The Social Effects of New Technology in Schools - the SENTIS report

by

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Statement:

This thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary institution and that, to the best of my knowledge and belief, the thesis contains no material previously published or written by another person, except where due reference is made in the text of this thesis.

Signed 22 Dec 95

Andrew E. Fluck **Date**

DEDICATION

This thesis is dedicated to

the students and their teachers in the project schools,

and those that naturally succeed them.

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Abstract

This SENTIS (Social Effects of New Technology in Schools) report examines some of the social effects of new technology in schools. The main focus is on the relationship between sociability and student computer use in schools. Other topics include gender bias, home computer use, socio-economic differences and attitudes to computer use. Evidence from personal interviews and a statistical survey analysis is presented.

The study was completed in two phases. In phase one, schools from all sectors were investigated. The data-collection techniques used in this first phase included an automatic network traffic probe. Analysis of this intial data focussed the second phase on state high schools. Three of the phase one schools were re-visited three years later in phase two.

In phase two, information was gathered from 12 representative Tasmanian High Schools. 4356 students completed surveys on their use of computers the previous school day. A sample of teachers and students at each school were interviewed.

Group integration, as determined from a sociogram of each class, was found to be highly dependent upon class size. The relationship between class size and group integration was determined, and eliminated from the data, so that different schools could be meaningfully compared.

No significant correlation between sociability and increased computer use was found. Therefore, the main finding of the SENTIS project is that computer use has no role in degrading friendship relationships in schools.

A significant conclusion from the study is the extremely rapid rise in the proportion of the curriculum which depends upon computer use in schools, and the equally rapid rise in the amount of time students are spending each day engaged in computer use. Teachers expressed concerns about the isolating effect of individual computer use. However, students felt that computers could enhance friendships.

Suggestions for future research include the idea that SENTIS monitoring should continue on a regular basis and cover additional aspects of socialisation. As the trend to greater computer use in education continues, it will be increasingly important to establish not only the academic efficacy of the new technology, but also whether the change in teaching methods is beneficial in terms of its wider societal effects.

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Introduction

By late 1994, computers had been introduced into most Tasmanian schools. There was a wide range in the level of provision across schools. At one extreme, some schools had either just introduced computers, or had a small historical legacy of different brands and types. At the other extreme, some schools ensured that every student had an individual laptop computer. The majority of schools were between these extremes, making this interim stage of development a crucial one to study. It will be a critical stage if information technology has its anticipated significant impact upon education systems.

This SENTIS (Social Effects of New Technology in Schools) study is not the first to look at the increasing use of computers in schools. Many researchers have been able to examine the efficacy of computers in education (Gates & Schibeci, 1992, p. 27 et seq.) and their effects upon teachers' and students' attitudes (Durell, 1990, p. 757; King, 1993, pp. 16-20; Ransley, 1991). There have been many examinations of the gender differences in use and attitude (Clarke, 1990, p. 53). Typically such studies have looked at a small number of students (up to a few hundred), and have concentrated on the style of learning in a single situation or school. Such studies have significant value due to the depth of their analysis, but often have little to offer in broader, more generalisable terms.

Some studies have examined the issues associated with the use of computers in teacher training. Three classes of studies are relevant. Firstly, there is the role of computers in the pre-service training of teachers (eg, du Boulay, 1983, p. 53). This, like many other components of their training, has to compete for time in the curriculum, alongside essential material related to the philosophy of education, psychology, subject specific matters, and teaching methodology. Secondly, there are many issues associated with technology within in-service training, and the ways in which practicing teachers can be introduced to the various new generations of technology. Teachers responses to such courses range from enthusiasm to reluctance. Lastly, there are focussed attempts to gain the minds of the decision makers in education, from large-scale commercial sales of specific hardware and software, to advisory sessions for school principals encouraging them to look at broader issues relating to computer use in their schools.

Three very different recent studies are worth mentioning at this stage. The three studies show the breadth of concern about computers in education. The first (Atkins and Vanzetti, 1992), looks at teachers perspectives of the system within which they work. This widespread study from the Australian Capital Territory showed that teachers believed that computers were making a

> "major contribution to the teaching/learning process, although they accept that there are some difficulties with this use, in particular the problems in time, money and energy associated with keeping pace with the latest equipment and software. (. . .) It appears that, with the exception of specialist courses such as computing studies and office management in secondary colleges and some high schools, computers have been, in the main, introduced into the existing curriculum as individual teachers see appropriate, rather than through a process of rethinking the curriculum to involve the power of the computer." (Atkins and Vanzetti, 1992, Abstract)

By contrast, Oliver's analysis of IT skills of high school leavers in Western Australia (Oliver, 1993), shows a significant difference between the perceptions of employers, teachers and the students themselves. A picture emerges of students who feel that access to new technology is restricted to those enroled in specialist subjects, whilst the remainder get very little access. The general attitude of most students is therefore that little IT familiarity is necessary for future life, whilst employers generally saw this skill-set as a highly significant item in assessing youngsters for work potential.

Finally, Ryser's study of 114 students in two primary schools in Texas, USA, looked at academic progress, attitudes and self esteem (Ryser, 1990). She found that matched student samples which used/did not use computers, differed little in terms of traditional subject skill acquisition . However, there were significant gains in the affective areas of attitude and self esteem by the computer-using sample. That study found no gender-related differences in achievement, attitude or personality characteristics. The degree to which students accepted responsibility for their own actions and believed they controlled their lives (internal locus of control) appeared to be somewhat predictive of achievement gains (Ryser, 1990, p. 105).

These studies illustrate the range of issues and concerns associated with the use of computers in the classroom. They give us a sense of a great change in progress, because it is clear that investment in information technology is not yet complete.

There is concern about the effect of computers in the classroom, but no commonly agreed perception of what they are doing there. The educational efficiency view has yet to come up with conclusive evidence to justify investments in new technology in monetary values alone. However, there is recognition that hardware and software are increasingly part of the school scene, and that they are important resources, here to stay.

The current study adopted a specific hypothesis to test. However, it is recognised that many of the social effects of new technology in schools (particularly computers in this case), are complex and may be inter-related. Therefore the study also collected data on a range of issues such as gender, home computer use, rurality of home, socio-economic status of schools, and access to modems. Some of these issues are discussed in the analysis sections of the thesis.

Chapter 1. The Problem

Statement of the problem

"... over the last decade there has been a large investment in computer technology in schools." (Vanzetti & Atkins, 1992, p 446).

Given this investment, what changes have resulted in the affective domain? A prime focus of the SENTIS project described in this report, has been an investigation of the effect of increasing computer use on the sociability of students. During the investigation, there have been significant developments in computer technology. One such development has been the emergence of Open and Independent Learning Systems. These combine a large library of inter-active learning materials with a computer managed learning program which is accessed over a computer network. A complete class of students can use such a system to learn on an individualised basis using a mix of learning styles. Such Open and Independent Learning Systems have the reported potential to improve learning outcomes, and use computers to give individual instruction (TES, 1994).

The growth of schooling

To put the anticipated social changes resulting from computer use into perspective, it is necessary to review the growth of schools. By understanding the different ways in which knowledge is conveyed from one generation to another, it becomes easier to think about the possible changes that computers might bring into modern schools.

Mass public education is a relatively new phenomenon. Although the ancient Greeks had schools, these were generally for a few aristocratic students with leisure. In

England, the dame schools gave way to charity schools run by the Society for the Promotion of Christian Knowledge (SPCK). The SPCK had about 2000 schools in London by 1741, and it took until 1839 for the Education Department to be formed and national schools to replace these charity schools. The first infant school is credited to Pastor Oberlin of Waldbach, Germany in 1769 (Raymont, 1937, p. 47), whilst the state of Massachussetts legislated for a free school in every town in 1789 (Mayer, 1961). These examples represent the start of education for all children - although monarches and others had founded schools for a privileged few, such as Eton College by Henry VI in 1440 (Williams, 1938, p 53).

So modern schools in the Western tradition initially concentrated on the cognitive domain - they focussed upon the transmission of knowledge and skills from one generation to the next. Other cultures focus more on the affective domain. In Nigeria, the common village education has been provided by elders, and students were segregated into age-sets by gender (Uka, 1973, p. 61). These age-sets are cohesive social units that persist until the members eventually die. They not only form the foundation of the education and training systems, but also become savings and banking organisations, and eventually turn into the bulwark of the sophisticated pension and social welfare structure.

The social aspect of this kind of Nigerian education is particularly relevant to the SENTIS investigation. Modern western schooling also includes socialisation and affective education, though not in such a focussed way as other cultures. Given the range of cognitive and affective domains, how does the organisation of a school affect each of them. How important are group formations and maintenance? What role does the delivery mechanism for cognitive development play in the affective domain? These delivery mechanisms of education are undergoing great change at this time. The concept of schooling in age-related groups is giving way to a broader idea of competencies and student centred learning.

Computers are becoming a significant educational delivery mechanism. The wide general spread of computers since the early 1970s has brought about significant changes in human affairs. There have been some obvious societal changes, particularly in the areas of finance and media (Large, 1984, p. 77; Lyon, 1986, p. 54). The scale of investment in information technology in some states indicates the scale of these changes. Sanders (1988, p. 4) estimated that the proportion of white-collar workers in the United States with personal computers would have increased from 1% in 1979 to 55% by 1989.

The introduction of new technology has also changed schools. The new computer technology has largely been used in the cognitive domain, and has rarely been applied specifically in the affective domain. However, it is possible that application of computers for type of learning task may influence development in another domain. This SENTIS study has examined some of the societal changes in schools. The study has investigated the possible change in personal relationships between students resulting from the use of computers. It has also provided an insight into the growth of computer use in the curriculum. Another aspect has been the increasing use of computers in the home, and the study has quantified this for the population concerned.

Significant changes in the school environment

In Tasmania, formal student assessment has changed over the last four years from a norm-referenced system to a criterion-referenced system. The Tasmanian Certificate of Education is awarded to all students from grade 9 (age 15) onwards, and is used for matriculation purposes. The Schools Board of Tasmania has expressed a belief that every student should receive a formal statement of attainment (Schools Board, 1991, p. 3). Therefore, there are a great number of criterion-referenced syllabuses that can be included in the certificate, because it is necessary to assign each student a course within their ability range. This proliferation of syllabuses is one factor that has made timetabling in schools more complex. Computerised timetabling and assessment recording is common in many Tasmanian schools (Elizabeth Computer Centre, 1990).

In addition, there is a current focus on student centred education and self-paced learning associated with the desire to improve the education system in order to compete more effectively on world trading markets (Hughes, 1992). This emphasis gives schools more freedom to introduce flexible learning, or even to disband age-cohorts. In this environment, computers, and especially those using interactive multi-media course-ware, are seen as an important resource for the delivery of individualised instruction.

Also, open learning is becoming increasingly relevant to mature students. Competency-based assessment and recognition of prior learning as outlined by the Mayer Committee have made individual curricula more common (Mayer, 1992, p.

2). These individual curricula are supported by the introduction of the Australian Vocational Certificate Training System, replacing apprenticeships and time-serving by pathways with credit transfers (ESFC, 1992, p. vii). Frequent career changes through a working life have increased the need for long-term education and training on an anytime, anywhere, anyhow basis. This trend towards the use of open learning style materials can be seen in schools, as mixed ability teaching is often resource-based. That is, the teacher acts as a co-ordinator of activities, which are performed by students following written instructions and accessing other resources such as books, apparatus etc. independently.

Schools are investigating alternative forms of curriculum delivery, including the use of computers and multi-media. These alternatives to a live teacher are useful for open learning and individualised instruction. Computers can play a role in managing the education, delivering sections of the course and also in assessing student understanding of the material.

Computers are being put into the home and school with the specific intention of giving wider access to education. A report shows that Australians have the second most computers per head in the world. The top 15 table looks like this:

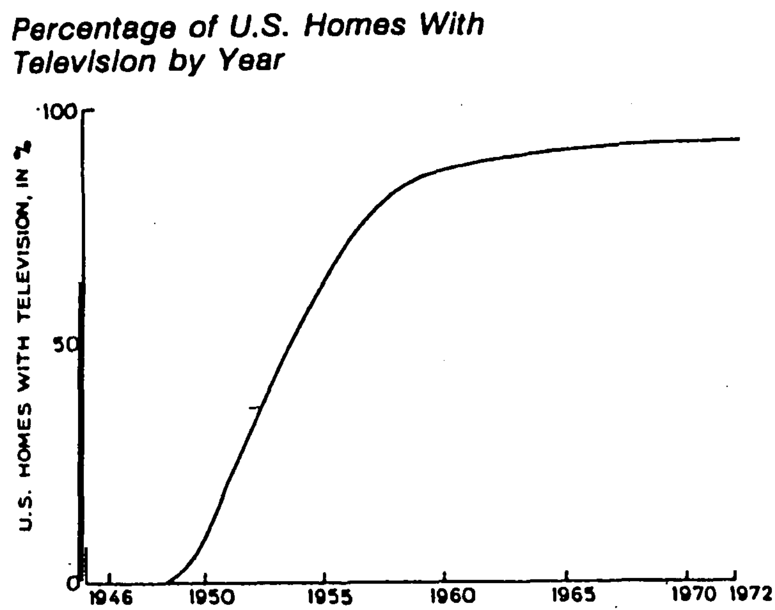
1.	USA	265 PCs per 1000 people
2.	Australia	175 PCs per 1000 people
7.	UK	134 PCs per 1000 people
15	Germany	104 PCs per 1000 people

60% of PCs bought for Christmas were for educational use at home, according to a representative from a large computer company (Computerdigest, 1994).

In this context then, the introduction of computers into schools needs to be evaluated. When compared to the introduction of televisions into the United States of America, the timescale for household penetration to rise from 10% to 90% was only 5 years from 1952 to 1957 to enter virtually every home. (Lepper, 1985 - see Figure 1). In retrospect, sociologists had no base line data against which to measure the social changes made by that device.

We have a similar situation in respect of computers in education. In some schools there is a computer for every student - saturation has been reached. In other schools, the staff are striving to reach a goal of one computer per class room. This study has shown that rates of increase are now on a very steep rise. The costs of this are tremendous. Since technological development continues to occur, schools have also been facing the need to upgrade old machinery with improved models. This becomes a necessity as courses based upon old equipment become redundant.

Figure 1 - Percentage of U.S. homes with television by Year (from Lepper, 1985, p.3)



In the case of television, the new technology changed the social scene completely. Families needed no longer to provide their own entertainment, to acquire skills for that purpose. The home use of video-recorders has also been under intense scrutiny to establish whether violent films have effects upon the behaviour patterns of viewers. One alarming study in particular (Barry, 1993) suggests that murder rates have risen in response to televised violence. This correlation is described as occurring in the United States as well as in other countries.

Causes for concern

What then, will the widespread introduction of computers do for the social life of the school? Will the screen and the keyboard become tyrants or helpers? Will reports of computer nerds become increasingly widespread? (Glover, 1992, Lepper & Gurtner, 1989).

Concern has been expressed from many quarters. Even large firms such as Mitsubishi are investing in research into the area. Nihei in 1991 issued a call for "information about computer-phobia, addiction to computers .. with the intent to predict negative outcomes by reference to the method of computer use .... and the child's personality." In response, details were given of a database of computerphobia literature.

In Britain, a teacher's union felt so strongly that the issue should be investigated, that it commissioned a survey to gather information about disturbing trends. The results were alarming. 75% of teachers were convinced of a causal relationship between computer games playing and tiredness and inattentiveness of their students. 40% of the teachers linked student aggression with computer games, and 20% noted addiction to games (PAT, 1994) .

The digitising and storage of information in electronic form also gives the future curriculum many possible shapes. Computers used as synthetic teachers have in some instances been shown to be as effective as human teachers, and sometimes more so. A curriculum-on-a-disk system called SuccessMaker (Anderton Associates, 1993) has recently been introduced to Australia and is undergoing trials. It purports to contain enough material to provide an inter-active lesson in Mathematics, English and Science for every day of a student's school career. This particular form of new technology evinced the following remarks from one principal:

> I was reading recently of the startling innovation in higher education in Great Britain which allows students to pursue certain courses taught almost wholly by computer. This conjured up the image in my mind of a futuristic education system in which modern technology had completely done away with schools, with teachers, and even with head teachers. Children could sit at home with sophisticated computer games, absorbing graded information and responding to self-imposed tests. . . . It would be as if Nintendo had taken over the Curriculum. Just think of the savings. And then think of the cost in human impoverishment, of the nightmare world which would have been created. (Kidd, 1992)

The SENTIS project arose from similar concerns. It aimed to investigate the possible links between computer use and changes in sociability. A range of schools was investigated, and the focus of the study narrowed to those where any links could be expected. Futhermore, the study collected additional information about gender, home computer use, socio-economic differences and attitudes to see whether any links were related to these variables.

Motivation of the author

As a computer advisor to schools, and a computer co-ordinator within some of them, the author found that the educational development of technology was often related to the perceptions and fears of the individuals involved. A school with young staff with close connections with the students, would typically be one where computer technology was deployed across the curriculum and used to assist the whole learning process. Other schools might be able to identify particular barriers to the deployment of computer technology and be unable to maximise its effectiveness.

In the latter kind of school, a common barrier was an anticipation of the socially isolating effect of solitary computer use on the part of the staff. Some benefits were recognised, such as the augmentative communication aspects or the support for slow learners, but teachers would balance this success against a fear of restricting social development through isolation.

These personal impressions combined with a theoretical understanding to produce the SENTIS study. The rationale for the investigation was strengthened by discussions with teacher colleagues, who felt that access to restricted computing resources inevitably involved a concern for equity - and in many cases this was expressed as a concern for gender equity.

It seemed quite possible that an understanding of the reality of the situation would be gained from a dispassionate study of a single hypothesis. However, the specific hypothesis would be illuminated by a wider examination of these issues, fears and deployment success factors. Therefore the study examined a broad range of these factors, before homing in on a central focus; but never discarded a concern for what might also be pertinent to the complex web of inter-related issues.

Chapter 2. Some ideas about the effect of technology on schooling

In Chapter 1 the changes in the school environment and the causes for concern were outlined. Chapter 2 looks at other studies that have focussed on the social effects of information technology, particularly in schools. Most of the literature relevant to these social effects has tended to be speculative, rather than empirical. However, there are some reports that include empirical studies, but these reports usually have a focus upon specific goals associated with the social effects of computers in schools. An example of such a focus might be the fear of individuals of technology, or the perceived utility of computer awareness for employment. Gender has more recently come under the microscope, and some of this material is relevant to the problem.

