SCARRING A GENERATION OF SCHOOL CHILDREN THROUGH POOR INTRODUCTION OF INFORMATION TECHNOLOGY IN SCHOOLS.

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Educational authorities worldwide are rapidly increasing the exposure of school children to computers. However what limited evidence is available suggests information technology is not being introduced appropriately for children and undesirable sequelae are anticipated. This paper reports on two studies on computers and children. One study investigated 24 schools in Canada and Australia and included assessments of physical environments and psychosocial environments in IT rich classrooms. A questionnaire was also completed by 1404 students. The findings included that physical aspects of computer workstations were rated poorest. The other study investigated 3 schools in Australia with mandatory laptop programs. A main finding was that 60% of the 314 students questioned reported discomfort using their computer. The potential implications of poor management of IT use by school children are discussed and suggestions made for ergonomics research. Without accurate and valid guildelines - and effective implementation of these guidelines - scarring or a whole generation of school children is predicted.

INTRODUCTION

Background

During the 1980s government and private organisations invested many millions of dollars in information technology (IT) hardware and infrastructure for office workplaces (Bergqvist et al. 1997). Unfortunately the introduction of IT brought four undesirable sequelae;
1. a failure to achieve the productivity gains expected,
2. an increase in psychosocial problems in the workplace,
3. an increase in reports of visual discomfort, and
4. musculoskeletal disorders (such as RSI).

Subsequent research identified a lack of consideration of the physical and mental capabilities and limitations of adult users as the reason for the poor outcomes.

Government and private education authorities in many countries have recently embarked on major initiatives to increase the access to and use of computers by school children. These are laudable initiatives to help develop 'knowledge workers' of the future. Further, the available education literature promises substantial productivity (in this case learning) gains (Berge & Collins, 1995; Churach and Fisher 1998; Jonasson, 1994; Maor & Phillips, 1996; McCreary et al. 1998, McDonald, 1995; Spears, 1995).

However, the few ergonomics studies conducted on children and computers suggest schools are making the same mistakes as office workplaces did in the 1980s.

Prior Studies

From internationally available research is appears that researchers in Sweden, Japan and the United States of America have identified the potential problem and initiated research to develop understanding and solutions.

At the Work With Display Units '97 conference Berqvist and colleagues outlined a planned international study involving questionnaires to people responsible for computers in various schools. The results of this study in 11 countries is being reported at IEA 2000.

Two other papers presented at WWDU '97 also focused on potential problems of school children using computers. Noro et al. (1997) reported observations of physical mismatches between computer workstations and child user anthropometry in Japan and Jonsson 1997 reported an education initiative for school children in Sweden.

Oates, Evans and Hedge (1999) evaluated the posture of 95 children (8-12 years old) in 3 schools in USA. Additionally, the dimensions of all computer workstations were recorded. None of the workstations were adjustable and all exceeded dimensions recommended. All of the student postures were in the unacceptable range, with postures worse for the younger students

Laeser, Maxwell and Hedge (1999) evaluated the posture of 58 children (11-15 years old) using a typical USA school computer workstation and one adjusted to each child. Their results demonstrated significant improvements in children's posture were achievable with appropriately adjusted equipment.

Figure 1 An IT rich classroom

IT RICH CLASSROOMS STUDY

Introduction

Information technology is changing rapidly with the expectation of continued rapid change. We could find no broad description of the IT environments being used by school children in the 1990s and believed such a description to be vital to the interpretation of current and future research in this area.

Further, research in adults has suggested important relationships exist between physical and psychosocial factors in the development of work-related musculoskeletal disorders.

The aims of this study were therefore to provide a broad description of IT rich classrooms in technologically advanced countries at the end of the 20th century and to examine the relationships between physical and psychosocial factors in computer use by children.

Method

This descriptive study was in 2 parts. Part 1 acquired a broad description of the physical and psychosocial environment of 43 IT rich classrooms in Canada and Australia. Data were collected via observation and measurement of the classrooms and by questionnaire to the 1404 high school students who used these classrooms. Measures included ratings of: workspace, computer, visual environment, spatial environment, air quality, cohesiveness, involvement, autonomy, task orientation, cooperation and satisfaction. Part 2 acquired more detailed information about a subset of 8 classrooms using observations of student behaviours, interviews with teachers and detailed physical environmental monitoring.

