

Are Learning Technologies making a Difference? A Longitudinal Perspective of Attitudes

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The call for quality research into the effectiveness of learning technologies is a common feature in much of the related literature and the broad question of how schools use technology to transform and improve the quality of student learning is one main area of concern. Projects like DECStech have flagged the need for research into student learning outcomes and the changes “attributable to the use of learning technologies across the full spectrum of learning areas” (DETE, 1999, p.22). This three-year study involves nine schools that received support to embed ICTs throughout mainstream curricula and affords a unique opportunity to measure change. The resulting study designed and used an online survey to measure change in student attitudinal outcomes. This paper summarises the longitudinal study and presents some preliminary findings.

ICT, learning technologies, student attitudes, longitudinal study, middle school

INTRODUCTION

Learning technologies, or more recently termed, information and communication technologies (ICTs), have become a major focus of state and national efforts to improve student educational outcomes. Around Australia, millions of dollars have been channelled towards the integration of technology into school curricula. South Australia is no exception.

The use of learning and information technologies has the potential to enhance learning for all students in our schools. In recognition of this, the South Australian government established the \$85.6 million DECStech 2001 Project aimed at ensuring that by the year 2001 technology ... is able to be an embedded, integrated part of learning activities, and technological applications will be, at all levels, curriculum driven. (DETE, 1999, p.1)

The call for quality research into the effectiveness of learning technologies is a common feature in much of the related literature (Cuttance, 2001). Kilvert (1997) highlighted this need in his paper discussing research issues facing Australian schools in the next ten years. The broad question of how schools use technology to transform and improve the quality of student learning was one such concern. The DECStech 2001 Project held a similar concern, and as one of its main objectives, flagged the need for research into student learning outcomes and the changes “attributable to the use of learning technologies across the full spectrum of learning areas” (DETE, 1999, p.22). As the cornerstone of this three-year project, a network of nine focus schools was given support to embed ICTs throughout mainstream curricula and afforded a unique opportunity to measure change.

In response to the need for quality research examining the impact of ICTs on student learning outcomes, collaboration between the Flinders University School of Education and the Learning Technologies Project resulted in the development of an online survey designed to measure change

in student outcomes at the focus schools. This paper summarises the attitudinal component of the longitudinal study and presents preliminary findings.

A LONGITUDINAL DESIGN

The design of this study was mainly shaped by two areas of need raised in the *DECStech* Report (DETE, 1999). The first was in response to one of the project's objectives, to measure changes in student learning outcomes attributable to the use of learning technologies, and the second was in recognition of the need for longitudinal research, as highlighted in the report, under directions for research:

... what is now required is a longitudinal study to establish structures and processes through which clear and useful advice and support relating to curriculum applications of learning technologies can be provided to department schools. (DETE, 1999, p.15)

The major school-based impetus for the *DECStech* Learning Technologies Project involved six Adelaide metropolitan public schools (four Primary and two Secondary schools), known as *Discovery Schools*, and three South Australian rural schools (two Primary schools and a R-12 Area school), called the *Global Discovery Schools*. The Project spanned a three-year period between 1999 and 2001, during which time the Discovery and Global Discovery schools were intensively involved in a process of development and change. The first year was an establishment year where the Discovery and Global Discovery schools identified their needs, planned and initiated strategies to build curriculum more widely enriched by ICTs. Over the following two years, students and teachers continued to experience changes in the learning environment as ICTs were increasingly embedded throughout the curriculum, with the objective of increasing students learning outcomes. Clearly, the *DECStech* Project offered a unique opportunity to measure change and a longitudinal study was considered the most appropriate method.

Student Learning Outcomes

Improving student learning outcomes clearly goes beyond merely increasing academic achievement. In Australia, many reports (DETE, 1999; Moran, Thompson, and Arthur, 1999; Education Victoria 1998) foresee opportunities for learning technologies to:

- increase and change the methods students interact and collaborate with each other and their teachers;
- support students' growth in independence along with an increase in the range, depth, the complexity and the originality of the thinking and production;
- allow students to take greater responsibility for their learning in classrooms that are more student centred and student controlled;
- allow students to participate in a more varied range of learning activities matched to their individual needs, interests and capabilities; and
- support students in acquiring knowledge, skills and attitudes which will be essential for a successful and fulfilling life in a digital community.

A United States study, based on 176 research reviews and reports (IESD, 1999), provides compelling evidence that technology, combined with good teaching practice, can:

- have a significant, positive effect on student achievement in all major curriculum areas;
- have positive effects on student attitude towards learning and self-concept; and

- encourage equality for students of different socio-economic background when used in the classroom, reducing the divide between the ‘haves’ and the ‘have nots’.

The integration of technology into a classroom changes the learning environment – what is being learned, why and how it is learned, the role of the teacher, social interaction, and more. It also changes how people think about technology, and how they think about themselves, learning and the school environment. Much of the research into the effects of ICTs recognises that student learning outcomes encompass the growth of the person and not just their performance. One method commonly used in longitudinal research to measure personal development is through the use of attitudinal questionnaires and it is the main tool adopted in this study.