Looking at the range of literature available, this section will consider first the speculative, and then the focused studies.

Speculative studies

In 1988, Miles et al presented a picture typical of the time. These authors described the 1980's as a time when the media were filled with pronouncements about the long-term consequences of the 'information revolution' These pronouncements included images of dramatic and sometimes cataclysmic change. The authors divided views about the effects of computers in society into three groups:

Continuists

IT is merely the current stage in a long-term process of developing technological capacities. Revolutionary claims overstated. Rate of diffusion of

IT is and will be much slower than claimed by interested parties. Likely to be many mistakes, failures and discouraging experiences. Main features of society liable to remain unchanged by use of IT: change will come from social and political initiatives. Forecasting can be largely based on extrapolation of past experience. . . .

Transformists
IT is revolutionary technology based on synergistic and unprecedented rapid progress in computers and telecommunications. Positive demonstration effects, and proven success of IT in meeting new social and economic needs, will promote rapid diffusion and organisational adaptation. As major a shift in society anticipated as that between agricultural and industrial societies. IT will change bases of political power and social classes. Forecasting requires identification of 'seeds of future' in exemplary organisations and experiments. .

Structuralists
IT has revolutionary implications for economic structure and may lead to reshaping of many areas of social life. Diffusion of IT will be uneven with some countries and sectors proving far more capable to capitalise on potential. Social change like that experienced in earlier 'long waves'; need for new organisational structures, styles and skills; changes in issue and leadership. Forecasting requires cautious use of both preceding methods, together with such approaches as historical analogy. . . . (Miles et al., 1988, pp. 4-5)

The approach of the authors is reflected in their summary of likely effects in education. Computer assisted learning has had a chequered past, they argue, and it has taken graphical user interfaces and student-centred design philosophies for educational software to regain lost ground. Combined with a movement to open learning, computers have proven more adaptable and useful than early experiments would have suggested. School systems have not fully encompassed these changes. Concentrating upon cognitive development, the introduction of LOGO has however bridged the gap, and this has proven a suitable way to teach problem-solving techniques. At a simple level, the LOGO programming language is used to give instruction to a small robotic turtle. This turtle can very accurately draw with a pen on paper, and students can learn to give it command sequences to produce shapes and pictures (Miles et al., 1988, p. 209).

This prompts the continuist suggestion that all this self-paced material will fail to de-school society, since children are unlikely to be motivated to learn if left to their own devices. The piece predicts that even significant curriculum implementation programs will only produce one computer per 200-300 students. They also point to the likely resistance from teachers, unless teachers become more computer literate. A concern from the structuralists is that the curriculum will be confused with the delivery - that the curriculum will somehow **become** the computer that is used for instruction.

Finally, a common worry in the speculative tradition, is the possible social inequities arising from new imbalances. In addition to the hungry and the well-fed, the rich and the poor, there will arise new classes of information-rich and information-poor (Phillips, 1994).

Mindstorms

A speculative study that has initiated a focused following began as the book "Mindstorms - Children, Computers, and Powerful Ideas" (Papert, 1980). Papert used the book to put forward his ideas of learning by exploring, and in particular, exploring ideas through the medium of a universal machine - the computer. He saw this exploration as an extension of a child's natural ability to acquire language - only in this case, it was the language of the machine - of LOGO. In teaming the child's natural language-learning ability to LOGO, he endeavoured to show that other areas of the cognitive domain could also be conquered. This was accomplished by giving children the chance to construct their own tools and materials to broaden their experience of mathematics, music and so on.

Of course, when using a computer loaded with LOGO software, the user has to be the initiator of any 'conversation'. Certainly, once familiar with the primitive syntax and rigorous spelling requirements of the language, it becomes a powerful way of implementing solutions to problems. However, it is unlikely that the machine will prompt the user with the syntax and effects of a new command as a 'buggy' solution is being put right. Therefore it is difficult for a child to extend knowledge of the language, without an aide or mentor.

In speculative mode, Papert wondered if the new technology would in fact lead to the demise of schools. He compares the preparations for the annual carnival in Rio de Janeiro with formal schooling. The first is spontaneous, yet focussed on a task. The second is formal, and the focus has to be maintained by the leader (the teacher). He hoped that LOGO will be the precursor of a learning environment that can be spontaneous and natural, which will develop because of itself. He saw the turtle as a bridge between the scientific and humanistic traditions, bringing them together (Papert, 1980, pp. 39 & 205-207).

In 'Mindstorms', revolutionists espouse computers as initiators of change. For reformists, the computer becomes a tool for enabling change. For Papert, the computer is a convenient device to stimulate and make significant changes possible - in the realm of ideas, not in educational delivery methods. Education will become concerned with domains of knowledge that can be explored, rather than learned. In summary then, Papert sees the evolution of computers as indistinguishable from the evolution of the people that make them (Papert, 1980, p. 189).

Educational Computing

'Educational Computing', edited by Scanlon and O'Shea (1985) is seminal, in that it forms an important part of a course of the same name offered by the Open University. The editors therefore have a clear commitment to this delivery mode, and it is likely that the reader will be expected to have a similar feeling.

An early contribution to 'Educational Computing' by Hawkridge (Scanlon & O'Shea, 1985, pp. 5 et seq.) comments on the artificial distinction between informal and formal learning. He points out that toys have an large number of computer chips in them, and that the informal learning that surrounds them is just as influential as the classroom. At that stage, the classroom was being transformed by the introduction of computer literacy, and programming to 'understand' the machine was popular. One point of debate was whether students using a computer to simulate a chemical process might confuse the situation with reality. (One notes that other contributors to 'Educational Computing' question whether learner constructs made using a computer will easily transfer to reality - almost a reversal of the earlier worry).

Kemmis et al in the same volume refer to the potential of the computer to keep track of individual students and respond to them or prescribe "for them in spite of wide variations in ability, learning styles and learning rates." (Scanlon & O'Shea, 1985, p. 63) There appears to be some concern here for the social effect of such a 'big brother' machine influence. On one hand in Tasmania, we have seen the introduction of SAS (Student Administration System) to colleges and CARTS (Computer Assisted Recording and Timetabling System) to high schools for administration. These purely record-keeping systems nevertheless have sub-texts of systemic change within them. Certainly with CARTS, the designers envisaged the potential for a more modular or unitised curriculum, and a greater proliferation of short courses in schools. Without a sophisticated timetabling system, the frequent changes of timetable, and the resolution of the interlocking changes for individual students and teachers would be prohibitive. In other Australian States the same picture is seen, with Oasis software in New South Wales, and MacSchool in many independent schools.

However, this aspect of computers in education is not restricted to administrative oversight. The authors are looking to the potential of CAL (Computer Assisted Learning) in a more general sense. They conclude their discussion by arguing that CAL will rarely become a substitute delivery mechanism to achieve the same student outcomes, but must be considered as a viable alternative delivery method for new and different courses. This then is another social effect to be considered - to what degree will prospective changes in the curriculum be engendered by the new technology, and how will internal stresses brought about by those changes be dissipated?

Another interesting facet to the problem is raised by J. Self. He discusses the advent of expert systems and artificial intelligence in education. The prospect was encapsulated by Chapman, who wrote: "if we can compensate for physical handicaps with artificial limbs, why not compensate for intellectual handicaps with artificial intelligence?" (Scanlon & O'Shea, 1985, p. 228). Another possibility (largely unrealised as yet) would be to model the personality of the learner in an expert system shell, and use this to direct CAL. The recent advent of very large capacity storage systems (CD-ROMS) and high bandwidth networking has meant that interactive multi-media (really sound and vision, including text) delivery systems could be coupled with such software. However, this can be considered to be just extended CAL, with the previous problem of curriculum change and consequent social dislocation identified above. This aspect however, makes it necessary to consider more seriously the effect upon, and the possible changing role of the teacher, as well as the position of the students.

In a later piece in the compendium, Hawkridge again takes up the theme, and identifies four social effects of new technology in schools which are very relevant to this study. The four effects are:

1. Age bias: the young take to new information technology more easily than the old.

2. Gender bias (Hawkridge uses the term 'sex', but this author reckons that is something people do): girls have been observed to be more reluctant to use computers than boys.

3. Culture bias: alphabetically written languages in the Anglo-American culture are more adaptable to information processing than others. Also, both hardware and software products tend to carry cultural values with them.

4. Social/class bias: students from lower socio-economic backgrounds may have more difficulty learning using the new technology than counterparts from middle or higher socio-economic homes. (Scanlon & O'Shea, 1985, pp. 240-241)

The implications of Hawkridge's ideas are that any study in this area should address these four issues. The views of older and younger members of the school community should be elicited and compared. Data should also be collected for the gender and socio-economic background of respondents and other participants in the study. There may be evidence of culture bias, and cross-over from other cultures could be apparent. All these issues (except the one relating to culture) were taken into account in the SENTIS project.

Ethics and Belief

To really understand the likely effect of computers in the classroom, it is appropriate to examine some of the important social issues that might be involved in that same classroom. Religion is an historical force with which to reckon, and belief systems form part of the awareness of every teacher. A general introduction to a religious view of technology is found in Lyon, 1986.

Lyon identifies many ethical dilemmas associated with decision-making about technology. The problem of job-displacement or technology causing unemployment is examined. However, he seeks to introduce a Christian perspective into the decision to introduce or upgrade computer technology. For instance, when contemplating the introduction of an office LAN (local area network), is the individual enhanced by being able to co-operate with absent colleagues? The cable connection to personalities hidden around the corner or across the continent might make good business sense, but is it humane? (Lyon, 1986, p. 116)

The argument is sound in an educational sense - that the choice to use technology should be made upon solid educational grounds, and not just because the technology is available. The question perhaps focuses the attention of decision-makers upon the educational reasoning for computers in the classroom - in all its manifestations. Improving the acquisition of cognitive skills might be one justification, but growth in one area might be compensated for by delayed development in the social sphere. The current study aims to help shed some light on this balance.

Peter Large (1984) has a more optimistic stance. He describes the rush to introduce computers into British schools, and compares this with the success of the ITeCs and the Threshold program. The ITeCs and Threshold gave computer competency training to the unemployed and school leavers. Despite lacking formal qualifications in the art, young people were able to become good programmers, and move into a shortage employment area. Analysis of the projects found that 30% of "school leavers had the intellectual ability to become programmers and that a qualification in English language is a better grounding for a programmer than mathematics" (Large, 1984, p. 112). It was particularly useful to see here the two facts brought to light - that computers are accessible to almost anyone, not just students with high general intelligence, and that linguistic aptitude is just as important as any ability to calculate. Language of course, springs from communication, ultimately with another human individual. Could it be that computers used in some modes might actually enhance communication skills, and therefore promote sociability?

Focussed studies

As computers have come more and more into schools, there has been increasing interest in the response of students. With a focus on computer literacy, and an intent to make students better prepared for the work-force, there has been concern to see that computers have been accepted into the classroom. King's (1993) study into anxiety about electronic learning is therefore apposite.

Computer anxiety and implementation

In this focussed study, King looked at the effect of intensive computer use upon 128 grade 7 students in a city school. The student to computer ratio was about 10 to 1, high at the time, but about average when the fieldwork for SENTIS Phase Two was done. King used a pre/post test methodology, and the trial was based upon 8 months of computer use by matched representative pairs of classes. The test used was a 26 item CAIN (Computer Anxiety Index) standardised instrument. The results showed that students generally recorded increased anxiety about computers at the end of the trial, except from one group of boys whose scores changed very little.

Criticism of this study is two-fold. Firstly, the numbers of students were relatively small, and it is difficult to have conclusive evidence from just 4 classes of students. The other criticism is not of the study itself, but of the instrument (CAIN) that was used. Teachers of the classes reported that the questions were 'not user-friendly'. The instrument was devised for an older population that the 13 year old students studied, and possibly the application mix being used on the computers for the standardisation was significantly different to that on the study machines. One aspect of the study that was useful though, was the identification through interviews of some of the major causes of anxiety. Restricted access to computers was seen by both teachers and students as a worry, even at the "greater-than-usual ratio" of 10 students to each computer. Another interesting comment about the application mix, came in the form of a contrast between 'game-like' and 'tool-type' educational software. In discussion, King speculates that game-like software encourages impulsive actions that do not work when students are confronted with software tools that require reflection for effective use.

But what about the feelings of students themselves towards the computers entering their classrooms? Some light is shed on this side of the question is shed by Oliver, 1993 as he examines the perceptions of school leavers towards information technology skills. Questionnaire responses came from 453 students, 19 teachers and 48 employers. The study showed that in Western Australia, final year grade 12 students had little access to computers. However, 37% of students used a computer at home (very comparable with the SENTIS results), and leisure applications formed a significant proportion of this use.

In Oliver's study, there was clearly some blurring of responsibility for IT familiarity. Schools, students and employers were all stake-holders, but there was no commonly accepted pattern or accountability for this aspect of skills education. Employers expected that far more students would be familiar with IT than the students themselves perceived likely.

It is fair to ask, what is being done with computers in schools? Once again, if there is a social effect of new technology in schools, it might well depend upon the activities it is associated with, and the part the machinery is asked to play in the life of the lesson. If computers are being put to work in unsuitable contexts, the expectation would be that students will feel negative towards them. This in turn might be a factor in determining their feelings towards one another.

A description of the role and use of IT in schools is available in an analysis performed in the Australian Capital Territory by Atkins and Vanzetti (1992).

Firstly, the results were patchy. That is, the degree of involvement of computers in the curriculum varied from school to school. Also, the perceptions of teachers were generally positive - they felt that computers had a considerable role to play in education, and enhanced the teaching/learning process. There were difficulties, either technical, budgetary or simply due to the pace of change in the technology. However, computers were still seen as an adjunct to an existing curriculum, rather than a tool to engineer radical curriculum renewal. Perhaps because access to the computers was still limited, they were not yet rated as significant agents of change?

This study is however, very useful in describing the application mix - the typical software used in the classroom. As one would expect; the pattern varies according to the age of the students. In primary schools, the concentration was upon desk-top publishing and integrated office productivity software. Nearly equal in terms of use were simulations and adventure games. Another big area was support for Mathematics, although this was divided between problem-solving software and drills. Lastly there was also some language software - which also included some adventure games. Very little computer support for the science curriculum was found.

In the high schools, a predictable high level of use in the specialist Information Technology courses was found. However, this was actually surpassed by Integrating Studies, whilst Mathematics and Science areas came behind. There was a general spread into most other areas of the curriculum at a lower general level. No mention of leisure activities, or of computer use outside the taught curriculum is made.

Achievement, attitudes and self-esteem

The study that gets close to the SENTIS problem area has been done by Gail Ryser (1990). She looked at 114 primary school students in a pair of matched schools over a 6 month period. One school were using a program which gave a lesson of computer instruction every day - the other did not use computers. Ryser tested four main hypotheses - and the results are briefly described below.

> Achievement: the computer using students did not record any significantly different academic achievement than the control group.
>
> Personality: students that used computers had a higher score on the internal locus of control dimension. This means that they generally took more responsibility for their own behaviour, and believe that they control the conditions of their lives.
>
> Attitude toward school: computer using students generally had a more positive attitude towards school, and they indicated that the computer lab was their favourite area of the school.
>
> Ability: IQ and age were found to be the best predictors of school achievement.
>
> (Ryser, 1990, pp. 100-105)

In summary then, Ryser argues that although academic achievement was not significantly different between the two groups, there were grounds to believe the increased motivation of the computer using students would lead to greater achievements in the future. Through using the computers, students had become more independent learners, and liked school more. Looking at the sub-scale results of the instruments she used, there was evidence that computer using students also had a higher estimate about their ability to do well in their endeavours, whether with other people or on individual projects. Ryser's conclusion about the short term effect of computers on achievement was echoed by Gardner (1992) in respect of a trial of 250 laptop computers over a one year period.

Another major study which examined the effect of computer use on student achievement has been done by Cox et al (Cox, 1993). The study was commissioned by the U.K. Department for Education and was conducted over a 3 year period to evaluate the impact of information technology on children's achievements. The results showed that those classes of pupils which had the highest regular use of information technology in a subject, experienced an improvement in learning compared with low or non users. There were an average of 19.9 students per computer in secondary schools in this ImpacT study. An average number of hours of computer use per student per term was calculated for the project, and although this was allocated to subject areas, no qualitative assessment of the nature of the use was possible.

Summary

The literature reviewed above gives us some pointers into the field of concern. The speculative studies were generally older, and were written in the mid- to late eighties. The focussed studies were more recent, showing a more refined approach to the concerns about the interaction between computer technology and the students in the care of schools.

The work of Mark Lepper forshadowed this current study in many ways. His work combined speculations about the effects of computers in education, with some empirical studies examining the situation. In Lepper (1985) he looked at the theoretical and practical significance of 4 issues.

1. The computer as a vehicle for studying intrinsic motivation.
2. The relationship between motivation and instructional effectiveness.
3. The contrasting philosophies of education encapsulated in software.
4. The effect of computers on social equality, social development and the goals of formal education. (Lepper, 1985, p. 1)

As far as the current study is concerned, the fourth item is relevant. Lepper examines the social equity question, the way in which information technology might widen the gap between rich and poor. However, he does report findings that show motivational materials boost the performance of lower ability children, actually narrowing the gap.

Lepper actually asks the questions closest to the intentions of the SENTIS study. "How will this new medium, for example, affect children's social interactions and social abilities? . . . . How will children view computers and interactions with others via computers or other telecommunications systems? Will their perceptions of human nature be affected? Will they come to learn that computers are dependable and consistently friendly, whereas people are moody and often unpleasant?" (Lepper, 1985, p. 15)

Further on, he raises the displacement theory being tested here: "Will children spend less time engaged in active sports or informal play activities?" (Lepper, 1985, p. 15) A contrast is made between the advocates and critics of computers in education, and a reflection on the fundamental theoretical disagreements about the basic empirical questions. The SENTIS project attempts to correct his conclusion:

> At present, there is virtually no research concerning such issues. What little comparative research has been done on the effects of this technology is almost entirely focused on purely cognitive and instructional questions. Yet it seems critical to examine the larger issues now, before this technology becomes such an integral part of our daily lives that it will be, as was the case with research on commercial television, too late to ask critical questions. (Lepper, 1985, p 16)

Therefore the SENTIS project was to have three main parts - empirical work to gather data on the actual computer use, recording of attitudinal information, and collation of friendship patterns. This would enable the speculative expectations of the participants to be matched against data drawn from the field.

