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ERGONOMICS FOR CHILDREN AND EDUCATIONAL ENVIRONMENTS - AROUND THE WORLD

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This paper briefly reviews activities and research related to children and educational environments. The increasing prevalence and role of information and communications technology in the lives of children as well as the incidence of back pain and heavy loads children carry in back packs are raising concerns around the world. Out of this concern an International Ergonomics Association Technical Committee has been formed. A survey was sent to Ergonomics for Children and Educational Environments membership and those who have communicated through the committee. The results are compiled to describe a cross-section of international efforts to address the health and the future of children.

INTRODUCTION

Throughout the world education has been shaped by culture, politics and economics as well as the technology of the times. For hundreds of years print technology played a powerful role in shaping education and disseminating information. During the past two decades the influences of information and communication technology (ICT) have been superimposed upon the traditional structure of education.

As schools in many parts of the world integrate technology into the learning environment, classrooms have changed in a fundamental way. Electronic devices are typically brought into a physical environment that has not changed to accommodate them. Computers are placed on tables and desks that are a legacy from the past. The science of human factors has rarely been incorporated into the design of school furnishings and children sit on chairs designed by tradition. The size and shape of computers, keyboards and pointing devices are usually not tailored to children.

Those concerned with the health and well-being of children in various parts of the world are recognizing the benefit of ergonomics education, design and implementation. There is a sense that the future health and careers of children could be at risk.

Background

Adults have always been concerned with the education of children. Awareness and formal study of the relationship between the physical characteristics of

children and the learning environment are relatively recent. A number of anthropometric studies of children related to educational environments were conducted in the 1960s (Norris and Wilson, 1995). Since the 1970s, concerns with school seating have continued to provide incentive for publications (Dillon, 1976; Knight and Noyes, 1999; Mandal, 1984). While ideal design of school furniture continues to be debated, efforts to make improvements have been launched. Work on higher tilted seats in Denmark has been used in the design of some school furniture (Mandal, 1997). For the most part, however, incorporation of ergonomic data into standards or design of low cost ergonomically designed furniture has not been widespread.

With the introduction of computers in schools in the 1980s, concerns with the health of children began to arise (Povlotsky, 1984). As computers have become prevalent even in the schools of developing countries, ergonomists, researchers and health professionals have begun to wonder about the effects on children.

Researchers have identified a surprisingly high prevalence of back pain among schoolchildren and adolescents (Balagué et al., 1999; Watson et al., 2002). Studies of back care education have been conducted in Europe (Cardon et al., 2001), but the inclusion of this subject in schools is not universal. Many have concerns with the loads that students carry in book bags and backpacks (Jacobs, 2002; Mackenzie et al., 2003). The relationship between current lifestyles, ICT and physical education is another area of concern (Trost et al., 1999). In addition to physical ergonomics and fitness, cognitive

and social issues related to child computer use have occupied the interest of some researchers (Wartella and Jennings, 2000). Others question the effects upon the developing vision of children (Marumoto et al., 1999). These and other issues have led to a growing number of individuals around the world studying or looking for information on ergonomics related to children.

The ECEE Technical Committee

The International Ergonomics Association (IEA) provides a forum for technical information exchange throughout the world. The Ergonomics for Children and Educational Environments (ECEE) IEA Technical Committee was created following a related symposium at the IEA2000 Congress (Bennett, 2000). The ECEE has become a virtual community of 120 members in 22 different countries. Volunteer efforts by a Canadian web editor have created a web site hosted on a server of the University of Minnesota in the US: www.ergonomics4children.org.

Through the web site and email the ECEE has been able to serve as a portal of information for students, researchers, educators, therapists, designers and parents, among others. Work and interest in the field of ergonomics for children and educational environments appears to be increasing. As requests for information have been received from various parts of the world, individuals have generously shared information and resources (such as photographs, see Figures 1, 2 and 3).

The ECEE receives requests for data. A Russian furniture manufacturer seeks additional evidence to support implementing new standards based on Danish studies. An ergonomist from the Ministry of Education in Chile was looking for information for the development of a Recommendations Guide for School Furniture. A Latvian researcher and professor shares information on an full educational ergonomics course at a teachers college.

Professors are evidently including ergonomics in some assignments. A student in South Africa sought information for an assignment to "improve and restore" a kindergarten including ergonomic considerations for children. A professor at the University of Jordan assigned students the task of determining "how to design the best computer work stations fit to the children". A student in the UK inquired regarding an assignment to devise adaptations to existing bus seats to ensure they are suitable for children. A student in India requested

information related to the design of chairs for disabled children.