The Attitudinal Surveys

Three well-known attitude scales were chosen that specifically address students’ attitudes towards school (Keeves 1974), self-esteem (Coopersmith, 1986), and the use of computers in learning (Jones and Clarke, 1994). These scales require students to respond to statements using a three-point or five-point Likert scale. The Likert Scale is used because it is easy to administer and is generally considered to be the most useful type of attitude scale for use in a group-testing situation. Additional questions, compiled and constructed by the author, measure students’ computer skill, expertise and access. The resulting survey, comprising a total of some 155 items, including responses indicating gender, age and the language most commonly spoken at home, was conducted online on three occasions during the term of the Project. Reports describing the instruments and detailing results of the first two student surveys are available (Dix, 2000, 2001).

THE DISCOVERY AND GLOBAL DISCOVERY SCHOOLS

The nine schools, originally chosen from among many entrants for the DEC*Stech* Project, were selected on both the quality of their submission and because they represented a diverse spectrum of learning environments. The diversity of these environments requires the analysis to be sensitive to the classroom, school, Primary/Secondary and metro/country level. At the classroom level, the teacher provides the greatest influence and differences in the teacher’s approach are evident. Students reflect these differences when they attribute their success or failure in a subject to a particular teacher. School level differences are evidenced when a visitor observes a distinct culture unique to that school. Usually the Principal and other teachers of seniority have greatest influence in shaping the climate of the school since they are in the position of leadership and provide guidance to less experienced teachers. At the Primary/Secondary level, other influences emerge, stemming from the different structuring of Primary and Secondary schools in South Australia. And at the country/metro level, the influence of community and distance emerge. The schools involved represent both Primary/Secondary and country/metropolitan settings and, to optimise findings, should be analysed in context at the school and even classroom level (Archer, 1999; Rowe, 1996). However, such an in-depth analysis is beyond the scope of this paper and can not afford more than a brief demographic of each learning environment.

The Discovery Primary Schools

The first of the four Discovery Primary schools is located in the western suburbs. This large school of approximately 630 students, comprises separate Junior Primary (R-3) and Primary (4-7) schools managed by two Heads and under one principal. The school development priorities of ICTs and Literacy support their long-term objectives to develop cultures of effective communication, of local and global inquiry and of critical thinking and creativity. The school has been recognised in the educational community for its participation and success in educational reform with a strong tradition of using ICTs, and include being selected as an Apple Distinguished School and a Technology Focus School (1995-1998).

Further south, the second school has approximately 400 students from reception to Year 7. Although ICTs are a priority, full network and internet access was only recently made available in 2000, assisted by their selection as a Discovery School. The school has a computing suite of 17 multi-media stand-alone IBM computers along with one in each classroom. A number of Apple Laptops are available for staff and students to book.

The other two Primary schools are located in the northern suburbs and both cater for a diverse range of students from reception to Year 7. One school provides for approximately 380 students with a strong focus on developing an information literate community. Through learning teams, constructivist approaches to learning and curriculum integration of ICTs are supported. The other school consists of approximately 250 students and has been involved in the disadvantaged Schools Program. Their main priority, to increase student directed curriculum, is supported by their focus and development in ICTs.

The Discovery Secondary Schools

The first of the two Secondary schools, located in the western suburbs, provides for a diverse range of approximately 700 students from Year 8 to 13, as well as Adult Re-entry. The school has a large number of Aboriginal students and as a Focus school, has been recognised as a leader in catering for students with Disabilities. Their strategic partnership with Microsoft allows the school to deliver the Microsoft Certified Professional course and the 3COM Networking Certificate.

The second High school is much larger with approximately 1200 students from Year 8 to Year 13 and lies south of Adelaide. The school caters for a diverse student population and continues to maintain a strong academic tradition. With one of the highest student to computer ratios of approximately 3:1, the school is focused on embedding ICTs throughout the curriculum in ways that enhance students' learning and support their development of lifelong learning skills.

The Global Discovery Schools

The three Global Discovery Schools are as diverse as their metropolitan counterparts as they are in location and play an integral role in their communities. One Primary school of approximately 60 students ranging from reception to Year 7 is located in the South East of the state. The main priorities include the expectation that ICTs are used in all classes and to implement strategies to support positive student attitudes, especially in boys. The other Primary school, on the Yorke Peninsula, caters for approximately 80 students organised into three class groupings (R-2, 3-4 and 5-7) along with a pre-school. A main priority is to promote a community of lifelong learning with a focus on the integration of ICTs throughout the general curriculum and learning programs.

The third Global Discovery School is an Area School located in the far north of South Australia and provides for approximately 360 students from reception through to Year 13, many of whom are from multi-cultural or Aboriginal backgrounds. As a LOTE Focus school, a major priority is to use ICTs to improve language teaching.

All nine schools were given support, through the appointment of Technology Project Managers, to research, develop and model exemplar ways to embed learning technologies across the curriculum over the three-year life span of the project. To assist in this aim, additional support was provided in the form of cash grants to upgrade ICT facilities. As part of their commitment to the Project, the Discovery and Global Discovery schools were supported in disseminating their experiences through focus school programs and liaising with educational organisations to participate in research. The Student Survey was one such research project.

The Study Sample

The Discovery Schools and Global Discovery Schools were encouraged to allow all middle school students, Years 5 to 7 in the Primary sector, and Years 8 to 10 in the Secondary level, to participate in the online survey conducted during the third term of each of the three years. Ultimately, however, the resulting number of students responding to the three scales depended on the schools' success in administering the online survey.