Chapter 3. Investigating the social effects of technology on schooling

Background

Definition of terms

Sociability

In this chapter, it is important to establish the meaning given to several phrases that will often be repeated. Social behaviour often arises through a process of socialisation - a process which establishes conformity of individual behaviour with prevailing perceptions of group norms. Theories of socialisation have moved from two opposing poles to a more didactic idea of the process and its nature. The *tabula rasa* pole described the way in which the young child went through a process of enculturation, acquired impulse control and was trained in a suitable role. A more Piagetian stance held that the infant in fact chooses his or her own developmental path, focusing on parts of the environment that were most relevant.

Schaffer and Crook (1978) introduce us to Ziegler and Child's characterisation of socialisation as:

> . . . .the whole process by which an individual develops, through transactions with other people, his specific patterns of socially relevant behaviour and experience. (Schaffer and Crook, 1978, p 58)

This moves us beyond the concept of socialisation as enforced conformity, whereby a child is pushed into compliance. Rather, we now see socialisation as a mutual development of the child and the people it comes into contact with. Examples are given of the synchronisation of sucking bursts on the part of the breast-feeding child, and alternate stimulation by the mother as the child rests. From this early stage, the infant learns to integrate responses over time, to the point where turn-taking is an established skill and alternating dialogue is possible. This is refined into adolescence and adulthood to the point where both partners in a conversation are able to sustain it and play mutually integrative and exchangeable roles ("speaker and listener, actor and spectator, giver and taker, and so forth").

A person's behaviour can be described as 'sociable'. An individual displaying 'sociable' behaviour is generally regarded as exhibiting behaviour which at least conforms to societal norms. Generally, sociable behaviour is an aspect of individual behaviour which is regarded as better than the norms. In western society, this kind of behaviour might be typified by an above average capability to co-operate, be honest, communicate with others, etc. Sociability is the ability of an individual to act in a way which is sociable. In this study, the sociability of individuals in groups is reflected by the presence of friendships which are based upon caring relationships between individuals.

Computer

Likewise, a recurring phrase in this report will be the term 'computer'. This does not have a simple stable definition. By juxtaposition in the SENTIS survey, students were given to understand that a computer at home was taken to be similar to those they see at school, though this similarity was not made explicit for fear of overloading the survey instrument with non-essential reading activity. Computers in the sample schools at the time were characterised by:

Accepting keyboard input, with some use of a pointing mechanism (typically a mouse)

Producing output on a screen, with some simple sounds

Most would use a textual interface - some would be using a graphical user interface.

All would be capable of word processing.

Academic success related to social interaction

The SENTIS project was concerned with the effect of computer use on sociability and socialisation. What are the mechanisms normally involved with these processes? What factors might inhibit the normal mechanisms, and how is cognitive development involved? An investigation by Perret-Clermont (1980) reported a series of studies demonstrating that children's chances of success at school vary according to their social origin. Further studies showed correlation between school success and verbal and intellectual aptitudes, which are linked with social class. Perret-Clermont's own study investigated the relationship between sociability and cognitive development within a Piagetian framework. She described the way in which discussion with peers enhanced a child's understanding of conservation, at the stage of concrete operations. This simple socialisation was reflected in cognitive development (Perret-Clermont, 1980, p 65).

The consequent thesis - that children's cognitive development is enhanced if they are allowed more social interaction with other children, lies at the heart of the modern-day co-operative education movement (Doise & Mugny, 1984, p. 27; Johnson et al, 1981; Hill, 1990, p. 2). It is also seen as a way to address the diversity of student needs, taking into account that 10 to 25 per cent that have academic or behavioural problems. Therefore, in the SENTIS project, any observed social effects of computers may well have linked effects in the cognitive domain.

Mechanisms relating cognitive development and socialisation

What is known about the links between cognitive and affective development? Perret-Clermont, Piaget and Vygotsky point towards an understanding of the nature of the link. Perret-Clermont notes that sociable behaviours are not necessarily the most complex. For instance, blackmail is not sociable, but requires a high degree of social intelligence. An individual generally exhibits the ability to see things from another person's point of view before displaying sociable behaviour. This decentering ability is generally noted at about 9-10 years of age (Flavell, 1968)

Piaget hypothesized an interdependence between cognitive structures and the forms of socialization - on the level of behaviour as well as of judgement or representation. Many experiments have examined the role of socio-cultural environments upon development, as well as the importance of social interaction in development. However, little seems to be known about the mechanism connecting these two phenomena.

Vygotsky's constructionism offers some clues as to a possible mechanism (Vygotsky *trans* Hanfmann, 1962). If one regards the cognitive development of each individual as an emerging construct, then speech and dialogue will be important in the formation of the construct. For through speech and dialogue, the individual explores the precursors of each construct, and refines the construct's relation with others that have been determined previously. According to this framework, social interaction is an important part of learning language, and therefore crucial to the continuous refining process of education.

Socialisation in a group context

Given a constructivist framework, what is the role of the social environment for the development of the individual? Groups of people often have a purpose which is collectively pursued (Sprott, 1963). In this context, they have standards of conduct, which are a necessary feature for group interaction to proceed. The standards can be derived from a wider group context (beyond the collection of individuals being considered) and can cover expectations and mutual esteem. Individual action in accordance with these group standards will be regarded as 'right' (Sprott, 1963, p.

13). It could be said that this framework of standards is essential for the persistence of friendships.

The nature of the primary grouping (whose members meet face-to-face) within a classroom, needs to be set in the context of the much larger secondary group within which it operates. A secondary group (such as a nation, whose members do not meet face-to-face but share common symbols) will provide some of the features necessary for friendships to form within the primary group. These might include a common language, legal and education systems, common symbols and a geographically dispersed communications infrastructure (Sprott, 1963, p. 63).

Within the primary group then, we need to examine the formation of specific group standards. Such standards cannot emerge without communication between the group members, vocal or in terms of other gestures. To become internalized, each individual needs to be able to anticipate the effects of an action, to reflect upon the possible response of a generalised 'other' who epitomises the group standards. This accords with Flavell's (1968) model of socialization related to decentering ability (as described in the previous section).

At this point it is appropriate to examine the role of the group in socialisation, as opposed to the growth of sociability. The pressure of the group on the individual is towards conformity. This is explained by a need of each individual for 'approval', said to be derived from nurturing in childhood where existence depends upon the goodwill of surrounding adults. Socialisation is achieved, sometimes enforced, by the discipline of parents and the demands of co-operation by other children.

From socialisation to sociability

Going on from socialisation, and the mechanisms by which it arises, sociability can derive from interaction. According to Homans:

> If the interactions between the members of a group are frequent in the external system, sentiments of liking will grow up between them and these sentiments will lead in turn to further interactions over and above the interactions of the external system. (Homans, 1951, p. 112)

Homans develops this thesis by putting it into the context of social scales or ranking, and socialization. This aspect was taken up by Moreno (1953) by the establishment of the technique of sociometry to measure group cohesiveness and the preference structure of a group.

Most children in Western cultures are age-graded. In many other cultures age-groups are cornerstones of community development and encompass all adults as well. In many cases entry into an age-grade cohort is by self-selection or initiation rather than the calendar methods used for western youth. Students selected for a class because they have birthdates falling in a single calendar year can have a wide range of abilities and interests.

Why bother to look into friendships? Because low socialisation correlates with social deviance. "All the evidence indicates that popular children are those who can adapt their behaviour to the needs of the situation, and to the needs of their companions. They are thus usually friendly, happy, talkative, energetic, enthusiastic and daring. It seems then, that popular children are those who are able to make good personal adjustments to their fellows according to the standards and values of our society, whereas unpopularity among other children may be a sign of emotional maladjustment in a child." (Lovell, 1971, p. 197).

In Hartrup (1978) inter-group fights between two matched groups of boys were only diminished when group members were required to work co-operatively on something important to them - such as restoring the camp water supply.

> Having friends is considered a significant social achievement, and indicator of social competence, and a mark of positive mental health. Not having friends brings children to consulting psychologists. And, as yet, little is known about friendship formation in children, the age-related vicissitudes of friendship, and the characteristics of children who have many mutual friends as compared to those who do not. (Hartrup, 1978, p. 149)

Friendships involve pairs of children - they are dyadic. They have nothing to do with popularity.

Therefore, the SENTIS study considered some important variables. For instance:

> Is the school organised using vertical age home groups? (This should promote socialisation).
>
> Do the students work in mixed ability groups or are they divided by ability for different subjects? (Stable mixed ability groups should promote socialisation).

Measurement techniques

Having established that friendship patterns can indicate the sociability of the individuals in class groups, how can data about these patterns be gained? The sociometric technique was used by Festinger, Schachter and Back (1950, p. 177) to conclude that friendships are established as a result of proximity in housing estates. Additional research has shown that the attitudes, habits and aspirations of the people living in the estates are also very important.

The sociometric technique was also used by Infield (1955) to predict the survival of returned war veterans' groups and to examine the relationship between economics and group structure in 'Clermont', a community of work in France.

Sociometry in the classroom

Teaching and learning involve particular kinds of interpersonal relationships. Positive self-esteem is established by feedback from peers and important people in a person's environment. (Schmuck & Schmuck, 1983, p. 173)

An empirical study of classrooms pointed directly to the importance of peer group interaction and interdependence (Calonico & Calonico, 1972). The study showed that the more frequently students interacted with one another, the stronger were their feelings of friendship for one another. The research also corroborated the common hypothesis that friendly people receive supportive feedback and unfriendly people receive negative responses. It also confirmed the idea that students with higher sociometric status tended to conform most closely to the group norms of behaviour.

Group structure

The research into classroom climate is also important here. Schmuck (1966) showed that classroom groups with diffuse friendship patterns exhibited more positive climate than classroom groups which were centrally structured.

> Centrally structured peer groups are characterized by a large number of pupils who agree in selecting only a small cluster of their classmates as pupils they like. along with this narrow focus on a small number of pupils, many other pupils are neglected entirely. Diffusely structured peer groups, on the other hand, are distinguished by a more equal distribution of liking choices; by no distinct sub-groups whose members receive a large proportion of preferences; and by fewer entirely neglected pupils. (Schmuck, 1966)

It is worth noting that in centrally structured classroom groups, students were more accurate in estimating their liking status than in the diffusely structured groups. Schmuck's further work on the subject showed a relationship between classroom liking structure, group norms and cohesiveness. This makes the investigation of group integration seem like a worthwhile avenue of research, since it seems closely tied to success in school, and is a tangible pointer to classroom climate, self esteem, and other variables that good education hinges upon.

The theoretical background for the accuracy in self-estimation and centrally structured groups is said to lie in Gestalt perceptual theory (Kohler, 1947) and group dynamics (Cartwright and Zander, 1969). The more distinctly defined the structure, the easier it is for students to perceive their place within it. From the point of view of a communication net, task leadership is more easily recognised in centrally structured groups in terms of the approvals for actions a student makes that are consistent with their position within the group. These approvals from within the group are an important indicator of an individual student's position, and such positive choices verify the student's behaviour as being consistent with group norms. However, in such centrally structured groups, as a new student strives to validate his or her social position, he or she gets more negative than positive choices, and consequently encounters some sense of rejection. This leads to negative opinions about self worth, making the classroom seem a threatening environment. In a more diffuse group, where there is no such clearly defined central structure, a student receives about as many positive choices as his/her peers, leading to high self esteem, and consequently good academic performance.

Lewis and St. John (1974) looked at the achievements of black students in 22 majority white classrooms in Boston. They found that acceptance of black students into the classroom peer group was especially important to their progress. This gives further evidence that friendships are important to success at school, and substantiates the suggestion that sociometric indices will prove helpful in unravelling the effects of individual computer use upon socialisation.

Cohesion and interaction

In Schmuck and Schmuck (1975), the authors argue that group cohesiveness is bred by high levels of interaction, and results in high self esteem for the members, and supportive norms. Group integration can be taken as a sociometric assessment of group cohesion, at one level. Evidence for this is given by the way in which classes with diffused friendship structures were found to be more cohesive than those with centralised friendship structures. Cohesion depends upon the degree to which the members of the class are allowed to interact, and in co-operative learning, this is enhanced.

The dependence of cohesion upon communication is explained by Luft's (Schmuck & Schmuck, 1983) model of interpersonal behaviour. In Luft's Johari model of Awareness in Interpersonal Relations, the Quadrant I contains behaviour, feelings and motivations which are known to self and also known to others (Schmuck & Schmuck, 1983, p. 174). By increasing the openness of this quadrant, group members become less afraid of giving feedback to one another, and this leads to greater communication. This greater communication leads to mutual liking, and hence cohesion. It can therefore be concluded that a possible approach to assessing sociability will be to measure group cohesion using sociometric methods.

Although standard sociometric methods can show group cohesion, Renato Tagiuri, (1966) gives details of an extension of normal sociometric methods. Using his extended method, subjects are asked to guess who might choose them, and who might not. With this additional detail, he is able to provide another method for measuring group cohesion. The additional data provided by this technique has to be weighed against the increased intrusion into the lives of the data subjects.

The validity of sociometric assessments.

If sociometric methods are used to measure group cohesion, how reliable are they? Byrd, 1966 gives details of a test of the validity of sociometric tests. By making the criterion of choice relate to a real situation, the correlation of a re-test was found to be 89%. This suggests that the degree of change in a choice behaviour between a sociometric test and a life situation is small, and similar to that between the test and a subsequent re-test. Therefore the sociometric method should be fairly reliable.

Cliques and larger groups

Sociometric methods have been used before in schools. Hargreaves, 1973, gives an intimate analysis of the 4th form of Lumley Secondary Modern school. From his sociograms of each of the classes, he is able to identify cliques, (sub-groups within each class), of members that identify together. Additionally, from his observations of the students, he is able to identify group norms, and their differences from group to group. These norms included attitudes to copying, fighting, etc. In one case, the class comprised three separate cliques, with no inter-linking choices at all.

This kind of information drawn from sociometric methods in a school adds weight to the idea that they can provide appropriate information for the SENTIS project. Another kind of information these methods can reveal is described by Dunphy (1983), who paints a coherent picture of the individual emerging from the family unit at adolescence. In Sydney, membership of a single gender 'gang' turned into a clique, usually based upon residential proximity. These cliques had about 6 members, and inclusion in such a group was essential for entry into a larger crowd of 14 to 15 year olds (Dunphy, 1983, p. 376). Boys in heterosexual cliques were on average 10 months older than the girls, and this age relationship was preserved in the uniformly heterosexual weekend crowds. As individuals matured, they passed through the crowd stage, which disintegrated into couples. To obtain membership of any of these groups, individuals had to push for inclusion, and show they shared the peer group values. Dunphy also noted the complimentary roles of the socio-centre (the witty one (p 383)) and the group leader, echoing the roles of parents in the family unit from which the individuals were emerging.

One commonly identified clique consists of computer nerds. Computer 'nerds' have been identified in the media for quite some time, and these will undoubtedly influence the results of the investigation. However, the purpose here is not to focus upon a relative few who experience a gross effect, but rather to see if there is a smaller but more pervasive effect over the total school population. Whilst there may be cause for concern for the nerds that requires individual treatment, a greater concern might be expressed if the structure of society was about to change in response to an unforeseen breakdown in the sociability of its future adult members.

Computers and microviews

If computer use is suspected to affect friendship patterns, what other effects might there be which could confound the situation? It might be helpful to consider other studies that have examined intensive computer. Taking a Piagetian view of a 6 year old's cognitive development, Lawler (1985) looks at learning LOGO. Although he starts the book by suggesting that the Intimate Study (a 9 month observation of his daughter's learning) was inspired in part by Piaget's focus on cognitive structures, the story unfolds to examine microviews. These are internalised understandings of the world, and of the aspects of the environment about which Miriam is learning. In many ways they resemble a Vygotskian series of interlocking and related constructs. Therefore these microviews can be considered as extensions of the learning that should normally be expected in a school.

Lawler identified four routes to learning within the context of LOGO, which have their analogues in many learning situations. Neat phenomena (inherently interesting situations), debugging (identifying faulty solutions and fixing them), giving hints (accessing additional information resources) and knowing good tricks (developing mastery) were all distinguishable aspects of significant learning opportunities. Given this categorisation of learning opportunities in a situation of intensive computer use, the expectation is that the computer in school should enhance learning by giving alternative ways to use standard learning techniques. The SENTIS project aimed to investigate whether these alternative ways to learn also have an effect on sociability.

The SENTIS study

In brief, there is an understanding that social interactions are an important part of cognitive development and are essential for socialisation. This socialisation has sociability as one aspect, which is evidenced by friendship patterns. An important variable in these patterns is group integration, a measure of sociability which can be quantified using sociometric methods. If increased use of computers leads to more isolated social behaviour, then this should be seen by a corresponding change in the group integration.

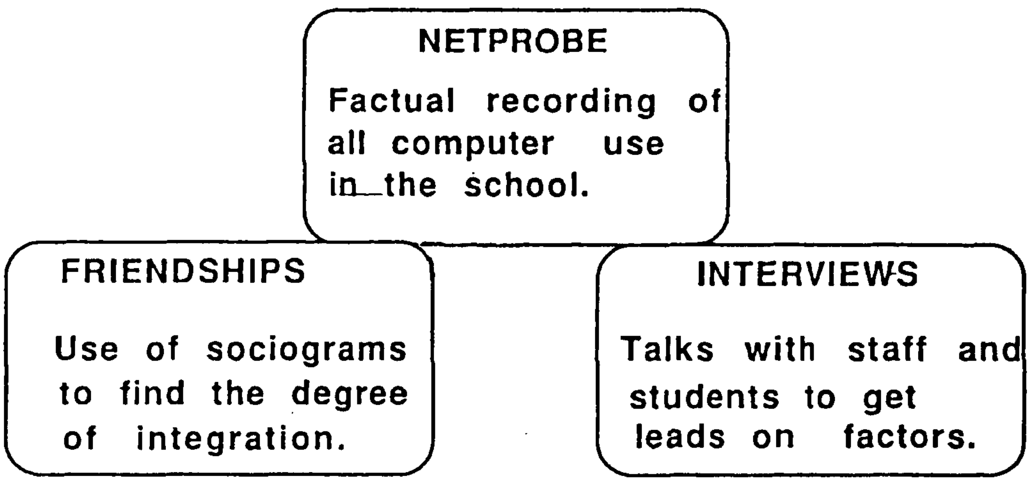
The null hypothesis

Having discussed the factors that are supposed to be relevant to the SENTIS study, it is possible to formulate a statement that can be tested. Since the background to the study does not predict the size or extent of the effect of using computers in schools upon sociability, a null hypothesis was used. In this study, the null hypothesis to be tested is expressed as follows:

"The use of computers in schools has no effect upon the sociability of the students."