Results

Figure 2 shows the mean (sd) ratings across 43 classrooms on the 11 measures. The aspect consistently rated poorest across classrooms was the workspace environment; which considered screen location, keyboard location, chair and desk. This result suggests the pattern of poor user-workstation dimensional matching identified in Japan (Noro et al. 1997) and Sweden (Bergvist et al. 1997) is also present in Australia and Canada. The psychosocial measure rated poorest was autonomy. Further exploration is required to identify which aspects of the IT rich classroom (physical environment, education material, teacher) is responsible for the low autonomy ratings.

Interestingly, satisfaction ratings were generally quite high, suggesting students view these classrooms positively.

Whilst a direct relationship between physical factors and satisfaction was not found in this study, significant associations were found between physical and other psychosocial factors. These associations provide evidence that the physical environment may influence the psychosocial environment and indirectly influence student satisfaction with learning.
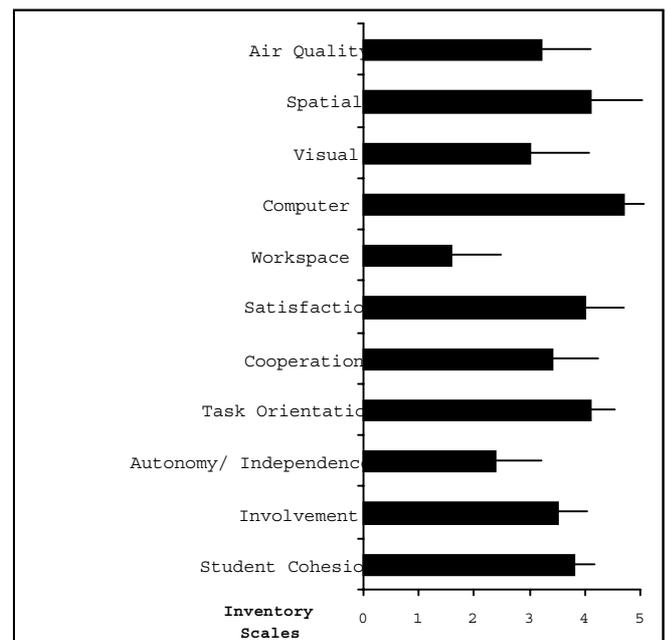

Figure 2 IT classroom ratings

Conclusion

This study was important in demonstrating how both the physical and the psychosocial factors can be investigated and importance of doing this given that these factors may indeed be related.

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Figure 3 Laptop computer use

collected via questionnaire from 314 students aged 10-17 years. Measures included: age, gender, height, locations of laptop use, postures of laptop use, other equipment associated with laptop use, time on computer, discomforts using and carrying laptops and other problems. Part 2 acquired more detailed information on laptop use locations and provided a validity check for the mainly internet completed questionnaire.

Results

Students reported using their laptop for a mean of 3.2 hours per day and 16.9 hours per week. Locations of use included school, home, boarding home, bus/car, other person's home and outdoors. Figure 2 shows the percentage of participants using different postures, with an interesting finding that desk sitting only accounted for one third of computer use. 60% students reported discomfort with computer use and 61% reported discomfort carrying the computer. Figure 3 illustrates the most frequent locations of discomfort for these two activities.

Conclusion

This study was important in providing a description of the ways students are currently using laptop computers in technologically advanced schools. Based on research on adults we expected such use would result in significant numbers of students experiencing discomfort and this was demonstrated in the study.
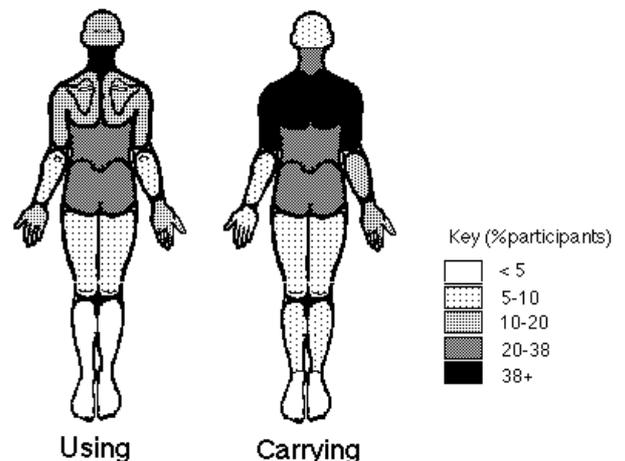