A total of 1749 Primary and 2463 Secondary students from the Discovery and Global Discovery Schools responded to the surveys, a response rate of approximately 78 per cent, and constitutes the database upon which the proceeding analysis was conducted. Table 1 summarises the number of students and average age at the time of data collection by year level and gender and demonstrates that the demographics of the students are representative of the broader educational sector.

Table 1. Discovery and Global Discovery school sample

		Year 5		Year 6		Year 7	
		Male	Female	Male	Female	Male	Female
Global Discovery Schools							
1999	N = 64	11	6	5	15	7	20
	Mean (SD)	11.21(0.52)	11.15(0.25)	12.06(0.60)	11.94(0.36)	13.07(0.28)	13.14(0.37)
2000	N = 65	17	16	6	10	5	11
	Mean (SD)	10.46(0.62)	10.72(0.39)	11.98(0.53)	12.16(0.66)	12.80(0.27)	12.72(0.36)
2001	N = 105	11	16	23	22	16	17
	Mean (SD)	10.88(0.36)	10.69(0.39)	11.68(0.50)	11.56(0.35)	12.77(0.50)	12.50(0.70)
Discovery Schools							
1999	N = 489	47	75	88	92	92	95
	Mean (SD)	10.79(0.33)	10.69(0.39)	11.78(0.56)	11.90(0.44)	12.61(0.45)	12.71(0.36)
2000	N = 533	99	78	73	102	93	88
	Mean (SD)	10.84(0.38)	10.75(0.49)	11.89(0.36)	11.80(0.34)	12.84(0.35)	12.92(0.41)
2001	N = 493	86	75	89	77	63	103
	Mean (SD)	10.82(0.38)	10.74(0.29)	11.68(0.40)	11.66(0.32)	12.79(0.30)	12.70(0.34)
		Year 8		Year 9		Year 10	
		Male	Female	Male	Female	Male	Female
Global Discovery Schools							
2000	N = 23	9	6	1	1	3	3
	Mean (SD)	13.94(0.39)	13.89(0.39)	15.59	15.75	16.88(1.14)	15.56(0.10)
2001	N = 64	10	21	12	7	9	5
	Mean (SD)	14.19(0.32)	13.94(0.43)	15.27(0.49)	14.96(0.31)	16.33(0.63)	16.49(0.35)
Discovery Schools							
1999	N = 736	159	124	138	117	115	83
	Mean (SD)	13.81(0.42)	13.73(0.36)	14.71(0.36)	14.65(0.39)	15.78(0.42)	15.69(0.34)
2000	N = 785	170	165	132	106	110	102
	Mean (SD)	13.92(0.75)	13.85(0.44)	14.93(0.42)	14.85(0.37)	15.79(0.50)	15.74(0.86)
2001	N = 855	157	160	144	144	146	104
	Mean (SD)	13.83(0.45)	13.72(0.46)	14.86(0.66)	14.73(0.36)	15.79(0.43)	15.76(0.37)

Missing Data and Statistical Comparison

The occurrence of missing data can arise through several different causes. Students can inadvertently miss an item, or choose not to answer on personal grounds. Some students omitted a whole section if they did not complete the survey in the allotted time or were absent. A final difficulty in obtaining complete data resulted from computer network conflicts, in which case the school server crashed with the result that any students in the midst of a section were unable to send their responses. Encouragingly, this cause of data loss, although a concern during the 1999 survey, appeared to be non-existent in the subsequent 2000 and 2001 surveys, an observation that is supported by the nine per cent increase in data obtained each year. In the case where the

majority of items were completed within any one of the three sections, those items missed were assigned the mean gender and year level value for that item, yielding a complete section.

Due to the small student populations in the three Global Discovery schools, total numbers were amalgamated and treated as a single entity during statistical analysis. All other schools retained their own identifications. To generate all statistical calculations, a spreadsheet and two statistical packages were employed; Microsoft Excel, SPSS and WestVar. Descriptive statistics (means and standard deviations) are used to describe the central tendency and dispersion on all measures. To test for differences between groups, probability testing was selected as the appropriate statistical method, since just two groups were compared in each case. Significance testing was performed using WestVar to allow for the effects caused by the clustering of students at the school level. The 0.05 level of significance was chosen for the rejection of the null hypothesis of no difference between groups.

Given the longitudinal nature of the study, information was collected from boys and girls on three separate occasions, in 1999, 2000 and 2001, and across six Year levels or grades. Such an array of data affords a multitude of statistical comparisons that can possibly be somewhat confusing. Figure 1 attempts to provide clarity. The main format in which students' attitudes are presented throughout this report uses the bar graph and represents the mean response for each occasion, clustered by Year level. Any changes in mean attitude over the period can be viewed at a glance. If the changes are sufficiently different, beyond the normal level of random variation (set at the probability of 0.05), these are considered to be statistically significant and potentially attributable to any major influence in the environment. Year 5 students show two significant positive shifts in attitude, indicated by the convex curves in Figure 1. Between the first and second and, the first and third testing occasions, the change in attitude is significant and possibly due to the increased use of learning technologies. The decline in attitude between the second and third occasion is not statistically significant. This main method of comparison looks at students in the *same grade* over the three occasions. Alternatively, students from the *same occasion* but different grades can be compared to examine attitudinal trends with age, or students from the *same group* can be tracked as they move from Year 5 in 1999 to Year 6 in 2000, and so on. In addition, but not represented on the graph in Figure 1, is the comparison of gender. Only the statistical comparisons of same grade, indicated by the curved arrows in Figure 1, along with the comparison of gender, are employed in this paper and reported when of interest.