Chapter 4. Phase One

Figure 2 - The Reasearch Strategy consisted of three interlocking investigations



The Research Strategy

In this SENTIS study, students were examined as part of a group. Generally these groups were established by the school, and students had little choice of which group they were put into. However, since the examination was done at the end of the school year, students identified as members of the group, and mutually interacted. This was demonstrated by the fact that they were able to name each other on the survey instrument.

The emphasis of this SENTIS study was upon the macro-effects rather than the small group apocryphal ones. By taking the group integration index of each class, and then averaging this for the whole school, any general pervasive effect of computers upon friendships would be discovered.

Phase One of the project was a pilot study to evaluate the methodology. It tested some of the research tools for the project and also established some base-line measurements for comparison purposes.

The methodology of the project was based upon a classical data triangulation technique, common in sociological and ethnographic investigations (Smith, 1975, pp. 271 et seq.; Jupp & Miller, 1980, p. 35). Generally such investigations are difficult to repeat, especially when they focus upon human behaviour. Therefore the researcher attempts to obtain data from several different sources. Ideally these sources contribute to an understanding of the problem being investigated, and reveal similar data about the problem area. The sources need to be discrete if they are not to contribute similar confounding information. By taking three kinds of data from different sources that give indications about the problem area, it is hoped that any difficulties in one area will be illuminated by the other sources. Together the several data sources can confirm findings found from any single source. Collectively, the several data sources can bring a wider understanding of the issues and relationships that are relevant to the problem area.

The SENTIS project used an investigation with three strands:

1. Recording of all computer usage in a school, to provide a measure of the actual distribution of human-computer interactions, usually with an automatic network probe, or from a survey of all students in a school.

2. Gathering friendship patterns and sociability data through the administration of standard sociograms.

3. Collection and collation of attitudinal data from personal recorded interviews with teachers and students to compare with the information from the first two stages.

Each strand has a different emphasis, and different strengths. If the same conclusions can be reached by separate strands, this increases the validity of the study. The characteristics of the three strands are summarised in the following table:

1. Computer-use recording: strong on internal validity - the automatic net-probe does not rely upon perceptions of the participants, nor does it require the investigator to make judgements.

2. Sociograms: the survey-like technique gives the researcher control over the stimulus, and provided the population sample is well chosen, good representation. The choice of sample is also important in ensuring population validity and ecological validity.

3. Interviews: structured interviews eliminated procedural reactivity. The final open-ended questions allowed a more ethnographic investigation, disclosing more about the expectations and understanding of the situation by the teachers and students.

Taken together, these three strands of the research design promised to give good validity after triangulation, for the results to be generalisable to Tasmanian high schools.

The initial stage in analysing the data would be to compare mean computer use per student per day with mean group integration, and see how this changes over time. This would then be matched with frequent or striking reflections from the interview data, and threads of concern followed into the numerical results. Additional information from the sociograms and computer use surveys would then be analysed to see if a range of other variables influence the situation. These included:

gender
home computer use
rural/metropolitan home
family modem access

Each of the variables could affect the way in which students had adjusted to computers, and how the environment in which they lived portrays them. If computers were an established part of the home, this may mitigate any deleterious effects of reduced human interaction in the school. However, if computers were not to be found in the home to any great degree, then this might mean that computer use at school has a significant effect upon sociability.

Fieldwork

The Phase One fieldwork was conducted during the latter part of 1989 in a broad sample of Tasmanian schools. The schools included both primary and secondary, single gender and co-educational, as well as a mixture of government and independent schools (Fluck, 1990, pp. 365-368). The intention was two-fold:

1. To collect initial data on the social effects of computers in schools, at a stage when availability and usage of the technology was at a relatively low level compared to the maximum possible (a computer for every student).

2. To examine the rough correlation between the sociability of students and the amount of computer use in schools.

Phase One data sample

At this first stage of the investigation, the sample chosen was as wide as possible. As will be seen in the results section, the subsequent sample for stage two was more refined. Since the primary schools showed a much reduced level of actual computer use, and also there was no sign of disproving the null hypothesis, they were omitted from Phase Two. Also, the independent single gender school gave results that were particularly different to the other schools, and it was also omitted from the subsequent phase.

The study was going to be longitudinal, so the design needed to carry some techniques into subsequent years. Design decisions at this stage concentrated on simple data collection, in case atmospheric changes made sophisticated analyses of similar data from the following matched studies impossible. The simple sociogram to measure group integration was a suitable instrument that could be used repeatedly for home classes towards the end of the academic year - when they had had a suitable length of time to become established. In the case of the measurement of computer use, the mono-platform netprobe mechanism became redundant for the second phase. Based upon the proprietary 'econet' cabling system of computer networks, it was out of date in technology terms within three years.

Phase One collection of computer use information

The computer usage information was gathered with a minimum of intrusion. In sample schools where all the computers were linked together by network cable this was done by installing a network probe machine (or netprobe). For stand-alone computers with no inter-connections, a simple record pad was placed by the machine for users to log each occasion they operated the equipment. It was difficult to know how reliably these pads were used, and in one case a school was eliminated from the investigation because the pads were not used properly (see Appendix Figure 19).

The original netprobe was based upon a piece of software written for an investigation of a special school network in the UK (Cumberland, 1988). The software was run on an extra computer loaned to the school for a timetable cycle, and monitored school network traffic for 5 minute periods. At the end of each 5 minute monitoring period, the computer printed out the unique station numbers of all the computers that had transmitted in the period. Since the physical location of each computer was known in relation to its station number, this created a data-file of each computer's use by time throughout the recording cycle. In the case of the St. Christopher's network, Cumberland found that the school computers were used most intensively during the lunchbreak, amounting to 26% of all the computer use throughout the week (Cumberland, 1988, pp. 24-26). To have a quarter of the actual resource utilised by student-directed leisure activities in lunch breaks seemed an unusual application of computers. An analysis was therefore made in the SENTIS project to map computer use according to the time of day, giving a picture of the relationship between free and lesson time use.

One difficulty arose with the automatic netprobe. Some students would use a computer intensively, and spend a lot of time continuously on-task. Depending upon the application, this pattern of use might produce no network traffic from the computer workstation. Therefore the computer would not be recorded on the netprobe as having been used in a 5 minute period, whilst in fact the student was typing a great deal into the keyboard. This difficulty was resolved by visually monitoring lessons in one of the schools, and comparing this assessment with the netprobe. It was found that about 30% of actual student computer use was missed by the netprobe because of this effect. Consequently, the duration statistics for computer use from the netprobe were multiplied by a 1.3 correction factor.

Phase One collection of friendship data

In Phase One, sociogram data was collected from a sample of home-group classes in each school. In the case of primary schools, students were in stable groups most of the year. In the high schools, students normally recorded their attendance in 'home-groups every day, and these groups often stayed together for core subjects like English or Social Studies. These home groups were well established by the end of the school year when the data collection was done. It was to be expected that group integration in the home groups would be higher than in any other school-established classes. Moreover, the group integrations measured in this way would be comparable from school to school.

The sociogram information was collected in the primary schools by the class teacher. Each teacher was given the same instructions for this activity (see Appendix Figure 20). Although the instructions required five friends to be nominated, this proved too hard for many respondents. For all the Phase One sociogram data-sets, the group integration was calculated both on the basis of five peer nominations, and also on the basis of the first three of the peer nominations. The results were so similar, that only three nominations were requested in Phase Two. Results for Phase One are tabulated with group integration calculated on the basis of the first three peer nominations from each responding student.

Phase One interviews

The interviews with the students and staff proved most informative. In the primary schools, the interviews with students were conducted as group sessions with the whole class. The classes selected were those that had given sociogram information. To provide some 'payback' for the information, the investigator conducted a lesson for each class. Three stimulus objects were introduced to the students - a loom, a hand-turned sewing machine and a laptop computer. The students were divided into three groups and asked to investigate the objects. After they had used them, and explored their construction, each of the groups reported back to the whole class. Each reporting group was asked to comment on:

when the object had been made

when objects like this had first been used

how it worked

what it did

how had it changed people's lives when it was first used.

After the reporting back session, the class was led into a discussion of the agrarian, industrial and information ages. The students were asked to comment individually on the effect of computer use on friendships. This information was collected on audio-tape (with consent).

In the high schools, an interview schedule similar to that used in Phase Two was employed. The details are given in the Appendix (Appendix Figure 21).

Data analysis and reporting back

Once the data had been collected, the researcher analysed and collated it. A portrait of computer use for each school was extracted, and sent to the relevant principal. In the case of Phase One, this included an analysis of computer use by time in the time-table cycle. This was found particularly useful in the identification of under-utilisation of the equipment. It was also useful in the identification of computers that were rarely used through the entire time-table cycle.

In each phase, anonymity for the school, the students, and the interviewees was assured. Therefore this report analyses the data by school, and gives each school an identifying code letter. In the case of comparisons between Phase One and Phase Two, the same letter is used for the same school, and a data collection year is appended.

Phase One results - computer use information

Figure 3 - Summary of Network Probe recordings from a Phase One School

Percentage of time computers are in use as a fraction of total computer time available in each area of the school
SUMMARY FOR COMPLETE RECORDING PERIOD

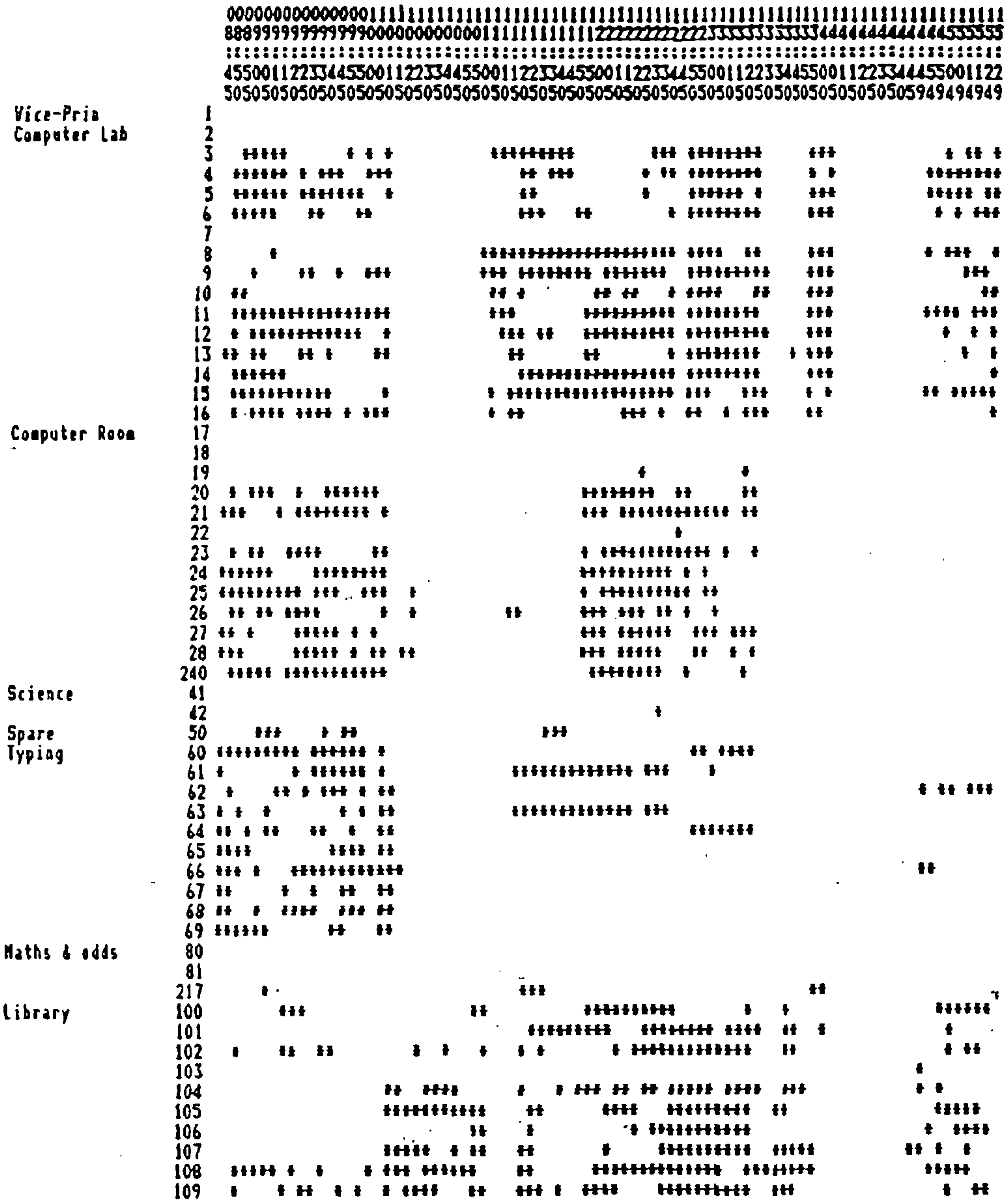
	Pre-School 00:01+	Period 1 2 3 08:35+	Recess 10:50+	Period 4 5 11:10+	Lunch 12:35+	Period 6 7 8 13:25+	After School 15:25+	TOTAL
Vice-Prin	n/a	2%	0%	4%	4%	2%	0%	2%
Computer Lab	n/a	43%	28%	51%	63%	39%	12%	44%
Computer Room	n/a	28%	28%	35%	45%	21%	3%	29%
Science	n/a	0%	0%	1%	0%	0%	0%	0%
Spare	n/a	23%	5%	35%	19%	13%	0%	20%
Typing	n/a	31%	10%	35%	9%	25%	4%	25%
Maths & odds	n/a	9%	5%	13%	6%	10%	2%	9%
Library	n/a	28%	20%	34%	58%	27%	5%	31%
TOTAL	n/a	30%	20%	34%	41%	26%	6%	30%

Computer use in each area of the school as a percentage of actual daily use
SUMMARY FOR COMPLETE RECORDING PERIOD

	Pre-School 00:01+	Period 1 2 3 08:35+	Recess 10:50+	Period 4 5 11:10+	Lunch 12:35+	Period 6 7 8 13:25+	After School 15:25+	TOTAL
Vice-Prin	0%	20%	0%	30%	20%	30%	0%	100%
Computer Lab	0%	30%	3%	23%	16%	26%	1%	100%
Computer Room	0%	3[illegible]	5%	24%	18%	22%	0%	100%
Science	0%	0[illegible]	0%	100%	0%	0%	0%	100%
Spare	0%	3[illegible]	1%	34%	11%	19%	0%	100%
Typing	0%	3[illegible]	2%	27%	4%	28%	1%	100%
Maths & odds	0%	29%	3%	29%	7%	31%	1%	100%
Library	0%	27%	3%	22%	21%	25%	1%	100%
TOTAL	n/a	31%	3%	24%	16%	25%	1%	100%

When the automatic netprobe information was processed, a record sheet of computer use was produced, as in Figure 3. From this sheet, a statistical summary was made, giving the percentage of time that computers were in use as a proportion of the time they were available. This showed the intensity of computer use in each area of the school. In some schools, the intensity of computer use was at a maximum at lunch time, rather as Cumberland had reported in his study (see Figure 4).

Figure 4 - Example analysis of Phase One computer use by each area of the school



The information was also presented in another way, to illustrate the spatial and temporal distribution of computer use in the school. Once the total computer use had been calculated, this was multiplied by the 1.3 factor obtained by comparing visual observations with simultaneous netprobe data to give weighted mean computer use. This was divided by computer time available to give an overall computer utilisation for each school. The weighted mean student-accessible computer use was also divided by the number of students on the roll, to give weighted mean computer use (hours per student per day). The computer use was also analysed on a free-time/lesson-time basis, to calculate the fraction of total use that occurred in free-time. The originally published results are summarised in Figure 5.

Figure 5 - Summary of Phase One results

School	Single /Mixed Gender	Grades	Students on roll	Students /computer	Overall computer utilisation	Weighted mean computer use (mins /student day)	Mean Integration index	Recording technique (Automatic /Manual	Free time use
A89	S	G8-G12	550	22.9	18%	3.6	.211	M	14%
B89	M	G7-G10	750	14.4	39%	12.0	.334	A	20%
C89	M	G7-G10	500	19.2	36%	7.9	.665	A	10%
H89	M	G7-G10	494	21.7	23%	6.7	.354	A	18%
D89	M	G1-G6	330	47.1	35%	2.9	.214	M	6%
E89	M	G1-G6	265	37.9	20%	2.6	.372	M	41%
F89	M	G1-G6	540	23.5	15%	2.3	.284	A	33%
G89	M	G1-G6	270	16.9	20%	4.9	.360	A	28%

In this first phase of the investigation, a comparison was made with the work of Cumberland (Cumberland, 1988). In his special school environment, 26% of all computer use was made during the lunch break, and was student directed leisure activity. In the first phase of the SENTIS project, a mean of 16% of all in-school computer use was in free time (out of timetabled lessons), in the co-educational (mixed gender) government high schools.