Figure 4 Discomfort location for laptop use and carriage

LAPTOP CLASSROOMS STUDY

Introduction

Whilst the majority of computer use by school children appears to currently be via desktop computers (Noro et al. 1997), there is a growing trend for laptop computers to be used. The pattern of use of laptop computers in schools appears to be radically different to desktop computer use.

Desktop computers tend to be located in specially dedicated IT classrooms. Students typically move to this classroom for some classes during a school week, but spend most of their school class time away from computers.

Conversely, schools which have introduced a mandatory laptop program have fundamentally changed their teaching methods to incorporate the use of the (laptop) computer into all classes. Thus not only are these students exposed to the use of a physically different computer, but use it throughout the day and in their normal classroom (Figure 3).

In the light of increasing queries by teachers and parents, the aim of this study was to identify how children were using laptop computers and what discomforts where they experiencing.

Method

This descriptive study was also in 2 parts. Part 1 acquired a broad description of how children were using laptop computers in 3 schools in Australia. Data were

RESEARCH NEEDS

Our knowledge base from research on adults and our small knowledge base on research from children point to computer use by children being an important issue. Predictions of rapid growth in computer use over the next two decades reinforces the importance of this issue. What research therefore needs to be done to help us understand the issue and be able to provide accurate and valid guidelines to educational authorities, teachers, parents and children?

We would like to suggest 3 tiers of research need to be performed.

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At the broadest level we need cross sectional and longitudinal epidemiological studies which measure exposure and outcome and provide indications of where more detailed research should be concentrated. At a middle level we need field studies which provide detailed exposure assessments to enable accurate guidelines to be developed. At the lowest level we need laboratory studies with detailed analysis of factors identified in the field.

CURRENT STUDIES AT CURTIN

Epidemiological Studies

To help identify important risk indicators we are currently conducting a longitudinal study on basic information technology exposure and outcomes. The study is being added to a larger study on child health issues in Western Australia - called RASCALS. The broader study has been following a randomly selected sample of 5% of all children born in Perth in 1995. A single page of questions to parents will be incorporated into the larger study questionnaire. Data will be collected on IT used, average amount of use, and musculoskeletal, visual and psychosocial outcomes.

Field Studies

Whilst there is some concern that laptop computer use may be more hazardous than desktop computer use, there is little data to support this, and none from children. We are currently conducting a case control field study in Canada to compare laptop and desktop computer use. A grade 6 class is currently piloting the use of laptops and we are monitoring their exposure and outcomes and simultaneously monitoring the closest comparison group we could find, the grade 5 class in the same school. We have developed the measurement instrument in association with teachers and intend using the same instrument in a number of studies. We would like to see other researchers to use the same instrument to facilitate data comparisons.

Laboratory Studies

To provide complimentary information on the comparison of laptop and desktop computer use by school children we are also conducting a laboratory study. This study is measuring the postures of children performing the same task on laptop and desktop computer using a digital motion analysis system.

CONCLUSION

Computer use by children is increasing rapidly. Currently ergonomists are guessing to provide guidelines for appropriate use of computers by children. We know very little about the visual, psychosocial and productivity aspects and the one aspect we know most about (physical workstation setup) shows that we have failed to safeguard our children.

The last generation of children barely touched computers and were therefore at little risk. This generation of children will be exposed to prolonged periods of computer use for all their childhood and probably their adulthood. Not since the development of a written language has the task performed by children and adults changed so dramatically.

We know from adults that unless computer use is very well managed physical and psychological scarring can occur. Unless we quickly develop some accurate and valid guidelines for use of computers by children - and see them implemented - we risk permanent scarring of a generation of children.

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