Figure 1. Students in South Africa (Intel)

Professionals in fields related to education also recognize the need for ergonomics information. An occupational therapist in Bogota, Columbia sought information for investigation of the ergonomics of primary school education while a physiotherapist in Spain wanted information about the relationship between furniture and the behavior of children. Principals, parents and teachers search for information to address their local needs.

SURVEY

In an effort to obtain additional information, an email questionnaire was sent out to 42 members of the ECEE. Additional questionnaires were sent to 28 contacts throughout the world. The responses received are summarized in Table 1.

Countries of Response (number of responses)

Australia (2)	Japan (2)
Canada (2)	Latvia (1)
Chile (1)	Portugal (1)
Columbia (1)	New Zealand (1)
England (1)	Russia (1)
India (1)	South Africa (1)
Ireland (1)	Singapore (1)
Israel (1)	United States (2)

Table 1

The recipients, who were not formal government representatives were asked about their knowledge of ergonomic leadership, policy and practices in schools within their country. All respondents stated no knowledge of a country wide ergonomics program, standards or practices. Referrals to statistics and other sources for information were given. Statistics such as

the numbers of computers in schools are readily available in some countries and difficult to obtain in others. The authors examined ICT statistics and noted the rapid increase in computers in schools even in developing countries. The statistics cover different time periods and measured differently so few were directly comparable. Regarding the teaching of ergonomics in schools below university level, for example, statements such as "...there are none doing so in (my country)," were common. Even with this lack of structure, some respondents described their personal efforts to introduce ergonomics. An eye specialist and ergonomist appointed to schools in Japan is able to offer training but believes it is rare. Post Secondary ergonomic training may lead to further research and program development as a professor in Israel stated, "We have already began to build Ergonomic Education Programs for the schools, as part of their physical education classes."



Figure 2 Students in Israel (Intel)

In the United States (Oates et al., 1998) and Australia (Straker et al., 1997) studies on the conditions of students have captured the attention of the press (McGrane, 2001). Press coverage of Australian research has inspired parents at least one private school in Canada to demand the school include a short course in ergonomics (Fraser, 2002). Schools in the US, England, Sweden, New Zealand have governments providing recommendations for ICT use in schools but ergonomics is not commonly specified. Meetings, conferences and symposia have played a role in information exchange and broadening the interest in these areas. In 1997 the Work With Display Units (WWDU) conference included papers on ergonomics for children by researchers in Japan, Sweden and Italy (Noro, 1997). The proceedings were posted on a Waseda University web site for several years after the conference and were frequently referenced.

The Johns Hopkins Center for Information Technology and Health Research organized a symposium in 2001 to define research needs for children and

information technology (2001). The need for an international organization was among many important recommendations made by participants.

For the most part, educators have not been demanding that ergonomics be included in required subjects. One notable conference that could be a good model for school districts was held in Vancouver, British Columbia (Gibson, 2001). This conference was led by a school health and safety coordinator but the target audience included educators, administrators, purchasing staff, risk managers, special education staff, facilities staff (such as maintenance and custodial) and teachers as well as health and safety staff. This kind of cross-cutting event could help facilitate the broad collaboration needed to integrate ergonomics into school district operations.



Figure 3. Students in Japan (Marumoto)

Student transition to the workforce

Some countries are focusing more attention on the preparedness of young workers and of students for their future work environments. One in seven young people in Canada hurt themselves on the job. In the US, 70 teens die and over 230,000 teens are injured while working on a job each year (NIOSH, 2003). In Sweden, the National Institute for Working Life has shifted their research focus from physical work environment towards issues of work organization and how workplaces should be formed to ensure individuals retain good health. Ergonomics education needs to be recognized as one of tools future workers need for recognizing hazards in their work environment.

Developing countries versus developed

There are more than 130 million children between the ages of six and eleven not in school particularly in sub-Saharan Africa where 12 to 14 countries have less than 50% of their young children in school. In countries such as Peru, Chile, Thailand and the Philippines the private sector is providing up to 40% of educational funding. The developing countries will depend on the next

generation workforce as much if not more than the developed countries. It is imperative that the health of children be protected for their own sake as well as for the stability of the future socioeconomic environment. The 1953 United Nations Educational, Scientific and Cultural Organization (UNESCO) Associated Schools Project (ASP) promotes education for international understanding, co-operation and peace and is piloted in 166 countries. Ergonomics is highly compatible with the emphasis on reinforcing the four pillars of Learning for the 21st Century as defined by UNESCO: learning to know, to do, to be and to live together.