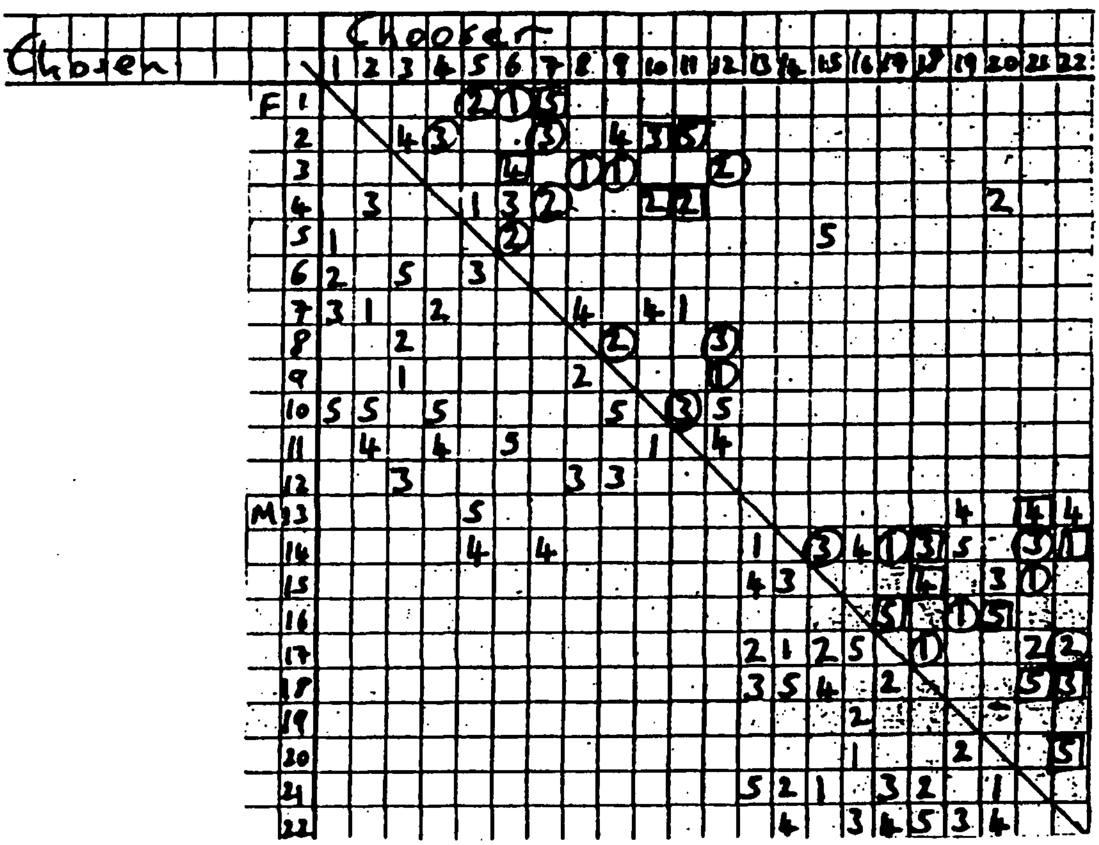
Phase One results - sociogram information

In Phase One the sociogram data was processed by hand. The group integration for each sample class was calculated from the formula:

$$I = \frac{R_0 q}{U_0 p}$$

I is the group integration. R_0 and U_0 are the observed numbers of reciprocated and unreciprocated choices, and p=1-q is the probability of being chosen, which depends upon the group size and the number of choices being made by each person. Further details are given by Criswell, (1960, p. 252). To perform the analysis, identification numbers were drawn up for each student of a class. These numbers were used on the axes of a grid to show the number choices of friends. Reciprocated choices within the first three choices were circled. For a class of 22 students making 3 choices each, 66 choices in total would be expected. In the example of Figure 6 there are 40 reciprocated choices => $R_0=40$ and therefore $U_0=66-40=26$. The probability of being chosen is p=3/21=0.143, and so q=1-p=0.857. Therefore in this example, the group integration is I=9.231.

Figure 6 - Example sociometric grid for a Phase One class



As originally reported in Fluck, 1990, the contribution from this class to the mean group integration for the school was normalised for group size to 9.231/22=0.42. Modifications to this procedure were made to deal with instances where friends could not be identified within the class, and where an inadequate number of friends were nominated.

There were only 2 to 4 sample classes from each school. This was chosen to be a representative sample, taking in about 10% of the student population across the entire age-range. Mean group integration figures were obtained for each school by averaging the group integration from these sample classes. It was later found (in Phase Two) that Criswell's measure of group integration is highly dependent upon group size. Although this was not detected in the first publication relating to the SENTIS project, the figures corrected by using residuals are given in the table below:

Figure 7 - Corrected summary of Phase One results

School	Mean School Type	N	Mean IN	students/ computer	Mean GI-Linfit	Free time use	Overall computer utilisation
A89	SecB	2	0.06	22.9	-2.48	14%	18%
B89	SecM	4	0.2	14.4	0.48	20%	39%
H89	SecM	3	0.112	21.7	0.73	18%	23%
C89	SecM	4	0.132	19.2	7.68	10%	36%
D89	Prim	2	0.0483	47.1	-4.00	6%	35%
F89	Prim	3	0.0383	23.5	-1.00	33%	15%
G89	Prim	3	0.0816	16.9	0.77	28%	20%
E89	Prim	2	0.0433	37.9	0.98	41%	20%

Notes:

Type:	SecB - secondary boys; SecM - secondary mixed; Prim - primary.
N:	Number of classes evaluated with sociogram in this school
Mean IN:	Mean hours of computer use in the school per student per day.
Mean GI-Linfit:	Group integration adjusted for group size by subtraction of the group size component as calculated in Phase Two.
Free time use:	Fraction of total computer use in the school that occurs outside lesson times.
Overall computer	Fraction of time computers are actually used in the school utilisation: compared to the time they are available.

Phase One results - interview information

Some typical comments from teachers

Q: Do you use computers in your teaching?

A: (Special Education teacher)

Yes, for essay writing skills, literacy and mathematics adventure games, and entertainment games for a reward in class.

Q: Could you say that computers have changed relationships between the students to any noticeable degree?

A: (Special Education teacher)

Social isolates become more isolated, but it is a tool to help normal students co-operate more.

Q: Do friendships become stronger when using computers?

A: (Information Technology teacher)

NO. We have a lot of problems in computer studies, getting students to work together in groups.

Q: What is your impression of the overall attitude of students to computers?

A: (Teacher of survival skills, English and Maritime studies)

OK, but not the way the teacher necessarily wants. Able students very much like to use Desk Top Publishing.

Discussion of Phase One

The Phase One investigation focussed the continuing study in two ways. Firstly, it indicated that the impact of computers in Primary schools was negligable, and at a very low level. Therefore further investigations in the study would be more profitably concentrated on the secondary sector if the hypothesis was to be more rigourously tested.

Secondly, the independent schools in the Phase One study had not contributed reliable results to the investigation. It appeared that the significantly different management approach, and the confounding factor of segregated genders, made inclusion of these schools unjustified in the planned Phase Two study.

Therefore the research strategy for Phase Two was modifed to take these two factors into account.

It was interesting to note the tension between the empirical evidence and the voices of the teachers interviewed. The teachers express the feeling that computers are exaserbating the isolation of students in their care, and making it more difficult for them to work in groups. Yet the students were being allowed to use computers to a great degree outside class, implying that the teacher's concerns were not translated into action to reduce the anticipated harm.

It seemed that this tension was also internalised within each teacher. One respondent became quite angry about the dialogue which emphasised the cognitive/academic benefits of computers for slow learners, yet the use of this technology on an exclusive basis restricted the social interactions of the same students, and therefore their social development. In some ways the teachers may have been making good judgements to balance the positive and negative aspects of the technologies in respect of the students in their care. In other ways, one suspected that they were unsure about the overall benefits, wondering if success in the cognitive area (helped by appropriate use of the computer) might boost self-esteem and lead to increased success in social relationships.

Chapter 5. Phase Two

Phase Two data sample

Phase One had shown that computer use in Primary schools was much less than computer use in high schools. The data from the 3 co-educational high schools in the Phase One sample had indicated that there was a chance that group integration was reduced by increasing computer use in school. The data sample for Phase Two was therefore chosen to include only co-educational high schools. The three schools from Phase One (B,C,H) were included again, and 9 others from the government sector selected at random from those willing to participate in the study. The selection ensured that a wide range of Educational Needs Indices was included in the sample. There were 32 co-educational government high schools in Tasmania at the time of the study. The means and standard deviations of the enrolments and Educational Needs Indices of all Tasmanian high schools and the Phase Two SENTIS project sample are shown in the following table:

	All Tasmanian high schools		**SENTIS phase 2 high schools**	
	Enrolment	Educational Needs Index	Enrolment	Educational Needs Index
Mean	514.1	43.3	494.4	46.5
Standard Deviation	149.8	13.5	154.6	18.3

By these two measures then, the sample was representative of the population.

Phase Two data collection.

By the time Phase Two of the SENTIS project was ready to proceed, 8 bit computers had largely been supplanted by 16 bit machines. The automatic netprobe was still valid for one particular kind of network, but several other types of network were now to be found in project schools. It was impractical to devise and use automatic netprobes in all of these school situations. The information was therefore captured by a survey instrument given to all students in each school.

The design of this instrument was restricted by several factors. Several thousand were to be produced, so the instrument had to fit comfortably onto one sheet of paper for reasons of economy and ecology. Secondly, there were the problems of administration. In Phase One, data recording sheets beside each computer had been used improperly or rarely, making this method unsuitable. Schools could not be expected to track the computer use recording sheets for all the students over a considerable length of time. Therefore a whole-school snapshot of a single day was going to be able to capture a restricted view of computer use, and a complete picture of friendship patterns. It seemed reasonable to ask schools to administer a short questionaire on a once-only basis, and to ask students to reflect upon a complete day's computer use on that occassion.

This survey instrument, together with the research plan, was submitted for approval by the Department of Education, and was accepted. It was trialled briefly in a college setting to check that the questions were understood, and with over 40 volunteer subjects, seemed appropriate for the task. The questionnaire was made a combined instrument, in that it captured details of computer use in school and at home, together with the sociogram data and a small amount of personal information (see Appendix Figures 22, 23 and 24). When the data was analysed, it was noticed that some responses were inappropriate because students had nominated friends not physically present in the home group being surveyed. In this respect the instrument could be improved, by eliminating the ambiguity of the word 'class'. Students in high schools are generally placed in several different classes, for different subjects. The students in each home group were therefore able to say they would be happy to work with a 'currently present class member' who was not physically present in the room with them at the time. However, a very small number of responses were spoiled in this way.

Schools that had accepted the invitation to join the study and been selected, were each telephoned by the researcher. In this initial contact, a visit date was agreed with the liaison person nominated by the principal. Also, interviews with students and staff were requested.

Phase Two interviews

When the researcher visited each of the project schools, the first discussion was with the liaison person. The liaison person was generally the teacher co-ordinating the use of computers through the school. Basic data was obtained from this first conversation, such as the enrolment, the number of computers installed, etc. Instructions were given to the liaison person about the way in which the survey instrument should be used - particularly stressing that it must not be given on a Monday, or any day immediately after a school holiday. A date was agreed for the data capture. The researcher prepared envelopes with ample survey forms for each home group, together with a sheet of instructions for the home group teacher. These envelopes were delivered to the school before the data capture day, and picked up immediately afterwards.

When visiting the school, the researcher also conducted interviews with students and staff. These interviews were tape-recorded when the subject agreed to this. In each case some standard questions were asked, and an analysis of the responses is given. Subjects were also given a chance to comment about the effect of computer use upon friendships. This free-form comment was requested in respect of either their own experience, or in respect of observations they had made.

The interview schedules and coding sheets are shown in Appendix Figure 22. Briefly, the Information Technology co-ordinator in the school supplied environmental data, whilst the staff and student members of the school community were led into a discussion on the relationship between computer use and friendship bonding.

When organising the interviews with the liaison person, the researcher requested to speak to at least four students and four staff. The students were to be representative of each of the four year groups in the high school, and to be gender-balanced. They should also represent a wide spectrum of ability and attitudes in respect of computers. Four staff were also to be interviewed, and it was requested that they too be gender balanced, and have a spread of views about computers. They were also to have teaching duties in a variety of subject areas.

Generally the interviews lasted from 5 to 15 minutes, and were most helpful in establishing the role of computers within each school, and the variety of opinion about them.

Phase Two results

The processing of the Phase Two investigation was done in two parts. The first part used a computer spreadsheet and statistical package to analyse the survey results from the students. The second part tabulated the comments from the interviews with students and staff.

The survey analysis was done by coding the return from each student in a standard way, putting their name and responses into a spreadsheet. For the purposes of the spreadsheet, the hours of computer use reported were converted to decimal hours. Modem access was coded as True or False, Gender was coded as True if female, and home inside the metropolitan area was coded as True. Friendship choices were coded using identification numbers allocated within each class - see Figure 8.

Figure 8 - Example analysis of a class survey by spreadsheet

School name= School			Printed on:	1/24/94
Group identification= Group			at:	17:54:29
date data collected = Date				

Number of students	N =	36	Total hrs IN	=	4.65
Reciprocated choices	Ro =	55	Tot hrs OUT	=	9
Total choices	T =	108	# users IN	=	5
Unrecip choices	Uo =	53	# users OUT	=	5
	d =	3	# Females	=	20
	p =	0.086	# In metro	=	30
	q =	0.914	# females IN	=	4
Integration index	I =	11.07	# females OUT	=	3
Tot female hrs IN	=	3.32	Tot female hrs OUT	=	5

Filename	N	Fs	#Modem	#Inmet	I	fhrs IN	fhrs OUT	Tot hrs IN	Tot hrs OUT	# IN
n/a	36	20	4	30	11.069	3.32	5	5	9	5

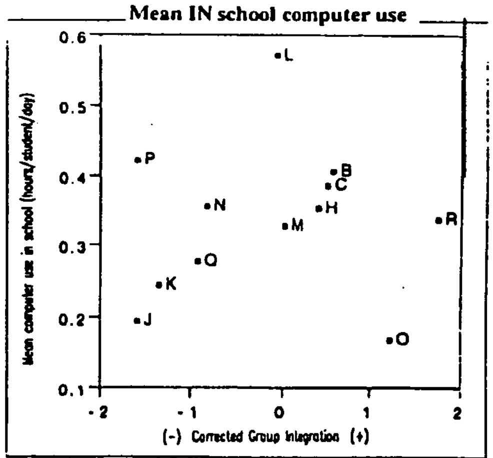
Name	#	computer use/hrs In	Out	Got modem	Female gender	In metro	Choices f1	f2	f3
Amanda	1	0.66	0.00	FALSE	TRUE	TRUE	22	35	6
Belinda	2	0.00	0.00	FALSE	TRUE	TRUE	?	?	2
Brett	3	0.00	0.00	TRUE	FALSE	FALSE	19	31	4
Cameron	4	0.00	0.00	FALSE	FALSE	FALSE	31	11	9
Christine	5	0.66	0.00	FALSE	TRUE	TRUE	1	8	?
Corina	6	1.00	0.00	FALSE	TRUE	TRUE	?	?	?
Damien	7	1.33	0.00	FALSE	FALSE	TRUE	31	11	4
Jackie	8	0.00	0.00	FALSE	TRUE	TRUE	22	16	5
Jason	9	0.00	0.00	FALSE	FALSE	TRUE	31	4	11
John	10	0.00	0.00	FALSE	FALSE	TRUE	28	12	36
Jonathon	11	0.00	0.00	FALSE	FALSE	TRUE	4	31	7
Joshua	12	0.00	0.00	FALSE	FALSE	FALSE	18	?	?
Kelly	13	0.00	1.00	TRUE	TRUE	FALSE	20	34	26
Kristie	14	0.00	0.00	FALSE	FALSE	TRUE	17	?	?
Lisa	15	0.00	0.00	FALSE	TRUE	TRUE	25	16	21
Louise	16	0.00	0.00	FALSE	TRUE	FALSE	25	21	15
Maree	17	0.00	0.00	FALSE	TRUE	TRUE	?	14	?
Mark	18	0.00	0.00	FALSE	FALSE	TRUE	24	12	?
Matthew	19	0.00	1.00	FALSE	FALSE	TRUE	24	26	20
Malanie	20	0.00	0.00	FALSE	TRUE	TRUE	13	34	?
Melinda	21	0.00	0.00	FALSE	TRUE	TRUE	15	16	25
Michelle	22	0.00	2.00	FALSE	TRUE	TRUE	35	1	6
Michelle	23	0.00	0.00	FALSE	TRUE	TRUE	33	34	?
Nathan	24	0.00	0.00	FALSE	FALSE	TRUE	19	34	20
Nicole	25	0.00	0.00	FALSE	TRUE	TRUE	15	16	21
Nigel	26	0.00	0.00	FALSE	FALSE	TRUE	13	34	?
Patrick	27	0.00	0.00	FALSE	FALSE	TRUE	31	4	9
Phillip	28	0.00	0.00	FALSE	FALSE	TRUE	10	?	12
Rebecca	29	0.00	0.00	FALSE	TRUE	TRUE	32	8	5
Rebecca	30	1.00	2.00	TRUE	TRUE	FALSE	?	?	?
Shane	31	0.00	0.00	FALSE	FALSE	TRUE	4	11	7
Shantelle	32	0.00	0.00	FALSE	TRUE	TRUE	29	5	8
Sherron	33	0.00	0.00	FALSE	TRUE	TRUE	?	?	23
Sonya	34	0.00	0.00	FALSE	TRUE	TRUE	20	13	?
Stacey	35	0.00	0.00	FALSE	TRUE	TRUE	22	1	6
Tanya	36	0.00	3.00	TRUE	FALSE	TRUE	28	10	12

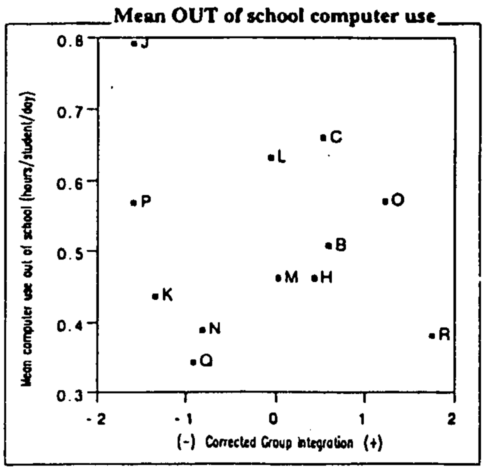
Once the Group Integration had been calculated using the spreadsheet analysis tool, the collated data for every student from every school surveyed, was transferred into a large file on a Macintosh computer. This file was further analysed using the JMP statistical analysis software.

