EQUITY, MATHEMATICS LEARNING AND COMPUTERS: WHO GETS A FAIR DEAL IN AUSTRALIAN SECONDARY SCHOOLS?

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Findings from a survey administered to large numbers of grade 7-10 students are presented in this paper. The focus is on the students' attitudes towards the use of computers for the learning of mathematics. Background information was also gathered which allowed the students' responses to be analysed by a range of equity factors – gender, ethnicity, socio-economic background – and by several other school-related factors. The results indicate that gender was the only equity variable on which significant differences were found. Grade level and type of computer used in class were the other variables for which significant differences were noted.

BACKGROUND

Contemporary mathematics curricula in many nations now include statements about the benefits to students' learning outcomes of using technology for mathematics learning (e.g., NCTM, 2000). Such statements do not appear to be backed by strong research evidence. Equity dimensions – gender, socio-economic factors, and ethnicity/race – also appear largely to have been ignored in this context.

Historically, both mathematics and computing have been considered the domain of white, privileged, males (Forgasz, 2002a). In recent decades, this view about mathematics has been challenged with some degree of success (Leder, Forgasz, & Solar, 1996). Yet, more males than females are enrolled in the most challenging mathematics and computing courses and related careers. Recent evidence reveals that differences in beliefs and attitudes and gaps in mathematics achievement favouring males have closed and, in some cases, reversed (Forgasz, 2001). As computers become more common in mathematics classrooms, it is important to monitor students' and teachers' beliefs about the effects that the technology has on mathematics learning, and to explore whether there are differences in these beliefs among groups of students representing a range of equity dimensions.

In the study reported here, a survey questionnaire was administered to a large sample of students in grades 7-10; a different version of the questionnaire was administered to their teachers. A collection of eight items with 5-point Likert-type response formats tapped students' beliefs about computers for the learning of mathematics. Analyses revealed that six of these items reliably formed a scale. Scale scores were found and examined by a number of school-related and equity factors. The findings and their implications are discussed in this paper.

SAMPLE AND INSTRUMENT

The total sample comprised 2140 grade 7-10 students from 28 schools representing the three Australian educational sectors; there were 18 government, 4 Catholic, and 6

Independent schools. Of the 28 schools, 8 were located in high, 15 in medium, and 5 in low socio-economic areas[1]. In Table 1 the characteristics of the students are shown.

Table 1. Characteristics of the 2140 grade 7-10 students

	Grade 7–10 students (N=2140)			
Gender	**Male** 1112 (48%)		**Female** 1015 (52%)	
English/Non-English speaking background [ESB/NESB]	**ESB** 1643 (77%)		**NESB** 491 (23%)	
Aboriginal /non-aboriginal [ATSI/non-ATSI]	**ATSI** 42 (2%)		**non-ATSI** 2079 (98%)	
Born in Australia or elsewhere	**Australian-born** 1886 (88%)		**Born elsewhere** 251 (12%)	
Student socio-economic status [high/medium/ low]	**High** 500 (24.2%)	**Medium** 1185 (57.4%)	**Low** 381 (18.4%)	
Grade level	**Gr 7** 558 (26.1%)	**Gr 8** 538 (25.1%)	**Gr 9** 522 (24.4%)	**Gr 10** 522 (24.4%)

The survey instrument that was used has been described more fully elsewhere (see Forgasz, 2002b). For the eight *Computers for learning mathematics* items (see Table 2) that are of interest here, a 5-point Likert-type response format, Strongly Disagree (SD) – Strongly Agree (SA), was used. It was hypothesised that the 8 items would form a single subscale. Subsequent reliability and factor analyses revealed that 3 items had to be reverse scored shown with [R] on Table 2. Following the reverse-scoring, further reliability and factor analyses indicated that only six items could be used to form a scale. The two items that were rejected (Items 3 and 7) are shown with an asterisk on Table 2. With a six-item scale, the range of possible scores was from 6 to 30 (mid-value is 18).

Table 2.The 8 Computers for learning mathematics items

1	I enjoy using computers to learn mathematics	5	My parents encourage me to use computers for mathematics
2.	*My teacher is excited about using computers for mathematics*	6[R]	I find it frustrating to use computers for learning mathematics
*3 [R]	I prefer solving mathematics problems without a computer	*7[R]	People who like using computers for mathematics are 'nerds'
4	Using computers helps me learn mathematics better	8.	I feel confident doing mathematics on the computer

[1] The Australian Bureau of Statistics [ABS] provides an index of socio-economic categories – high, medium, and low – based on area postcodes (zip codes). In the survey questionnaires used in this study, data on school location postcodes and students' home postcodes were gathered.