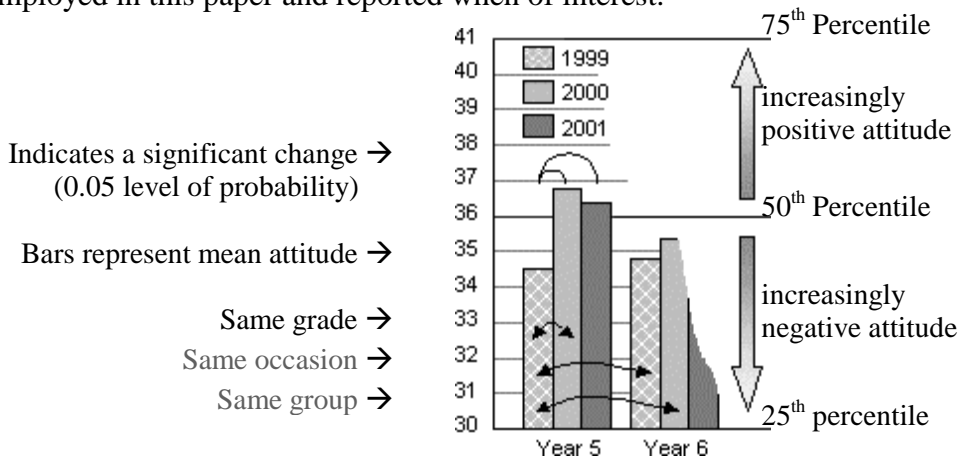


Figure 1. Comparison over three years (the convex curves represent a significant change in attitude between occasions)

To further aid interpretation, the lowermost and uppermost values of the graph represent the 25th and 75th percentiles, respectively. Responses above the 50th percentile, indicated by the black,

rather than grey grid lines, are increasingly positive, while those falling below, are increasingly negative. Percentiles are calculated for each variable from the entire data set of that variable.

RESULTS: CHANGES IN ATTITUDE

The nature and degree of change in the Discovery and Global Discovery schools will vary in extent from school to school, and although the use of ICTs is a major priority within each school, it may not be the only program that effects the learning environment or influences attitudes. With this caveat, any changes in student attitude could be attributable to the increased use of technologies in the learning environment.

Changing attitudes towards school

Attitudes towards school and school learning

Students responded to items that ranged from a strong dislike for school and a strong desire to leave school as soon as possible, to enjoyment of school and a desire to obtain as much schooling as possible. Primary school students, particularly those in Years 6 and 7, show significant increases in their attitudes towards school and school learning and, in the final year, show an increase with age (see Figure 2). Students in Secondary school, on the other hand, reveal a decline in school attitude with age but show a growth in these attitudes over the three-year period. These changes are significant in Years 8 and 9. The 50th percentile score of 36 shows that students in Primary school generally like school and are considerably more positive than their senior colleges who show a general dislike for school and learning. The influence of ICTs appears to be most significant in Years 6 to 8 and generally appears to have been positive.

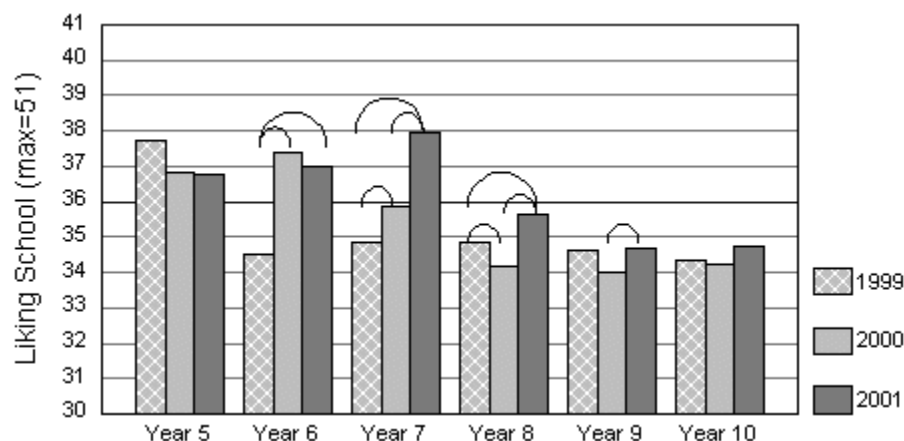


Figure 2. Attitudes towards school and school learning (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Motivation to achieve in school learning

Students' academic motivation is measured by questions ranging from, a lack of effort and involvement in school learning, to a desire to succeed in school learning and achieve academically. The 50th percentile score of 42, shown in Figure 3, suggests that Primary school students maintain strong motivation towards school learning, but that this clearly declines with age. The influence of learning technologies is questionable, with only significant increases in the Year 7 and 10 cohorts. Although Secondary students' are less motivated academically than their younger counterparts, an increase in attitude across all Year levels suggests that the increased use of ICTs may have positive benefit.