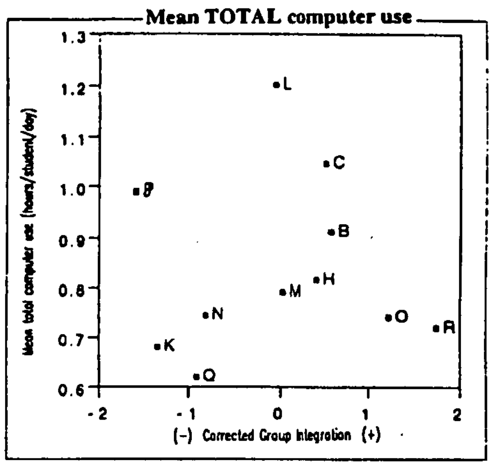
In the case of Phase Two, schools were sent a compilation of statistics, with comparative values for all the sample schools (Appendix Figure 26) together with graphical representations (Figure 9). A statistical breakdown is in Figure 10.

Figure 9 - Summary graphs of Phase Two sent to participating schools

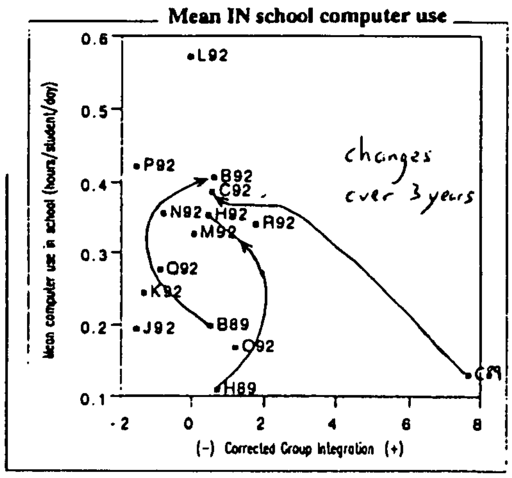
SENTIS 2 - 1992 data







SENTIS 2 - 1989 & 1992 data



Note: In this study, group integration has been used as a measure of sociability, or friendship circle size. Groups or classes with higher positive scores have more reciprocated friendships within them.

Figure 10 - Summary of results by school

School	B92	C92	H92	J92	K92	L92	M92	N92	O92	P92	Q92	R92	All schools studied Min	Mean	Max	
Number of students in the school	584	399	598	661	340	337	289	646	685	640	250	504	250	494	685	
Percentage of the school day when computers are used	8	8	7	4	5	11	6	7	4	8	6	8	3.65	6.77	11.46%	
Computer utilisation	67	77	53	29	17	62	17	49	37	48	26	42	16.55	43.72	77.28%	
Mean computer use by girls IN the school (hours/day)	0.37	0.47	0.36	0.19	0.34	0.52	0.45	0.37	0.14	0.37	0.24	0.46	0.14	0.36	0.52	hrs/day
Mean computer use by boys IN the schools (hours/day)	0.43	0.33	0.35	0.20	0.16	0.61	0.21	0.34	0.19	0.48	0.33	0.23	0.16	0.32	0.61	hrs/day
Mean computer use by all students IN the school (hours/day)	0.41	0.39	0.35	0.20	0.25	0.57	0.33	0.36	0.17	0.42	0.28	0.34	0.17	0.34	0.57	hrs/day
Mean computer use by girls OUT of school (hours/day)	0.23	0.20	0.19	0.42	0.38	0.28	0.40	0.25	0.36	0.18	0.21	0.28	0.18	0.28	0.42	hrs/day
Mean computer use by boys OUT of school (hours/day)	0.68	1.02	0.69	1.21	0.49	0.91	0.53	0.51	0.74	1.01	0.52	0.47	0.47	0.73	1.21	hrs/day
Mean computer use by all students OUT of the school (hours/day)	0.51	0.66	0.46	0.79	0.44	0.63	0.46	0.39	0.57	0.57	0.35	0.38	0.35	0.52	0.79	hrs/day
Mean computer use by girls IN and OUT of school (hours/day)	0.60	0.66	0.55	0.62	0.72	0.81	0.84	0.62	0.50	0.55	0.45	0.74	0.45	0.64	0.84	hrs/day
Mean computer use by boys IN and OUT of school (hours/day)	1.11	1.35	1.04	1.41	0.65	1.53	0.74	0.85	0.94	1.49	0.86	0.70	0.65	1.05	1.53	hrs/day
Mean computer use by all students IN and OUT of school (hours/day)	0.91	1.05	0.82	0.99	0.68	1.20	0.79	0.75	0.74	0.99	0.62	0.72	0.62	0.86	1.20	hrs/day
Percentage of students that probably have access to a computer at home	46	41	39	46	29	45	47	38	44	44	30	42	29	41	47%	
Students per computer in the school	9.9	11.4	8.7	9.9	6.3	6.4	4.4	9.9	13.2	14.9	6.1	7.3	4.4	9.0	14.9	
Ratio of computer use OUT of the school to IN the school	1.25	1.70	1.31	4.05	1.78	1.10	1.40	1.10	3.36	1.35	1.24	1.11	1.1	1.73	4.05	
Percentage of students that have access to a modem at home	23	16	20	28	15	21	33	26	18	25	18	28	15	23	33%	
Percentage of girls that actually use a computer at home	18	16	14	24	17	22	24	17	22	15	15	17	14	19	24%	
Percentage of boys that actually use a computer at home	40	45	36	43	21	43	23	29	41	45	21	25	21	34	45%	
Percentage of all students that actually use a computer at home	31	32	26	33	19	34	24	24	33	29	18	21	18	27	34%	
Mean GI-linfit (corrected group integration)	0.60	0.54	.43	-1.58	-1.35	-0.06	0.03	-.82	1.22	-1.59	-0.92	1.75				
Minutes in the school day	310	305	305	315	280	300	320	315	280	315	280	265	265	299	320	
Number of computers available for students	59	35	69	67	54	53	65	65	52	43	41	69	35	56	69	
Educational Needs Index	24.4	37.8	36.2	31	78.7	46.5	42.2	57.2	29.8	29.5	77.1	67.4	24.4	46	78.7	

Phase Two sociogram information

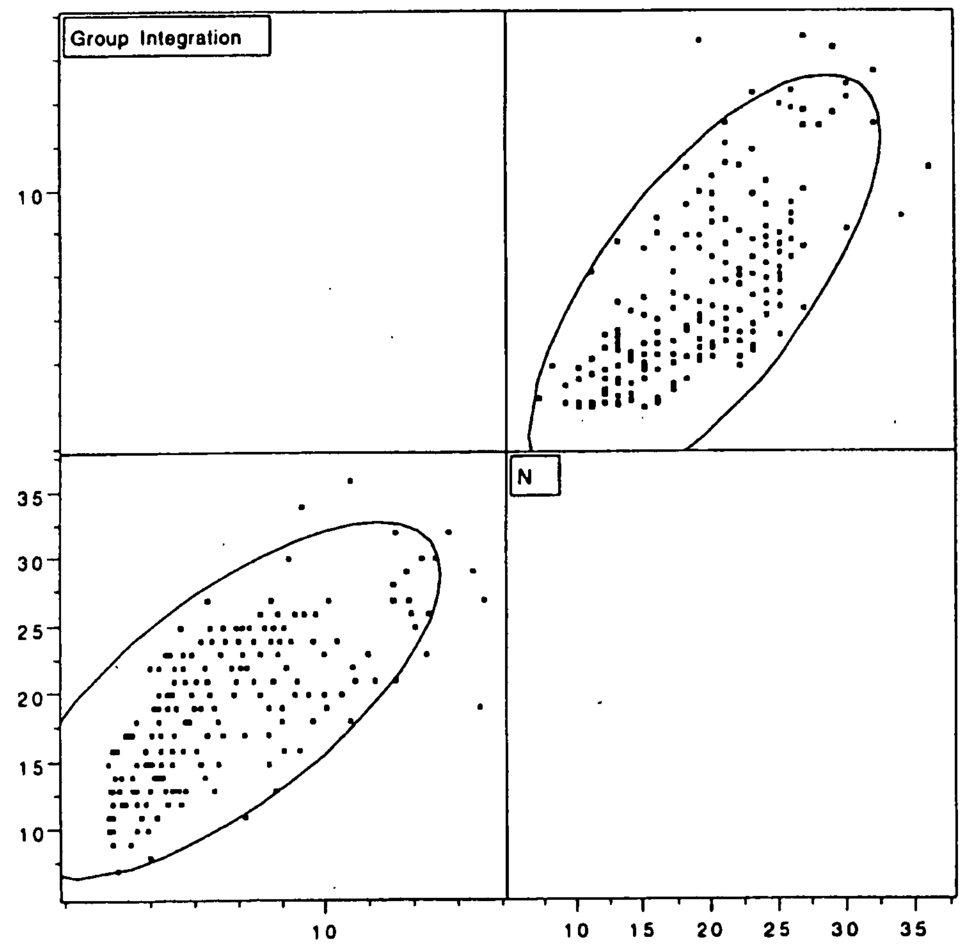
When the survey data had been transferred into the statistical analysis package, it was possible to plot the group integration of each class against the number of students in each class. This scatter-plot revealed a 71% correlation between group integration and class size (See Figure 11).

Figure 11 - Correlation of Group Integration and number of students in class (N)

Correlations
Variable

Group Integration	N	
Group Integration	1.0000	0.7078
N	0.7078	1.0000

Scatter Plot Matrix

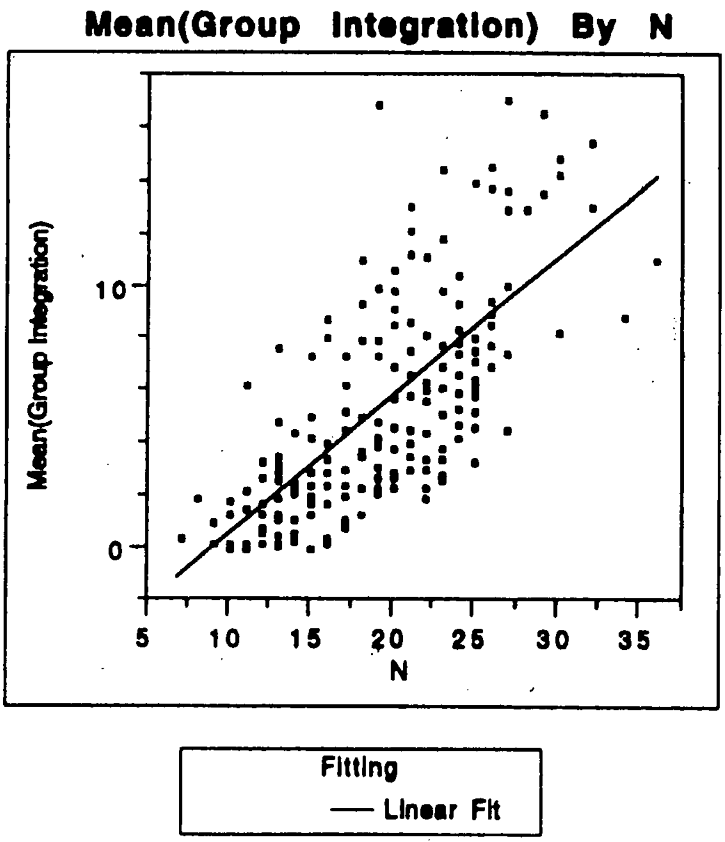


Several fits were tried to relate the Group integration to class size, but the linear fit was found to be the best. Information about this linear fit was used in subsequent analysis to eliminate the effects of different class sizes. By subtracting the component of the group integration due to size effects, corrected group integration was found.

Corrected group integration = group integration - (0.530081 * N - 5.016988)

The details of the linear fit are given in Figure 12.

Figure 12 - Linear fit analysis for group integration v. class size (N)



Linear Fit
Summary of Fit

Rsquare	0.501022
Root Mean Square Error	2.826304
Mean of Response	5.503589
Observations (or Sum Wgts)	223

Phase Two interview information

The interviews produced information that was of great value. Most of the information from the computer co-ordinators in each school was used in the statistical analysis of the survey data. The length of the school day varied from 265 minutes to 315 minutes from school to school. The number of students per computer varied from 4.4 to 14.9 with a mean of 9.0. Three schools had a clear policy forbidding the use of computers outside lesson times. Two schools made all computers available throughout the school day, and in fact encouraged their use before and after lessons. Integration of computers into most subjects was accepted as an aim, but some co-ordinators were unable to affirm the use of the equipment outside computing specialist classes. In the main, programming was only taught to students specialising in Information Technology.

Interviews with teaching staff in the schools revealed a wide range of comfort levels with the technology, and more importantly, with the rate of change of the technology. Commenting on the level of computer use in their school, some staff reasoned that the equipment was badly timetabled, was configured for a single subject, were a security risk or had unfriendly software and these difficulties impaired cross-curricula activities. One teacher found the last question about the perceived social effects of computers very hard to answer. On the one hand the teacher had personal experience of students who spent a great deal of time working with computers, and who seemed to be delayed socially. On the other hand, the same teacher knew very few students who did not use computers at all, and the vast majority of these were well-balanced in their social development.

There were echoes of this ambivalence in the talks with several of the teachers. They had seen students fight over who would get to use the equipment. They also knew some students used computers as an escape, from peer conflicts, from personal problems - from reality in general, especially boys. However, there were benefits to be gained from the technology - computers were seen as being excellent for remedial use and to give a sense of security and individual attention. There was a view that the distribution of computers around the school was important - and that supervision was necessary to get the benefits from the computing resources without having consequential discipline problems.

Some of the comments the staff made included:

> "The computers are used a great deal in this school - this is good for the students - not so good if you're a member of staff wanting to use them!"
>
> "Kids who have socialisation problems [because of computers] are usually boys, very bright - they don't connect well with common reality."
>
> One teacher related experiences from the USA, where:
> "I asked if the timetables produced by the computer could be proof-read by a teacher. I ended up with a student time-tabled into a class with another boy that had stabbed him the previous year!"

The students that were interviewed revealed a wide range of computer uses, both within and outside the school. There was a predominance of word processing based activities, and students appreciated the quality of work that could be achieved using the computer. One student said her main use of the school computers was to prepare her curriculum vitae, and the quality of the presentation she achieved was important for this. In one school a lot of the students expressed a split opinion about the effect of computers on friendships. They had all seen examples of friction and fights originating from restricted access to computers. All of them were also aware of friendship groupings in which common knowledge and use of computers was an integral factor in the reciprocated relationships. In another school, some students had some ideas about the degree of computer use determining the social effects. In their words, up to 7 hours a week of computer use would not impair anyone's friendships. However, they thought that more than 20 hours of computer use per week would be socially damaging or indicative of a socialisation problem for an individual. One student gave a response that encapsulate this ambivalent thinking:

> "Yes, in a way computers help us work together co-operatively. You end up liking people and agreeing with them.... I've seen heaps of fights over computers; mostly about which is the best sort - Macs or Profounds (a local PC clone) - also over ones with mice and those without."

Other comments were made that threw light onto the thinking students had about the whole area:

"My sister is a bit of a whiz on computers"

"My brother's the computer whiz - he bought the Amiga - he's got over 200 games for it."

"I had a mouse pad, and he didn't, an' when he tried to get mine, I bashed him."

"I play computer games on it, and store stuff on it, like how to get into other computers and stuff."

"I got into the Commonwealth Bank, but I couldn't get past the security lock."

"Yes, sometimes I help other kids get in, I help the teachers reset the network, when they don't know how to."

"Thems always out of order though."

"Pen friends and stuff like that, in Japan and stuff, sometimes help you make friends using a computer."

The following analysis of the coded responses summarises the major findings from the interview strand of Phase Two (refer to Appendix Figure 22 for details of the coding scheme):

Analysis of coded responses

IT co-ordinator

Question	*Response*
What is the school policy on computer use:	
(a) For use in lessons (eg. is there general computer literacy for all students, or is the equipment used exclusively for Information Technology courses)?	*Respondents indicated that computer use was generally split between general subject support and specific computer classes (mean = 0.48).*
(b) For use outside lessons (eg. if students are allowed to use the equipment outside lessons, what for, and how is its use monitored/controlled/made equitable)?	*Respondents indicated that slightly less than half of the school computers were used outside lessons (mean = 0.42).*
(c) Are computers integrated into the curriculum for all relevant subjects?	*Responses showed that computers were integrated into the teaching of just over half the subject areas of the school (mean = 0.59)*
(d) Do students learn to program at all?	*Responses to this question indicated that about 35% of students learned to program.*

Staff Member

Question	*Response*
Do you have access to a computer at home, and if so, what do you use it for?	*41% of staff had access to a computer at home.*
Do you have access to a computer in school, and if so, what do you use it for?	*79% of staff had access to a computer in the school.*
Would you say that computers in this school are used more than 30% of the time?	*69% of staff estimated the school computers were used for more than 30% of the time.*
Would you say that students in this school are friendly to one another, that they know each other well, that they socialise well together?	*Generally staff thought that students were friendly towards one another (mean = 0.63).*
Do you see any problems associated with computer use so far as socialisation is concerned?	*Staff thought that computers had a slight tendency to break down friendships (mean = 0.43).*

Student Member

Question	*Response*
What is your grade and age?	*The mean grade of students interviewed was 8.65. Since the students in High schools span grades 7 to 10, a representative sample would have had a mean grade of 8.5, depending upon actual enrollments in each grade.*
What optional subjects are you currently studying?	*<Wide range of responses>*
How often do you generally use a computer in the school each week?	*The students interviewed estimated that they used computers between one and two times a week (mean = 0.84).*
What do you use computers in school for?	*The activities cited included keyboarding, word processing, computer aided drawing and design, educational games, authoring, music, art, mathematics, desk-top publishing as well as computer studies.*
How often do you generally use a computer outside school each week?	*Students estimated that they used computers outside school slightly more than once a week (mean = 0.73). The activities involved included games (57%) and word processing (30%), mathematics, graphics, programming and computer hacking (2% each).*
What activities do you generally enjoy with your friends?	*The most popular response was 'talking' (33%), 'sport' (25%) and 'walking' (16%) whilst 'role-plays', 'wrestling' and 'fighting' were also mentioned.*
Do you think that computers help friendships, or not?	*Students tended to think that computers could assist marginally in friendship relations (mean = 0.57).*