RESULTS

The mean score on the *Computers for learning mathematics* scale for the cohort of 2140 students was 18.77 (sd = 4.18). As appropriate, independent groups t-tests or ANOVAs were used to explore for statistically significant differences by the range of equity related factors shown in Table 1 and several school-related factors. The mean scale scores, levels of statistical significance, and appropriate effect size measures resulting from these analyses are shown in Table 3.

Table 3.Means and p-levels for independent groups t-tests and ANOVA analyses on the *Computers for learning mathematics* scale by various equity factors.

FACTOR		**MEAN**	**Stat. sig. & p-level**
T-tests			
Gender	M	19.25	t=-5.69, p<.001 ES (Cohen's d) = 0.251
	F	18.21	
English/Non-English speaking background [ESB/NESB]	ESB	19.05	ns
	NESB	18.68	
Aboriginal /non-aboriginal [ATSI/non-ATSI]	ATSI	19.39	ns
	non-ATSI	18.75	
Born in Australia or elsewhere	Australia	18.72	ns
	Elsewhere	19.10	
School location: [metropolitan/non-metropolitan]	Metropolitan	18.83	ns
	non-metropolitan	18.68	
School location: [urban/country]	urban	18.78	ns
	rural	18.74	
Computers used [Laptop/Desktops]	laptop	18.06	t=-2.46, p<.05 ES (Cohen's d) = .187
	desktop	18.84	
ANOVAs			
Student socio-economic status [high/medium/ low]	High	18.74	ns
	Medium	18.88	
	Low	18.65	
School socio-economic location [high/medium/ low]	High	18.72	ns
	Medium	18.69	
	Low	19.03	
School type: [Government/Catholic/Independent]	Government	18.90	ns
	Catholic	18.34	
	Independent	18.71	
Grade level [7, 8, 9, 10]	7	19.28	F=17.22, p<.001 ES (η_p^2) = .024
	8	19.45	
	9	18.48	
	10	17.81	

The results in Table 3 reveal that none of the socio-economic variables, the ethnicity variables or the school-related location variables appeared to produce statistically significant differences in the mean scores on the *Computers for learning mathematics* scale among group members. Although the effect is small, student gender was the only equity factor on which statistically significant differences were found. The mean score for males was higher than for females, indicating that the males were more positive about the use of computers for mathematics learning.

Even though the sample size differed greatly, and the effect is small, it was interesting to note that students who use laptop computers were less positive about using computers for learning mathematics than were desktop computer users. The results also revealed small but statistically significant differences in attitudes by the grade level of respondents. The attitudes of students in grades 9 and 10 were less positive than those of the younger students.

Space constraints preclude a detailed discussion of the analyses by individual item which did produce some interesting patterns. A summary of the findings follows:

- By gender, it was found that males scored higher on average on each of the six items comprising the *Computers for learning mathematics* scale, with statistically significant differences noted on all items except Item 2 (*My teacher is excited about using computers for mathematics*).
- By computer type used, laptop users scored lower than desktop users for all items except Item 5 (*My parents encourage me to use computers for mathematics*). Significant differences in mean scores were found on only two items: Item 4 (Using computers helps me learn mathematics better) and Item 6 (I find it frustrating to use computers for learning mathematics – reverse scored item). In other words, laptop users agreed less that computers help them learn mathematics better, and agreed more that they found it frustrating to use the computers.
- By grade level, the grades 7 and 8 students scored higher than the grades 9 and 10 students on all items and for all items the mean scores were significantly different by grade level except for Item 5 (*My parents encourage me to use computers for mathematics*).

CONCLUSION

Close examination of the six items comprising the *Computers for learning mathematics* scale reveals wording that reflect a very personal dimension, that is, students had to respond about themselves or their own experiences. With respect to the equity dimensions explored, statistically significant differences were only found by gender, with males holding more positive views about learning mathematics with computers. There were no significant differences by a range of socio-economic and ethnicity measures. Significant differences were also found by student age and by computer type used in schools; more negative views were held by older students and laptop users respectively. The findings raise important questions that invite further investigation. Are the results context bound? If so, what were the Australian societal and/or school-based factors that appeared to neutralise the expected impact of socio-economic and ethnic factors with respect to students' responses about technology and mathematics learning encapsulated in the *Computers for learning mathematics* scale?

Unlike many other educational innovations, technology is here to stay. Pressures to incorporate graphics and CAS calculators and computers into mathematics classrooms at all levels is unlikely to abate. It is therefore imperative that decisions about the use of these technologies is based on sound research evidence. We cannot allow equity considerations to be ignored.

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