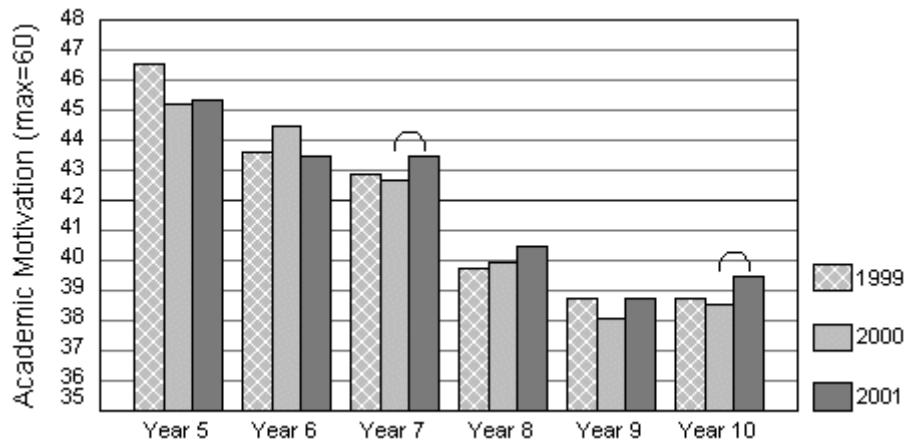


Figure 3. Motivation to achieve in school learning (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Gender differences in school attitude

Female students continue to maintain a higher regard to school and learning than their male peers, shown in Figure 4, significantly so, across both Primary and Secondary school settings. The shift in girls' attitudes toward schooling significantly increases over the three-year period, unlike their male counterparts. Secondary school boys show a significant increase in their liking of school but only between the second and third year. A similar shift in academic motivation is observed in their female peers. Primary school girls generally hold a positive attitude towards school, falling above the 50th percentile score of 77, while only Year 5 boys hold a similar attitude.

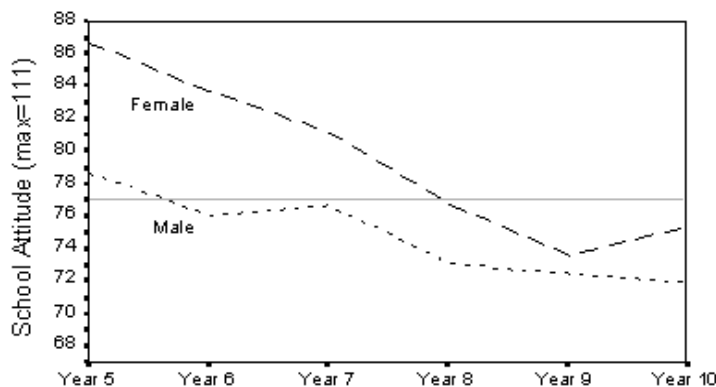


Figure 4. Gender differences in school attitude over six grade levels

Changes in self-esteem

Self-esteem is viewed as a many-faceted personality characteristic, which may vary according to differences in age, gender, life experiences and aptitude and can be described as, "a personal judgement of worthiness that is expressed in the attitudes the individual holds towards him or her self" (Coopersmith, 1967, p.5). Four areas of self-attitude were examined and include general interests, peer, parents and school. Combined, these areas form an overall measure of self-esteem and provide important insight into the influences on students of embedding ICTs into the curriculum.

General personal attitudes and interests

Students responded to questions ranging from not being easily bothered and having a high opinion of themselves to often wishing they were someone else and taking a long time to get use to

anything new. The use of ICTs in learning appears to be beneficial across all age groups, significantly so in all but Year 8 students, presented in Figure 5. The 50th percentile of 61 suggests, however, that on average, general self-esteem is low but increases with age.

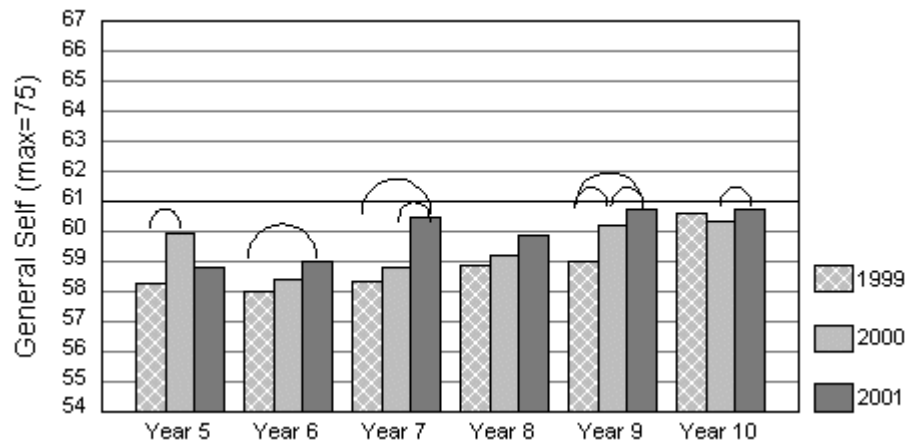


Figure 5. General Self-esteem (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Attitudes towards peers

The influence of ICTs on peer and social relationships is an interesting but little studied area in relation to ICTs. To gauge changes in these beliefs, students responded to a selection of statements ranging from, being popular with kids their own age and having ideas that other kids usually follow, to not liking to be with other people and often being picked on by other kids. All but Year 10 students, as depicted in Figure 6, experienced significant positive shifts in social self-attitudes and may reflect the effectiveness of the communication aspects of learning technologies.