Chapter 6. Discussion and Summary

Discussion of results

The null hypothesis not rejected

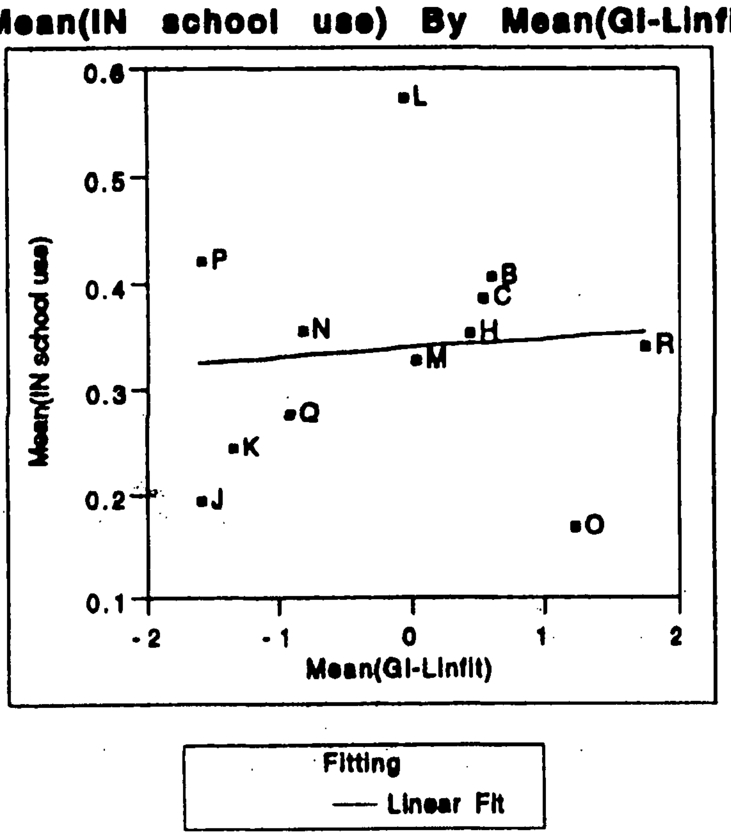
The SENTIS project investigated the nature of a theoretical relationship between computer use and sociability (as measured by group integration). Such a relationship was thought possible, since cognitive development and socialisation are believed to require social interactions. Increased computer use might restrict the time available to students for such interactions. If students were being isolated through computer use, this should be reflected as a macro-effect by corresponding changes in sociability, and hence group integration. The null hypothesis to be tested was expressed as:

> **"The use of computers in schools has no effect upon the sociability of the students."**

This was tested in three ways. Mean computer use per student per day was compared with mean group integration for several schools. This comparison was then matched with frequent or striking reflections from the interview data, and threads of concern followed into the numerical results. Additional information from the sociograms and computer use surveys was analysed to see if a range of other variables influenced the situation.

Mean computer use per student per day was calculated, and plotted against corrected group integration. The simple plot for Phase Two is given in Figure 9. A numerical analysis revealed that there was very little correlation between computer use and corrected group integration - see Figure 13.

Figure 13 - Linear fit for computer use IN school against corrected group integration



Linear Fit

Summary of Fit

Rsquare	0.007689
Root Mean Square Error	0.113901
Mean of Response	0.338321
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00100526	0.001005	0.0775
Error	10	0.12973383	0.012973	Prob>F
C Total	11	0.13073910		0.7864

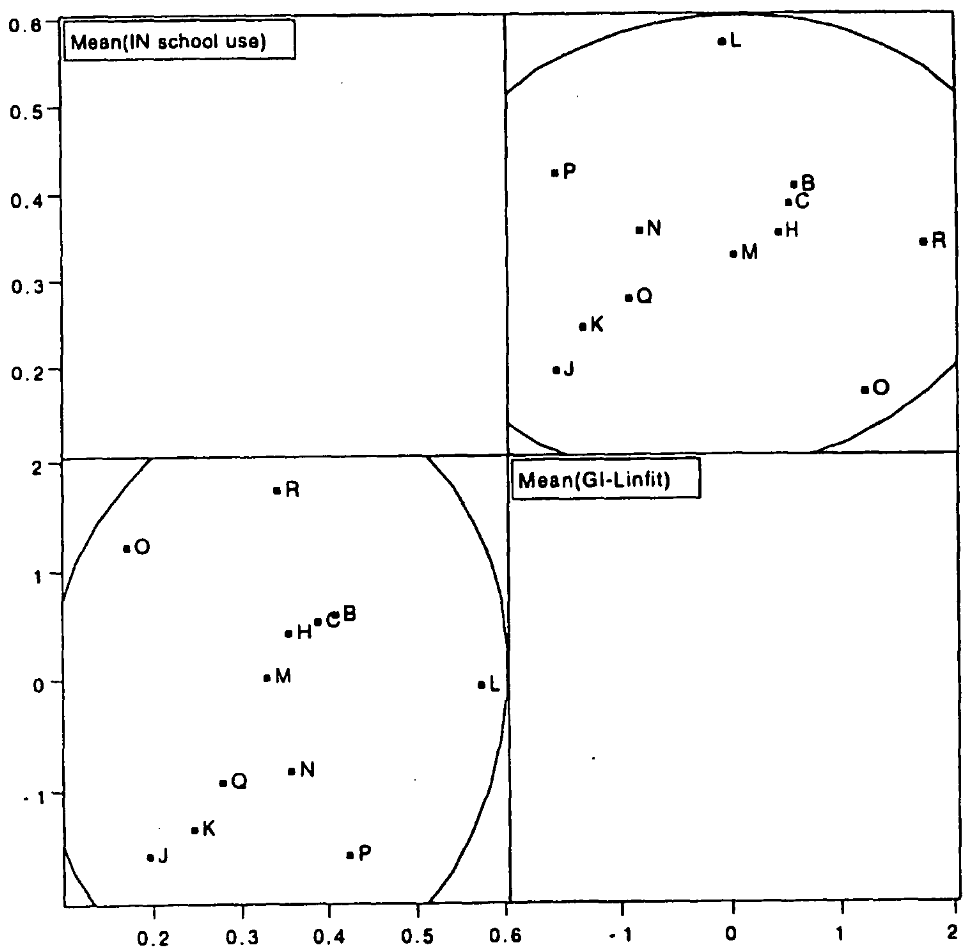
When the correlation between computer use and corrected group integration was calculated (Figure 14), it was found to be) 0.0877. By this evidence then, the null hypothesis cannot be rejected.

Figure 14 - Correlation coefficient for computer use in school and corrected group integration

Correlations
Variable

Variable	Mean(IN school use)	Mean(GI-Linfit)
Mean(IN school use)	1.0000	0.0877
Mean(GI-Linfit)	0.0877	1.0000

Scatter Plot Matrix



Since the investigation had obtained additional information, a further calculation was done to see if computer use OUT of school provided a correlation with corrected group integration. The results are shown in Figure 15.

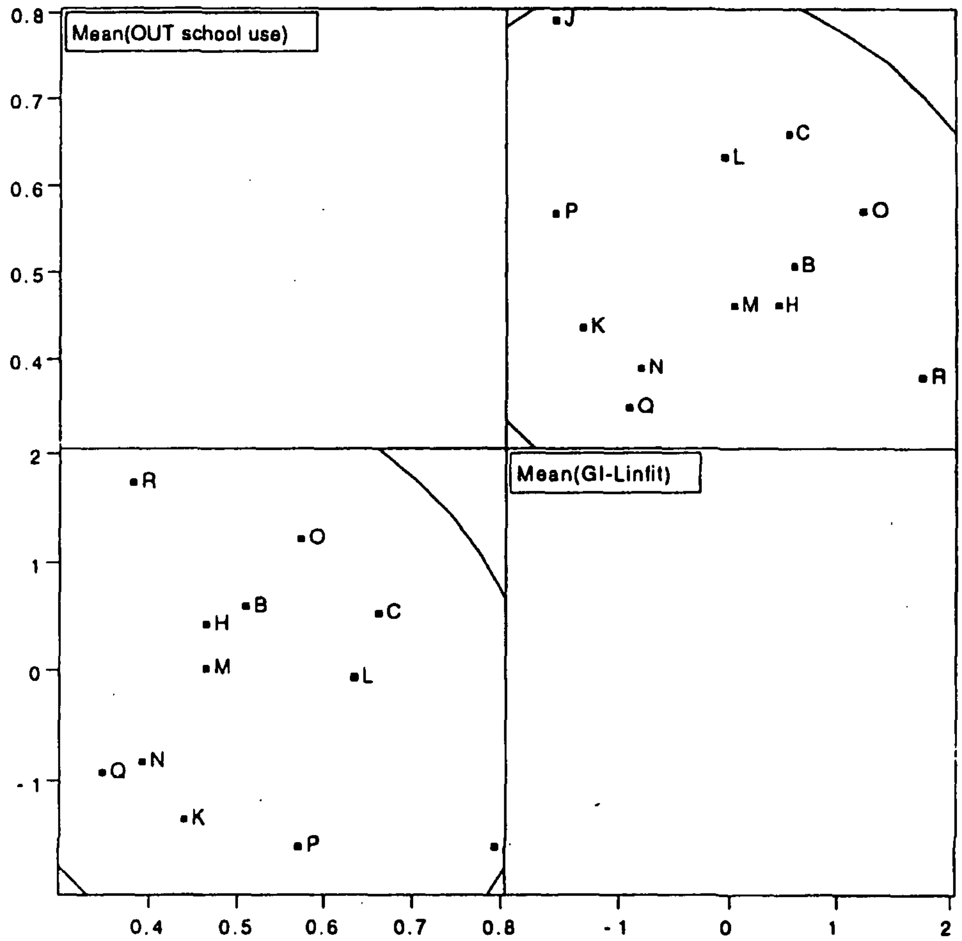
Figure 15 - Correlation coefficient for computer use OUT of school and corrected group integration

Correlations

Variable

Mean(OUT school use)	**Mean(GI-Linfit)**	
Mean(OUT school use)	1.0000	-0.1758
Mean(GI-Linfit)	-0.1758	1.0000

Scatter Plot Matrix

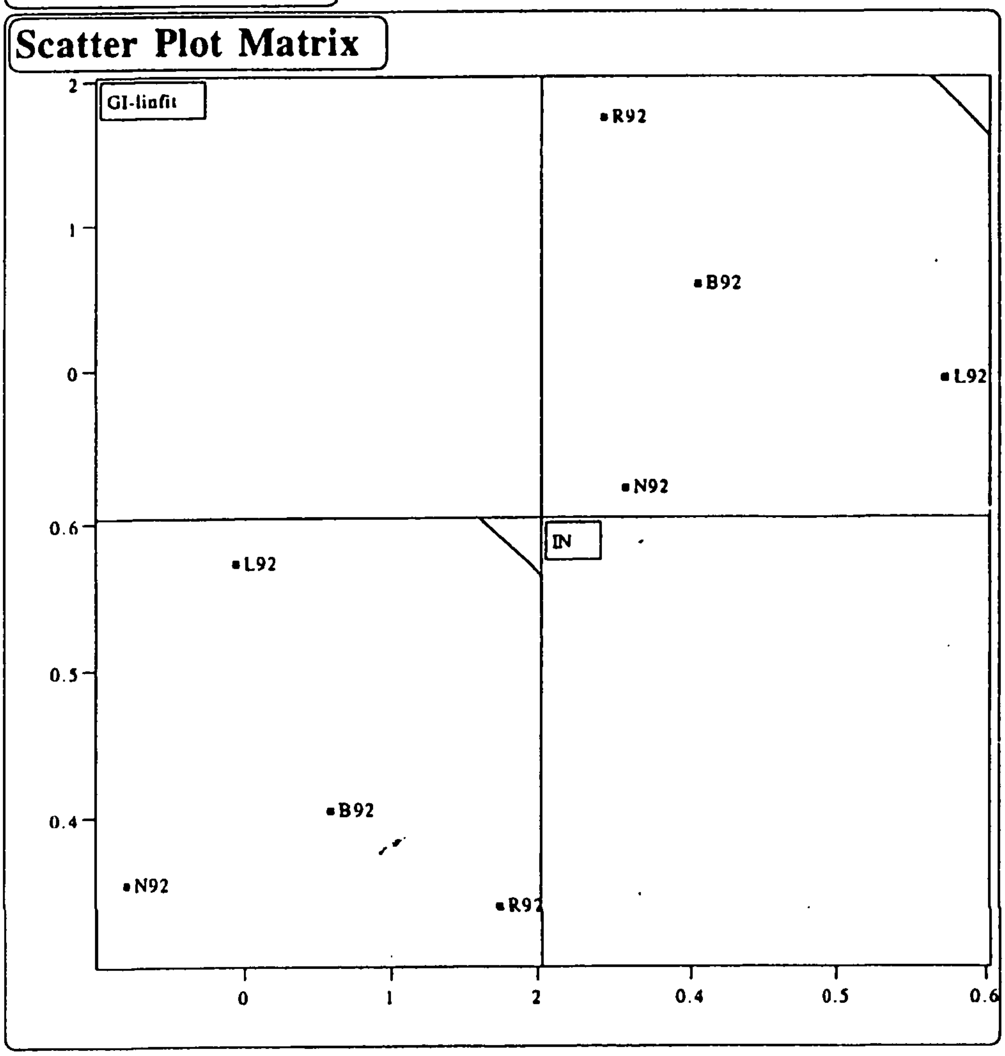


Several other approaches were also tried, but in all cases the correlation between amount of computer use and sociability was negligible. One interesting case was that of schools that allowed significant numbers of computers to be used outside lessons. It had been found in Phase One that there was a significant amount of this, and one primary school in particular (E89) recorded nearly half of all computer use outside lesson times (refer to Figure 5). Phase Two schools L92, N92, B92 and R92 allowed a significant amount of computer use outside lesson times, and they did indicate a tendency to reduced corrected group integration as higher amounts of computer use per student per day were found. See Figure 16.

Figure 16 - Significant correlation for schools that allow students to use computers out of lesson times

Correlations

Variable	GI-linfit	IN
GI-linfit	1.0000	-0.2951
IN	-0.2951	1.0000



Home computer use

Overall, the numerical results of the SENTIS project should not be seen as surprising. Two years earlier, Tully (1990, p. 11) had found a surprising proportion of students in primary schools had access to a computer at home. Similar proportions were found in the SENTIS Phase Two study.

	Tully 1990	SENTIS Phase Two 1992	Oliver 1993
Percentage of students with a computer at home	(primary) 53%	(secondary) 41%	(grade 12) 37%
Percentage of teachers with a computer at home	24%	41%	

Relating these results on home computer access to the speculative literature, it can be seen that Miles's (1988) continuists are at fault. The spread of information technology in Tasmania has been rapid, achieving about a 50% penetration of homes. If Hawkridge's (1985) speculation that informal learning surrounding toys is as influential as formal education, then computers are already having a great influence on young children. Compared to the Oliver result in chapter 2, grade 7-10 students in Tasmanian High Schools had much greater access to computers than grade 12 students in Western Australia. However, the two populations were very similar in their use of computers at home.

Computer anxiety

Both Oliver and King (1993) considered computer anxiety. They showed that students recorded increased anxiety with respect to computers, and Oliver's group felt that computers were not all that important in terms of increasing student employability. The SENTIS Phase Two study showed a marked difference in attitudes towards computers between students and staff. Students believed that computers were marginally beneficial for friendships, whilst staff thought that computers were marginally detrimental for friendships.

Access to computers in school

In 1989 the peak mean use of computers in the SENTIS Phase One state high schools was 12 minutes per student per day (tabulated as 0.2 hours in Figure 7). In 1992 the peak mean computer use in the SENTIS Phase Two schools was 34 minutes per student per day. Another way of expressing this is to say that in some schools, 11% of the entire taught curriculum is computer-based. Although this is peak mean usage, the overall average for the schools in SENTIS Phase Two was still 20 minutes per student per day.

Computer:student ratios

The trends in computer:student ratios detected in this SENTIS study are similar to those reported in other industrialised nations:

Students per computer in high schools

Year:	1989	1992
Tasmania (SENTIS)	17.5	9.0
United States of America (Barker/Anderson)	32.2 (1984)	8.57
United Kingdom (Fluck, McIntosh)	32	9.5

Other factors revealed

Gender bias

Hawkridge and his four social effects of new technology in schools. It was not going to be possible to study age bias or gender bias within the SENTIS project, but data to examine the effect of gender and socio-economic background was collected. The observed reluctance of females to use the computer was one aspect to look at, and this could be compared with the use in school made by males. Also, it would be interesting to see if students used computers at home, and how this varied according to gender. The issue of gender, and its construction implicit in current computer systems was explored more fully in Saunders and Stone (1986).

In Phase Two of the SENTIS project, some gender specific data was obtained:

Figure 17 - Gender specific results from Phase Two of the SENTIS project

	Girls	Boys
Mean computer use IN school	.36 hrs/day	.32 hrs/day
Mean computer use OUT of school	.28 hrs/day	.73 hrs/day
Mean proportion that actually use a computer at home	19%	34%

These results showed that in the sample, gender equity policies were effective in Tasmanian schools, to the extent that girls made more use of computers in the school environment than did boys. In fact, in one school, the mean use of computers by girls was over twice that of boys. However, this did not extend to the home, where a much smaller proportion of girls used computers than boys. Since about one third of boys had used a computer at home, this brought the mean computer use per day for boys to 44 minutes per day - well over twice the time for girls on average. The identifiable ages for the groups of boys and girls were virtually the same; the mean grade for boys was 8.463, whilst that for girls was 8.485.

