13.40 (123)
Sometimes	38.91 (128)	35.75 (79)	26.90 (99)	33.33 (306)
Often/always	38.60 (127)	53.39 (118)	66.30 (244)	53.27 (489)
Total	100 (329)	100 (221)	100 (368)	100 (918)

The table shows a statistically significant relationship between perception of usefulness and access; the greater the access level, the greater the perception of usefulness.

The next statement examined the time factors associated with calculator use and the statement is given following. Results are given in Table 3.

Teaching with graphics calculators reduces the time needed for explanation

Again a statistically significant relationship was found between perception of time needed for explanation and access with time saving being seen as more common as the access level increased.

Table 3
Perception on Whether the Calculator Reduces the Time Needed for Explanation

	Graphics Calculator Access in the Classroom % (count)			
	Poor	Basic	Good	Total
Never/rarely	57.49 (188)	49.54 (108)	44.81 (164)	50.49 (460)
Sometimes	24.77 (81)	27.52 (60)	27.60 (101)	26.56 (242)
Often/always	17.73 (58)	22.94 (50)	27.60 (101)	22.94 (209)
Total	100 (327)	100 (218)	100 (366)	100 (911)

Teaching with graphics calculators makes learning mathematics easier for students

In the next statement we look at whether the calculators ease the learning process. A previously the actual statement given to teachers is supplied here. This is based on teacher perception not student perception and results are in Table 4.

Table 4
Perception on Whether the Calculator Makes Learning Easier

	Graphics Calculator Access in the Classroom % (count)			
	Poor	Basic	Good	Total
Never/rarely	34.76 (114)	22.37 (49)	16.89 (62)	24.62 (225)
Sometimes	35.98 (118)	36.99 (81)	34.60 (127)	35.67 (326)
Often/always	29.27 (96)	40.64 (89)	48.50 (178)	39.72 (363)
Total	100 (328)	100 (219)	100 (367)	100 (914)

The table shows a statistically significant relationship between perception of easing learning and access. For teachers with good or basic access, the belief that graphics calculators makes learning easier is much stronger. For those with poor access opinion is more divided.

Graphics Calculators Improve Students' Understanding of Mathematics

One aspect of interest is the quality of the learning. Teachers were asked to rate the graphics calculator's ability to improve students understanding. The actual statement is supplied.

Results are shown in Table 5. There is a statistically significant relationship between a belief that the graphics calculators aid understanding and access. The results show that teachers are very divided on the issue of whether graphics calculators improve understanding. This division occurs particularly in the lower access groups with the poor access group having the most negative perception. The 'good' access group shows a strong degree of support for calculators aiding in understanding.

Table 5
Perception on Whether the Calculator Improves Understanding

	Graphics Calculator Access in the Classroom % (count)			
	Poor	Basic	Good	Total
Never/rarely	39.51 (130)	26.82 (59)	19.89 (73)	28.60 (262)
Sometimes	32.22 (106)	39.09 (86)	37.60 (138)	36.03 (330)
Often/always	28.27 (93)	34.09 (75)	42.51 (156)	35.37 (324)
Total	100 (329)	100 (220)	100 (367)	100 (916)

Usefulness of Graphics Calculators in Your Lessons Depends on Your Teaching Style

The final aspect of teaching and learning was a personal one - the interaction between teaching style and the use of calculators. This was not a result which appeared to be dependent on access. Results are in Table 6.

Table 6
Perception of Dependence of Use on Style

	% (count)
Never/rarely	15.97 (165)
Sometimes	29.82 (308)
Often/always	54.21 (560)
Total	100 (1033)

Over all groups, the teachers showed a similar belief in the usefulness of calculators depending on teacher style. The statement implies that usefulness is not intrinsic and suggests a recognition of the possibility that more could be gained from the calculators by some teaching approaches.

CONCLUSION

The results of the analysis shows that teacher perceptions of usefulness of the graphics calculators generally depends on the level of access to the calculators which occurs in the classrooms. The 'good' group represent the presumed optimal classroom situation with everyday student/teacher access to a graphics calculators and, in this 'expert' group, the

perception that the graphics calculators improves understanding and makes the work easier is quite striking.

However, the degree to which access affects perceptions varies with the aspect of teaching under discussion however and even the regular users (the good access group) found that the calculators do not seem to save time in explanations. This may be partly due to the grafting of the graphics calculator use onto an existing syllabus instead of creating a syllabus which anticipates their use. For example, it is easy to imagine that using a calculator to perform log/antilog calculations might still have been time consuming although it was unnecessary.

Finally, theresults reflect views of student learning filtered through teachers perceptions as the survey only went to teachers themselves and teachers may have different views from the students. For comparison, student views on learning wereanalysed directly in a small survey of fifty students selected at random in a UK undergraduate course (Zand and Crowe, 1997) conducted by distance education. In this survey, 45% of the group claimed graphics calculators contributed to understanding to a 'large extent' and 27% to a 'reasonable extent'. These results compare well with the views of the teachers in our own 'good' access group on the issue of understanding where 42.5% said this always or often occurred with their students.

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APPENDIX

Data Recoding

in cases where both students and teachers can always use graphics calculators in the classroom the access level is defined as **good**. In the survey 370 of 925 cases (40%) were in this group. Where students often have access to classroom use and teachers often or always do too or students always have access and teachers often or sometimes do the access level is rated as **basic**. This group included 222 respondents (24%). All other cases are considered **poor** in this discussion.

In some survey forms some lack of completeness means that there are minor fluctuations in the actual case numbers. In addition a large number of respondents did not complete most or any of this section.