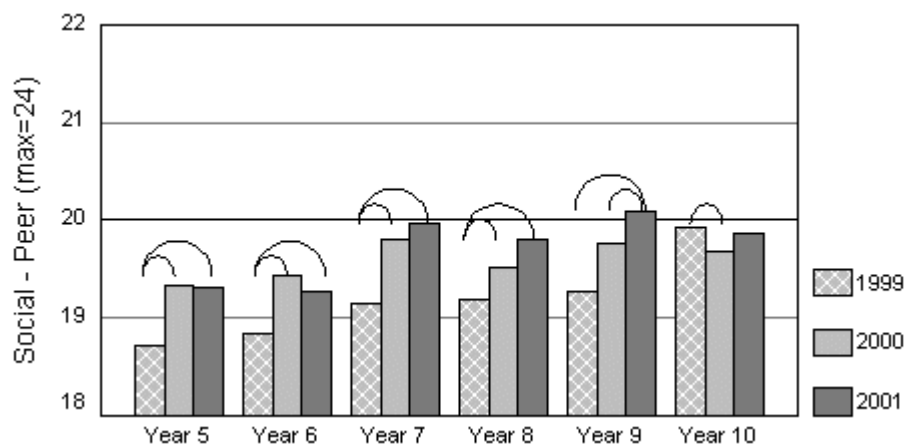


Figure 6. Attitudes towards peers and social relationships (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Attitudes towards parents and the home environment

Although schools were the main focus of increased use of ICTs in learning, their influence on students' beliefs about parents and home is of interest and may give insight into the increasingly high levels of computer ownership at home. Questions ranging from, being considered and understood by their parents to, wanting to leave home and being pushed too hard, are the kinds of items to which the students responded. Compared to the other measures of self-esteem, Figure 7 shows that the use of ICTs appears to have had relatively little influence on students' attitudes

towards parents and the home environment. Over the three-year period, however, an increase in students' attitudes towards their parents is experienced across the cohort with the majority of significant shifts occurring in the older students.

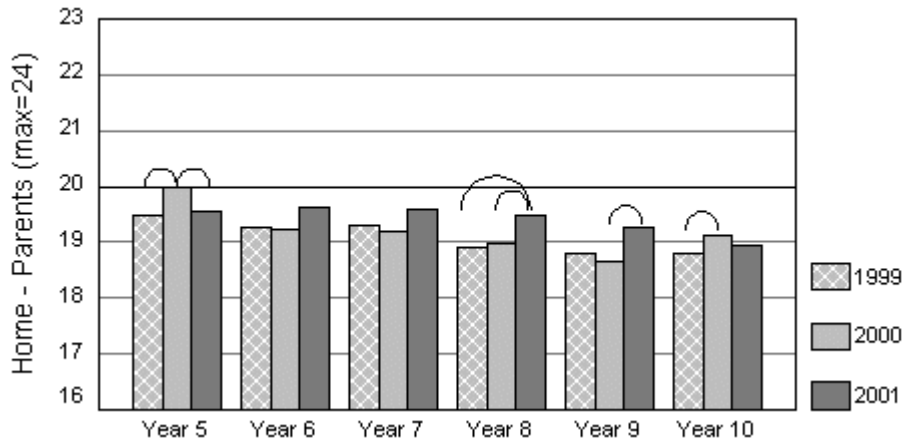


Figure 7. Attitudes towards parents and the home environment (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Academic self-esteem

To gauge students' school and academic self-attitudes questions were posed ranging from being proud of their school work and wanting to do better in school to, finding it hard to talk in front of the class and believing that the teacher does not make them feel good enough. Students' attitude toward themselves as learners (see Figure 8) strongly mirrors their attitudes towards school and learning. Across all age groups, a positive shift in academic self-attitude occurs over the three-year period, and suggests that the increased use of ICTs has provided beneficial influence, significantly so in the older cohorts.

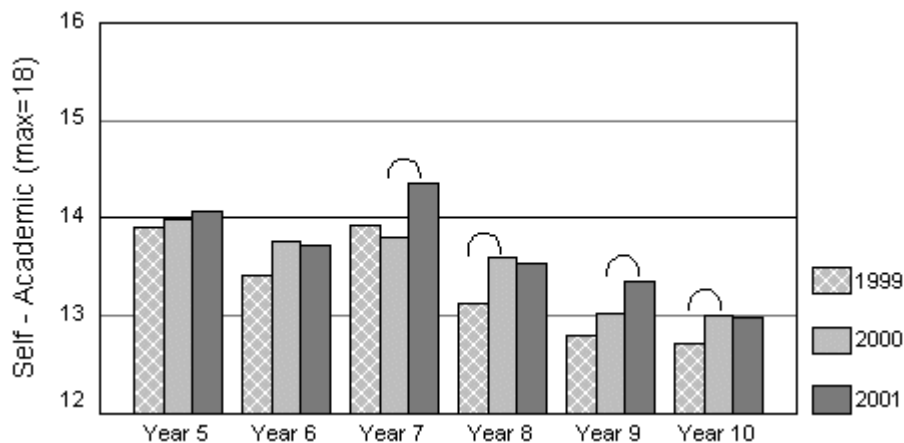


Figure 8. Students' attitude toward themselves as learners (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Gender differences in self-esteem

The difference in self-esteem between boys and girls has been a topic of much debate in research. The findings presented in Figure 9 are common to many previous studies and show a divergence of attitudes with age. Male students grow increasingly positive as they get older, whereas female students show declining self-esteem with age, differences that are significant in both the Primary and Secondary sectors. The change in girls over the period, however, is significantly positive,

while the change in boys self-esteem is inconclusive, and suggests that the increase use of ICTs supports girls attitudes towards themselves.