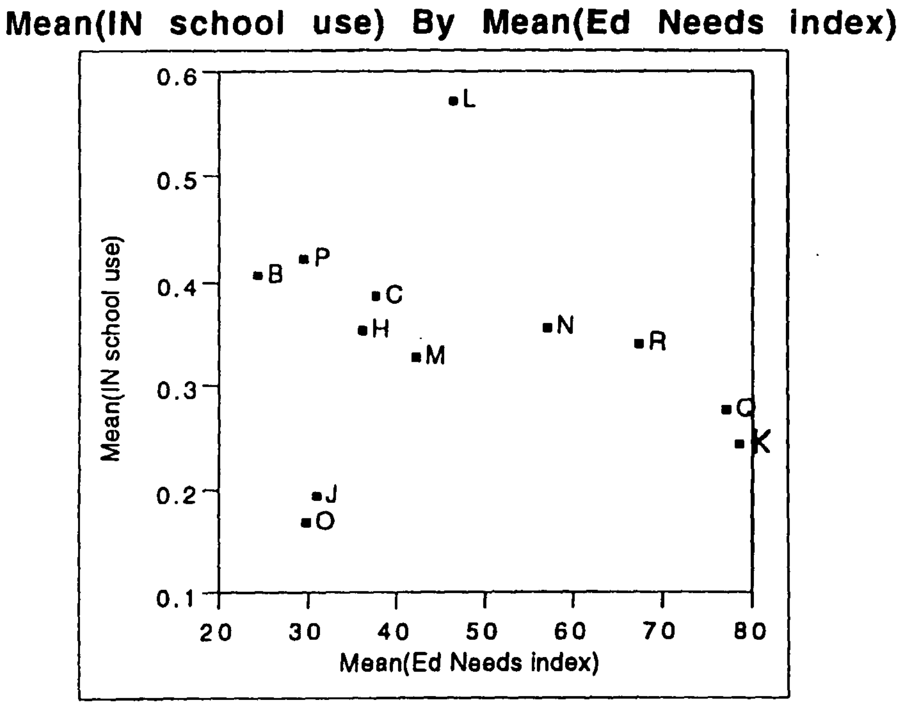
Socio-economic differences

Analysis of results by school was possible using the socio-economic data in the educational needs index used to calculate the government grant to schools. This index is obtained by adding the percentage of students on loan-issue (passing a means test to prove they are unable to pay standard school levies) and the Socio-Economic Situation index. This later is a composite index, with the following components from the (Australian) Commonwealth Bureau of Statistics:

occupation	50%
unemployment	10%
educational level of parents	15%
family income	20%
aboriginality	5%

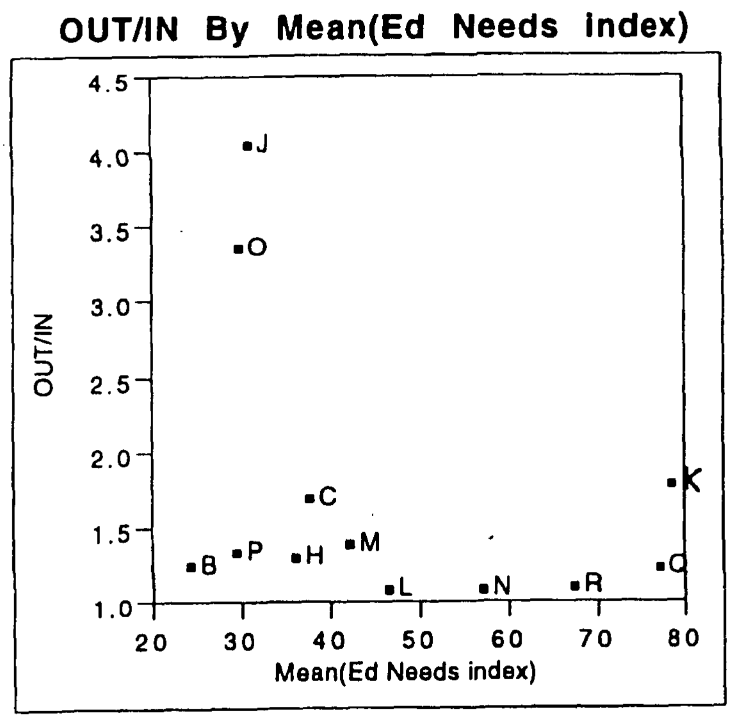
Firstly, the amount of computer use in school was plotted against the Educational Means Index. This showed that students in schools with higher needs used computers slightly less than students in schools with lower needs (Figure 18)

Figure 18 - Mean IN school computer use v. Educational Needs Index



It was apparent that mean computer use out of school was significant compared to mean computer use in school. To compare these proportions, and to see if students from higher socio-economic areas used computers more out of school, the ratio of computer use out of school to computer use in school was plotted against Educational Needs Index. This showed that the ratio was very similar for most schools, except for a couple of outliers (Schools J and O in Figure 19). These school are in higher socio-economic areas, and their students use computers a great deal out of school, compared to use in school. However, this appears to be compensation for the fact that these students do not get as much computer use in their school - they are at the bottom end of the scale in Figure 18, and total use for these students is not exceptionally great.

Figure 19 - Ratio of mean computer use in school / mean computer use out of school, plotted against Educational Needs Index



Discussion of methodology and criticism thereof

Terminological variation

The word 'class' was obviously interpreted by the respondents in a non-specific way. It was intended that respondents would nominate peers in the same group as themselves, at the time when the questionnaire was administered. However, in a High school, a student is generally a member of many classes - for different subjects and administrative functions. This was particularly apparent in the school which organised administration on the basis of vertical groups. The SENTIS project also showed that 78% of reciprocated choices were between students of the same gender.

The interpretation of the idea of 'computer' needs some elaboration also. At one level a definition might include the ability to operate as an office tool - particularly as a word processor. However, this specific functionality generally requires a printer to be effective, and this additional hardware requirement might make respondents tend not to think their installation qualifies. On the other hand, a television games console contains a micro-processor, but it cannot generally execute office automation software. The definition is blurring all the time, and any researcher needs to specify the functionality or <u>potential functionality</u> being investigated. For instance, the definition might be

"a computer that can operate as a word-processor"

The definition might be expanded to ensure that the software to operate as a word-processor need not be owned by the respondent, but the equipment might be operated in conjunction with appropriate software to become a word-processor. Therefore, in future studies, the definition of a computer can be expanded to include equipment that is capable of being used for learning tasks and personal productivity support, whilst it should exclude equipment dedicated to stimulus-response activity games and the like. The important point would be to select a definition which would be specific enough for the study, yet simple enough for young respondents to find accord with easily.

Masking effects

Ryser (1990) found that students using computers had a greater sense of achievement than other students. This finding is particularly important to the SENTIS project, since any deleterious effect of computer use associated with a decrease in personal communication, might be masked by an increased sense of self-esteem induced by the motivation inspired by computer use. There would be no easy way to compensate for such counter-balancing forces within the scope of this study, but it is certainly worth consideration in any subsequent research.

Suggestions for future research in the area

Better sociometric methods

As explained in Chapter 1, Renato Tagiuri (1966), gave details of an extension of normal sociometric methods that can provide an alternative measure of group cohesion. This method could be used in future extensions of the SENTIS study provided the return to the data subjects was increased beyond the general improvement in planning and organising the use of computers. One such improved return for the study participants might be achieved by the use of mark-sense cards for the survey responses, ensuring that the amalgamated results could be given to every participating class before the end of the school year.

Assessing the impact of networking

The conclusions of the SENTIS study are restricted to the levels of computer use encountered within the study. Schools with higher levels of computer use need to be studied to see if the null hypothesis can be rejected in different circumstances to those he study. Computer based education can deliver a degree of one-to-one tutoring, and this is seen as of great potential benefit. Since many computers in schools are being connected together in networks, these could include opportunities for groups of students working on the same task to collaborate, both by voice, in person and screen to screen. In this way, one might reduce the amount of solo individual working time, and increase group awareness and friendships. The effect of these computer-based group working opportunities could be monitored.

One corollary of such a group approach, is that members of the group should be able to work together consistently over time. Therefore they would have to be matched academically, though not in other ways. It is possible that emerging global communications technologies would be appropriate for such groups to be based in more than one school or country.

Classroom structure and development

Bearing in mind the thinking of Schmuck (1966) on the central and diffuse structures of groups, one future research question might be:

> "As individual solitary computer use increases in education, do classroom groups tend to become more centrally structured than diffusely structured?"

The SENTIS project has charted significant intrusion of computers into the curriculum, and showed that students work for significant amounts of time per day on computers. The first two phases of the project have been conducted at an interval of three years, and it is recommended that further phases be introduced at similar time intervals. Should there ever be a time when computers are used for 100% of the school day, then the project should come to an end. It would seem that sociability as measured by group integration is not a factor of socialisation that is being affected by increased computer use in schools, despite teacher fears that this might be the case. Therefore, it is recommended that monitoring of this variable continue, and that other aspects of sociability be included. These might include:

1. Anticipation of the needs of other people (decentering ability).

2. Awareness of grammar in spoken language (preparing a base-line against which this variable can be assessed as voice-driven computers become more popular).

3. Geographic span of important personal relationships (preparing a base-line prior to wide-spread introduction of broad-band personal communication systems).

4. Reward value to the student of other people (Staats, 1974, p. 82)

5. Level of moral thinking (Kohlberg, 1974, p. 145).

As computers are used in more areas of human life, consequential changes in behaviour are to be expected. Whether these are changes for the better or not will be a judgement that will probably be made in the future, well after they have taken place. However, a continuing project like this can provide information to policy-makers to direct the changes technology is making upon society, and to choose options which have minimal negative effects.

Conclusion

This SENTIS study has investigated some potential social effects of computers in schools. No effect upon sociability (as measured by group integration) was found.

The level of computer use in schools was found to be increasing at a rapid rate. Up to 12% of curriculum time was taken up by computer use in 1992. Teachers were in general fearful, whilst students felt optimistic about the social effects of computers.

Within schools, girls were found to to be the highest computer users. However, this position was entirely reversed when home computer use by boys was taken into account. A wide variation in home computer access and use was found. 29-47% of students had home access. These home computers were invariably accounted for more computer use than those at school - up to 4 times more in some cases. Future studies might therefore have to take this into account.

The SENTIS study represents a base-line measurement against which further changes in the electronic learning environment can be compared. Students now leaving school are the last to have had little or no computer use in the early years of their education. Their successors my benefit from an historical view of pre-processor dependent learning.

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Appendix

Appendix Figure 20 - Example of a student computer-usage data sheet

SENTIS Computer Usage Data Sheet

Computer Identification   Department

Please make an entry on this sheet whenever you use the computer.
Your comments will be very helpful.

Age	Name(s) (if you want to tell us)	Day of the week	Time you started using the computer	Time at which you finished	The progam(s) you used	Any Comments

Please continue with another sheet when this one is filled up.

Appendix Figure 21 - SENTIS friendship information collection procedure

SENTIS friendship information collection procedure

Instructions for the teacher

It would help greatly if you could use the following dialogue guidelines to collect the information from you class. If it is at all possible, I would very much appreciate a copy of your class list, with boys and girls distinguished. In this case they will not need to put the gender on the slips. Hopefully you will be able to give me a collection of papers at the end of this session, which will be of great use to the SENTIS project. This dialogue is a suggestion only - your own variations should work without problems.

"Today we have been asked to help in some research. The idea is to look at the way we work and co-operate together. The person looking into this is also interested in the way we have been using computers.

What I am going to ask you to do will involve each of you and your friends. But I want you to know that whatever you write will be private to each of you alone.

First of all, I am going to give you a small piece of paper. I'd like you to write your own name on the top of the paper, and underneath, write whether you are a girl or a boy. This is because the person doing the study unfortunately doesn't know each of you individually.

NOW, turn over the paper. I want you to write down the names of five other people in this class that you would most like to work with in this room.

Finally, fold your paper twice, and put them into the box I will be passing round.

Thank you - and be assured that the person doing the study will be glad to have these views from you."

Appendix Figure 22 - Phase Two interview schedule

SENTIS 2 - interview schedules and response coding

IT co-ordinator - School Information Sheet

1. How many minutes are there in the school day?

(Code: - number of minutes on average over a timetable cycle)

2. How many computers are there available for student use in the school?
(Code: number of computers)

3. What is the school policy on computer use:

(a) For use in lessons (eg. is there general computer literacy for all students, or is the equipment used exclusively for Information Technology courses)? *(Code: 1 if computers are used for all students in general computer literacy in all subjects, 0.5 if the use is split between general and specific computer classes, O if all the equipment is used only for specific computer classes)*

(b) For use outside lessons (eg. if students are allowed to use the equipment outside lessons, what for, and how is its use monitored/controlled/made equitable)? *(Code: 1 if all computers are always allowed to be used outside lesson times, 0.5 if half are, O if none are)*

(c) Are computers integrated into the curriculum for all relevant subjects? *(Code: 1 if computers are integrated into all subjects, 0.5 if integrated into half of them, O if no computer use outside computer based lessons)*

(d) Do students learn to program at all?
(Code: 1 if all students learn to program, O if none do)

Staff Member

1. Do you have access to a computer at home, and if so, what do you use it for?
(Code: Y/N and application)

2. Do you have access to a computer in school, and if so, what do you use it for?
(Code: Y/N and application)

3. Would you say that computers in this school are used more than 30% of the time?
(Code: Y/N)

4. What do you think about the amount of computer use in the school? *(Code: comment)*

5. Would you say that students in this school are friendly to one another, that they know each other well, that they socialise well together? *(Code: 1 if teacher considers students friendly to one another, O if (s)he considers them unfriendly to one another).*

6. Do you see any problems associated with computer use so far as socialisation is concerned? (Code: 1 if the teacher believes they have a beneficial effect upon friendships, 0.5 if they have no effect, O if they break down friendships)

Student Member

1. What is your grade and age? (Code: grade and age in years)

2. What optional subjects are you currently studying? *(Code: subjects)*

3. How often do you generally use a computer in the school each week? *(Code: 1 if more than twice a week, 0.1 if 5 times per year)*

4. What do you use computers in school for? *(Code: activities)*

5. How often do you generally use a computer outside school each week? *(Code: 1 if more than twice a week, 0.1 if 5 times per year)*

6. What activities do you generally enjoy with your friends? *(Code: activities)*

7. Do you think that computers help friendships, or not? *(Code: 1 if student believes computers help and support friendships, 0 if (s)he considers they break up friendships).*

Appendix Figure 23 - SENTIS Phase Two Questionaire

SENTIS 2 Questionnaire

Social Effects of New Technology in Schools

This survey will help look into the effects computers can have upon relationships between students. All responses will be kept completely confidential.

1) For how many hours did you use any school computers yesterday? [ ] Hours

2) For how many hours did you use any computer outside the school yesterday? [ ] Hours

3) Do you have access to a modem outside the school? [ ] Yes/No

4) Please write down the names of 3 currently present class members with whom you would be happy to work.

5) What is your gender? [ ] Male/ Female

6) Is your home inside or outside the metropolitan area? [ ] In/Out

7) What is your name?

Thank you for responding to this survey. You are welcome to request an interim report for the SENTIS 2 project after 1st February 1993 by phoning (002) 611683.

Please fold this paper, and hand to your teacher when they are collected.

Appendix Figure 24 - School Liaison person notes

Notes on SENTIS 2 Questionnaire.

Ideally the questionnaire should be completed by all students during home group time. It takes about 5 minutes.

However, if vertical home groups are in use, it might be better if it was completed as part of a lesson which brings social groups together.

The questionnaire shuld NOT be completed on a Monday. It asks students to review their computer activities at school and at home on the previous day.

The aim of the questionnaire is to capture information across the whole of the student population on:

How much they use computers at school

How much they use computers at home

How integrated are their friendship groups.

It should not therefore be given under conditions which might overall detect untypical values for these.

Appendix Figure 25 - Home group teacher notes

SENTIS 2 Questionnaires

Social Effects of New Technology in Schools

All students in your group should complete the questionnaire at the same time. The researcher will collect this envelope on the date below and will be available to talk about the project to any interested persons.

Group:
Number in group:
Teacher
Please return to:
By (date):

Appendix Figure 26 - Example letter to Principals summarising SENTIS 2 results

Dear Principal

At the end of 1992 you were kind enough to allow me to gather some data from your school in relation to an investigation I was undertaking.The data set was very large (4356 students) from 12 Tasmanian High Schoo with a wide range of Educational Needs Indexes. I'm afraid it has taken me quite some time to process all th student responses, but I enclose below details of your school, and the way in which it fits into the pattern of the sample as a whole.

		All schools studied		
	No School	Min	Mean	Max
Fraction of the school day when computers are used	0.00%	3.65%	6.77%	11.46%
Computer utilisation	0.00%	16.55%	43.72%	77.28%
Mean computer use by girls IN the school (hours/day)	0.00	0.14	0.36	0.52 hrs/da
Mean computer use by boys IN the schools (hours/day)	0.00	0.16	0.32	0.61 hrs/da
Mean computer use by all students IN the school (hours/day)	0.00	0.17	0.34	0.57 hrs/da
Mean computer use by girls OUT of school (hours/day)	0.00	0.18	0.28	0.42 hrs/da
Mean computer use by boys OUT of school (hours/day)	0.00	0.47	0.73	1.21 hrs/da
Mean computer use by all students OUT of the school (hours/day)	0.00	0.35	0.52	0.79 hrs/da
Mean computer use by girls IN and OUT of school (hours/day)	0.00	0.45	0.64	0.84 hrs/da
Mean computer use by boys IN and OUT of school (hours/day)	0.00	0.65	1.05	1.53 hrs/da
Mean computer use by all students IN and OUT of school (hours/day)	0.00	0.62	0.86	1.20 hrs/da
Percentage of students that probably have access to a computer at home	0.00%	28.90%	40.95%	47.13%
Students per computer in the school	0.00	4.4	9.03	14.88
Ratio of computer use OUT of the school to IN the school	0.00	1.10	1.73	4.05
Percentage of students that have access to a modem at home	0.00%	15.03%	22.54%	33.14%
Percentage of girls that actually use a computer at home	0.00%	13.56%	18.58%	24.42%
Percentage of boys that actually use a computer at home	0.00%	21.05%	34.38%	45.08%
Percentage of all students that actually use a computer at home	0.00%	17.61%	27.00%	34.03%

The main thrust of the research was to see if there was a socially detrimental effect of computer use in schools. The statistical evidence for any detrimental effect was not significant. Therefore we cannot concluc that computers have any negative effect upon sociability at this stage. I have reproduced the graphs of sociability against total, in-school and out-of-school computer use for you to examine. Your school is represented by the letter XXXX on these graphs.

I would like to thank you, and your staff, for your kind assistance in this project. If you have any further queries about the results, I would be glad to go into further detail with you or your staff if you wish. The project is now being written up as an MEd thesis at the University of Tasmania, and a copy will be lodged with the Department of Education and the Arts upon completion.

Yours sincerely

Andrew E. Fluck