REFERENCES

- Balagué, F., Troussier, B., and Salminen, J. J. (1999). Non-specific low back pain in children and adolescents: risk factors. *European Spine Journal*, 8, 429-438.
- Bennett, C. (2000). Children, Computers and Classrooms. *International Ergonomics Association Congress and Human Factors and Ergonomics Society (IEA/HFES 2000)*.
- Cardon, G., Bourdeaudhuij, I. D., Clercq, D. D., et al. (2001). Generalization of back education principles by elementary school children: evaluation with a practical test and a candid camera observation. *Acta Paediatr*, 90, 143-150.
- Dillon, J. (1976). *School furniture: standing and sitting postures*. London: HMSO.
- Fraser, M. (2002, June 10-12, 2002). *Ergonomics for Grade School Students Using Laptop Computers*. Paper presented at the Proceedings of the XVI International Occupational Ergonomics and Safety Conference, Toronto, Canada.
- Gibson, M. (2001). *Demystifying Ergonomics: Practical Solutions to Complex Issues*. Paper presented at the ergo ed: 2001 Conference & Trade Show, Vancouver, British Columbia.
- Jacobs, K. (2002). *Are Backpacks Making Our Children Beasts of Burden?* Paper presented at the International Occupational Ergonomics and Safety Conference, Toronto.
- JHUCITH. (2001). *Children and Information Technology: Report of Symposium June 11-12, 2001*. Baltimore, Maryland: Johns Hopkins University Center for Information Technology and Health Research
www.jhsph.edu/cithr/RepChildren.pdf.
- Knight, G., and Noyes, J. (1999). Children's behavior and the design of school furniture. *Ergonomics*, 42(5), 747-760.
- Mackenzie, W., Sampath, J., Kruse, R., et al. (2003). Backpacks in children. *Clin Orthop*, 409(April), 78-84.
- Mandal, A. C. (1984). The correct height of school furniture. *Physiotherapy*, 70(2), 48-53.
- Mandal, A. C. (1997). Changing standards for school furniture. *Ergonomics in Design*, 5, 28-31.
- Marumoto, T., Sotoyama, M., Villanueva, M. B. G., et al. (1999). Significant correlation between school myopia and postural parameters of students while studying. *International Journal of Industrial Ergonomics*, 23, 33-39.
- McGrane, S. (2001, January 4, 2001). Creating a Generation of Slouchers. *New York Times*.
- NIOSH. (2003). *Young Worker Safety and Health*. NIOSH. Retrieved, 2003, from the World Wide Web:
<http://www.cdc.gov/niosh/adolespg.html#infoY>
- Noro, K. (1997). *Proceedings of WWDU '97*. Paper presented at the WWDU, Tokyo.
- Norris, B., and Wilson, J. R. (1995). *Childdata Handbook, Department of Trade and Industry, Nottingham, UK, 1995*. Nottingham, UK: Department of Trade and Industry.
- Oates, S., Evans, G., and Hedge, A. (1998). A preliminary ergonomic and postural assessment of computer work settings in American elementary schools. *Computers in the Schools*, 3(4), 55-63.
- Povlotsky, B. (1984, June 11, 1984). It's vital to consider health when placing VDT's in schools. *Pittsburgh Business Times*, pp. 8S and 11S.
- Straker, L. M., Pollocka, C. M., and Mangharama, J. E. (1997). The effect of shoulder posture on performance, discomfort and muscle fatigue whilst working on a visual display unit. *International Journal of Industrial Ergonomics*, 20(1), 1-10.
- Trost, S. G., Pate, R. R., Ward, D. S., et al. (1999). Correlates of objectively measured physical activity in preadolescent youth. *American Journal of Preventive Medicine*, 17(2), 120-126.
- Wartella, E. A., and Jennings, N. (2000). Children and Computers: New Technology—Old Concerns. *The Future of Children: Children and Computer Technology*, 10(2), 31-43.
- Watson, K. D., Papageorgiou, A. C., Jones, G. T., et al. (2002). Low back pain in schoolchildren: occurrence and characteristics. *Pain*, 97(1-2), 87-92.