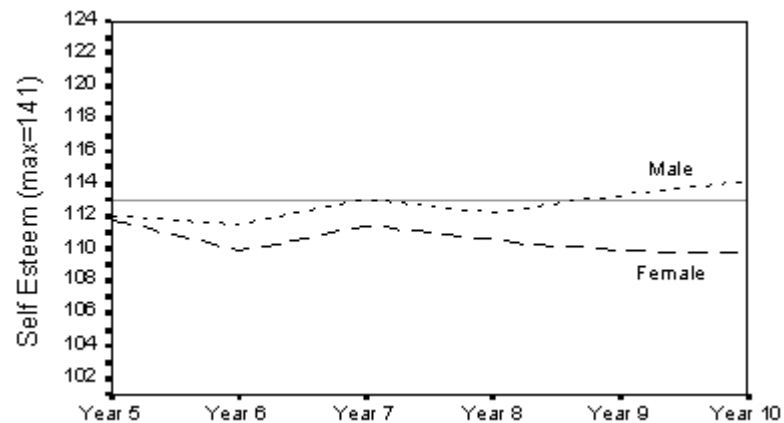


Figure 9. Gender differences in self-esteem over six grade levels

Changing attitudes towards the use of computers in learning

Any direct influence between students' increased use of ICTs and their attitudes towards themselves and towards learning is not obvious, but nonetheless, well documented and supported by research. Although these attitudes may reflect the influences of ICTs indirectly, they are an important consideration in the overall learning outcomes of a student. Equally important and possibly more direct, is the relationship between the use of ICTs in learning and students' attitudes towards them. To measure changes in students' attitudes towards the use of computers in learning, students responded to a series of statements formulated within the framework of a tripartite model of attitudes, which identifies affect, behaviour and cognition as three distinct but interrelated attitudinal components (Jones and Clarke 1994).

Affective attitudes towards computers

The affective component contains the encoding of feelings associated with an attitudinal object and requires students to respond to a selection of negatively worded items ranging from, being highly intimidated and threatened by computers and feeling helpless when asked to perform new tasks on a computer, to being bored and frustrated with computers. In an environment where students are increasingly confronted about their feelings towards computers, the positive shift, overall, in affective attitudes (presented in Figure 10) is encouraging. Students in Years 6, 7 and 10 show significant growth over the period and generally hold a positive attitude towards technology, by falling around the 50th percentile score of 59. These changes in affective attitudes could, arguably, be attributed to the increased use of ICTs and appears to be equally supportive in both the Primary and Secondary school environments.

Behavioural attitudes towards computers

The behavioural component includes behavioural intentions, verbal statements regarding behaviour and overt behaviours in response to an attitudinal object. Students responded to positively worded items that range from, wanting to learn more about computers and to use computers more often, to finding ways to use computers more efficiently and wanting to learn new tasks independently by trial and error. Students appear to find the increasing use of ICTs behaviourally more confronting, particularly in the older cohort, as evidenced in Figure 11. Although positive shifts in attitude, overall, were experienced in the Primary sector, only those increases in Years 5 and 7 were significant. The influence of technology on behavioural attitudes in the Secondary school environment is less optimistic and shows significant declines in Year 9

and 10 students' attitudes between the first and second occasion. The final testing appears to be more encouraging with sufficient improvement that results in an overall drop in behavioural attitude that is not significant. Across the cohort a clear decline in behavioural computer attitudes is observed and may indicate an increasing pressure on access to computers.

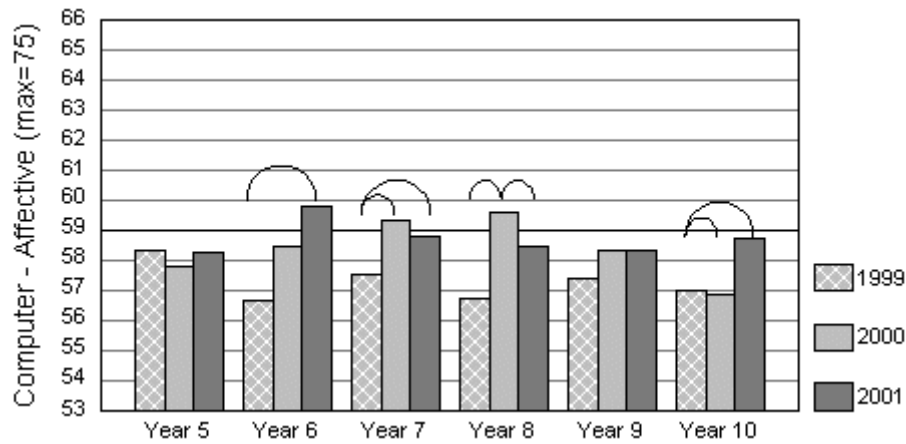


Figure 10. Students' affective attitudes toward computers in learning (the convex curves represent a significant change (0.05 level) in attitude between occasions)

