Computers & Education 55 (2010) 276–284

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Computer-related posture and discomfort in primary school children: The effects of a school-based ergonomic intervention

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ARTICLE INFO

Article history:
Received 18 June 2009
Received in revised form 14 January 2010
Accepted 24 January 2010

Keywords:
Computer
Child
Posture
Discomfort
Ergonomics

ABSTRACT

This study investigated the effect of a school-based ergonomic intervention on childrens' posture and discomfort while using computers using a pre/post test study design. The sample comprised 23 children age 9 and 10 years. Posture was assessed with Rapid Upper Limb Assessment (RULA) and a workstation assessment was completed using a Visual Display Unit (VDU) checklist. Self reported discomfort was also recorded at the beginning and end of the computer class. Following an ergonomic intervention that included education of the children and workstation changes, the outcome measures were repeated. There was a positive response to the intervention with significant changes between the pre-intervention and post-intervention scores for posture ($p = 0.00$) and workstation ($p = 0.00$). The change in discomfort scores from beginning to end of the computer class between the pre-intervention class and the post-intervention class was also significant ($p = 0.00$). The study highlights the need for continuing concern about the physical effects of children's computer use and the implications of school-based interventions.

1. Introduction

The use of computers in schools is now well established worldwide and strategies to increase the level of use of computers by children are ongoing. The implementation of information technology (IT) in schools continues apace as educational institutions are increasingly looking at the use of IT in the development of new teaching and learning models. A recent study by McMahon (2009) found a statistically significant correlation between students' computer skills and their level of critical thinking. He advocates that IT should be integrated across all learning areas in school to facilitate the development of higher order thinking skills. The use of information technology in schools and the factors that influence or contribute to its use have been investigated (Albirini, 2006; Baek, Jung, & Kim, 2008; Haydn & Barton, 2008). However, there continues to be little thought given to ergonomic factors during the setting up of computer workstations in schools or to the subsequent use of the computers by the children. There also continues to be concern about the short and long term physical effects that poor ergonomic workstation design and use of the computers can have on children. Previous research has highlighted the mismatch between the size of the computer workstations and the size of primary school children (Noro, Okamoto, & Kojima, 1997), and further research has identified poor user-workstation dimensions (Bergqvist, Sotoyama, & Piccolic, 1997; Zandvliet & Straker, 2001). McGrail (2007) reported that the physical classroom environment, such as space and furniture, played a significant part in the negative outcomes of computer use in school.

The benefits of educational technologies in terms of student learning, classroom organisation and curriculum development should be complemented by effective, safe and productive use of computers by schoolchildren. Ergonomics as a discipline, addresses these factors, but there are few studies to date that examine ergonomic issues related to computer use in schools.

1.1. Intervention studies

Studies have investigated the effects of an intervention on various aspects of computer use by children. Studies have been laboratory-based (Laeser, Maxwell, & Hedge, 1998; Straker, Briggs, & Grieg, 2002) home-based (Williams & Jacobs, 2002) or school-based (Cardon, De

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doi:10.1016/j.compedu.2010.01.013

Clercq, & De Bourdeaudhuij, 2000; Geldhof, Cardon, De Bourdeaudhuij, & De Clercq, 2006; Rowe & Jacobs, 2002). Some positive outcomes of ergonomic interventions in children have been demonstrated. The outcome measures included knowledge (Cardon et al., 2000; Geldhof et al., 2006; Rowe & Jacobs, 2002; Shinn, Romaine, Casimano, & Jacobs, 2002; Williams & Jacobs, 2002) and behaviour (Geldhof et al., 2006; Williams & Jacobs, 2002). Interventions have comprised a single session of verbal instruction and demonstration (Williams & Jacobs, 2002), a 12-min education session (Rowe & Jacobs, 2002), a 6-week back care education programme (Cardon et al., 2000), and a 2-year multifactorial intervention (Geldhof et al., 2006).

Williams and Jacobs (2002) carried out a home-based education intervention and investigated its effects on knowledge and sitting posture of six children (mean age 12.7) and their parents. They concluded that knowledge of ergonomically correct computer use improved but that sitting posture did not improve following the intervention. Rowe and Jacobs (2002) in a school-based 12-min intervention programme with 19 children (mean age 11.6) reported that the intervention improved knowledge of correct computing habits. Similarly, Shinn et al. (2002) found that ergonomic knowledge can increase as a result of a school-based education intervention. They mention that the environment should also improve to allow the children to put what they have learned in the education session into practice.

Geldhof et al. (2006) investigated the effects of a school-based back education programme on 193 children who were 9–11 years old. The study also included 172 controls. They reported that the childrens' back posture knowledge and observed postural behaviour improved as a result of the intervention, but there was no effect on back and neck pain in girls, although there was a trend for decreased pain among the boys. They concluded that back posture education as part of the school curriculum was an effective way to teach back care to children.

With these issues in mind, the current study set out to investigate the effect of an ergonomic intervention on the posture and discomfort of school children. Some aspects of the intervention were similar to other studies in that it was educational in nature and was school-based, as this has been recommended by previous authors (Geldhof et al., 2006). In addition to the educational intervention, the current study included the assessment of the changes implemented to the workstations that were used by the children in school so that they could put their new knowledge into practice.

1.2. Aims and objectives

The main aim of the study was to assess the effect of an ergonomic intervention on the posture and discomfort of primary school children while working at computers in school. The objectives were to: (1) assess primary school childrens' posture at a computer; (2) record discomfort levels before and after computer use; (3) assess computer workstations; (4) plan and implement an intervention programme; (5) compare posture pre and post-intervention; (6) compare the levels of discomfort pre and post-intervention; and (7) compare computer workstations pre and post-intervention.

2. Method

2.1. Research design

A pretest–posttest design was used and was conducted in three stages. The pre-intervention or baseline stage involved the assessment of the children as they worked at the computers and the assessment of the computer workstations in the school. The intervention stage consisted of the ergonomic intervention which included education and advice for the children and their teacher, introduction of new work practices based on current ergonomic advice, and changes to the workstations as required. The post-intervention stage involved a follow-up assessment of the children as they worked at the computers and the assessment of the computer workstations in the school in order to ascertain if there was any difference between the pre and post-intervention stages. This methodology was used to evaluate the impact of the ergonomic intervention.

2.2. Ethical approval, consent and assent

Ethical approval was granted by the Trinity College Dublin Health Sciences Faculty Research Ethics Committee. The school principal and board of management were approached to obtain permission to carry out the study in the school. The class (4th) was chosen for participation in the study. A meeting was arranged with the class teacher to seek informed co-operation with the study. Information sheets and written assent and consent forms for the potential participants and their parents/guardians were distributed by the class teacher. Completed assent and consent forms were returned to the teacher and subsequently to the researchers.

2.3. Tools

2.3.1. Rapid Upper Limb Assessment (RULA)

Posture was evaluated using RULA (Rapid Upper Limb Assessment) which was developed by McAtamney and Corlett (1992). RULA is an observation method of posture analysis. It involves the allocation of a numerical score to an observed posture of different body parts (upper arms, lower arms, wrist, neck, trunk and legs). The posture scores are calculated and combined with a score for static muscle load and force,

Table 1
Rapid Upper Limb Assessment (RULA) levels.

Action Level	Grand Score	Indications
1	1 or 2	Posture is acceptable if not maintained
2	3 or 4	Further investigation needed. May need changes
3	5 or 6	Further investigation and changes needed soon
4	7 or more	Investigation and changes required immediately