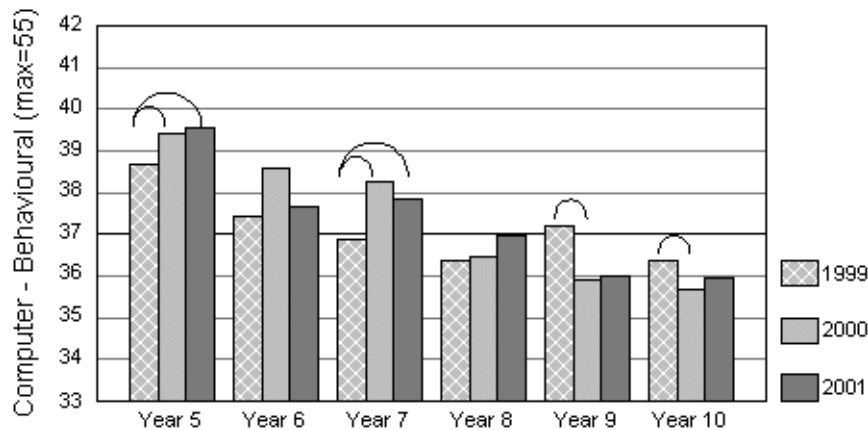


Figure 11. Students' behavioural attitudes toward computers in learning (the convex curves represent a significant (0.05 level) change in attitude between occasions)

Cognitive attitudes towards computers

The cognitive component refers to beliefs, knowledge structures and thoughts held, regarding the attitudinal object. Students responded to statements ranging from, being creatively inhibited when using computers and believing computers to be a waste of time, to finding computers difficult to understand and isolating. Compared to students' behavioural attitudes, reverse trend with age is apparent. Figure 12 shows that Year 5 students provide an anomaly by finding strong accordance with the negatively phrased items. More encouragingly, the older students show positive shifts in cognitive attitude towards computers over the interval that generally increases with age. In Years 6, 7 and 10, some of these shifts are significant and are a probable result of their increasing exposure to ICTs.

Gender differences in computer attitude

The difference in computer attitude between boys and girls has been a topic of much concern in research, particularly for girls. The findings presented in Figure 13 are common to many previous studies and show a divergence of attitudes with age. Male students grow increasingly positive as

they get older, whereas female students show declining computer attitudes with age; differences that are significant in both the Primary and Secondary sectors. Encouragingly, the change in girls over the period is significantly positive, while the change in boys' computer attitudes is inconclusive, and suggests that the increase use of ICTs may support girls' attitudes towards the use of computers in learning.

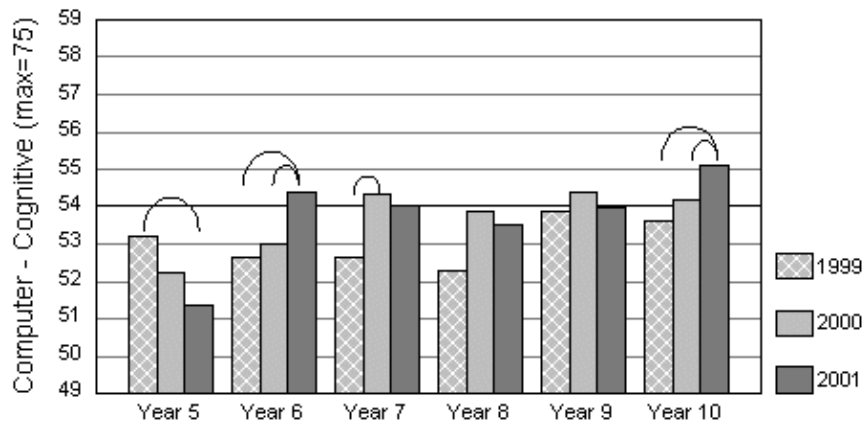


Figure 12. Students' cognitive attitudes toward computers in learning (the convex curves represent a significant change (0.05 level) in attitude between occasions)

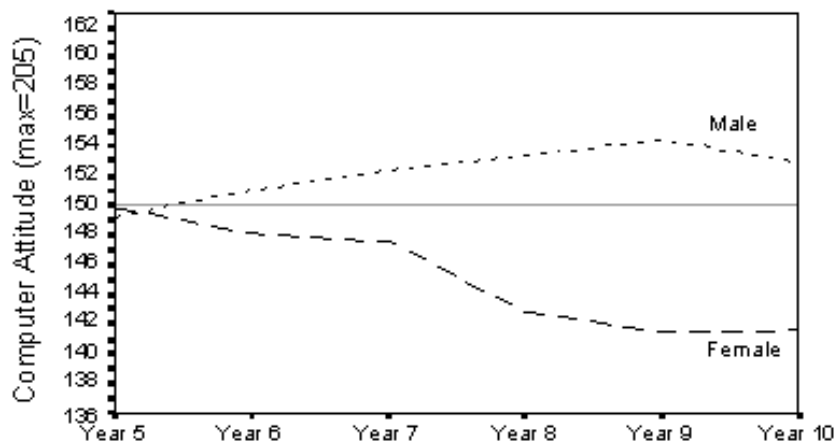


Figure 13. Gender differences in attitudes towards the use of computers in learning

IN SUMMARY

With so many attitudes, what does it all mean? Are Learning Technologies making a difference? At this early stage of the analysis, definitive answers to the driving inquiry of how learning technologies influence and support students', are not yet available. Clearly, the preliminary findings presented in this paper should at best, be treated as conjecture, but do present an encouraging longitudinal perspective of students' attitudinal development. The overall view of technology as an educational tool is highly optimistic and reflects much of the findings from similar research. In general, Learning Technologies are found to have positive effects on students' attitudes towards learning and on student self-concept. Students feel more successful in school, are more motivated to learn and have increased self-esteem when ICTs are employed as an integral tool in their learning environment.

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