

THE TEACHING OF ERGONOMICS IN SCHOOLS: A REVIEW OF THE SITUATION IN THE UK

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The lack of enthusiasm for ergonomics displayed by designers and engineers has long been recognized in the profession. Various methods have been employed to reduce this. This paper reviews work conducted over a number of years to look at the way in which ergonomics is taught in schools, in the UK, with a view to determining whether there is potential for increasing the awareness of ergonomics and integrating it into the curriculum, to build up 'grassroot' support and understanding of the discipline, which can be built upon by tertiary educators.

INTRODUCTION

This paper summarises the findings of a number of studies undertaken by the author over the past three years concerning the teaching of ergonomics in UK schools. This research originated in doctoral work in automotive design, where it was noted that ergonomics was used neither efficiently nor effectively by designers and engineers. There are many reasons for these, which have been previously documented (e.g. Woodcock and Galer Flyte, 1997) and for which solutions have been proposed.

Given the pressure on practicing designers and engineers to cater for niche and global products against tight windows of opportunity, the author noted surprising reluctance in undergraduates from these disciplines to apply ergonomics information and adopt a user centred design philosophy. Basically, design and engineering students seemed to come to university already prejudiced against ergonomics. This led to a new stream of research investigating pre-university exposure to ergonomics, which is the focus of this paper.

The paper will consider the teaching of ergonomics in primary (catering for 5-11 year olds) and secondary schools (at qualification stages related to 16 and 18 year olds) and the attitudes/remembrances of undergraduate engineers and designers towards ergonomics. It will conclude by reviewing current, UK initiatives to support the teaching of ergonomics in schools and lessons learnt from the research.

ERGONOMICS AND YOUNG CHILDREN

Baynes (1992) points out that children start school already

able to design and make through their everyday interaction with the world. Part of this ability is a concern for users in their designs. This might be relatively simplistic, e.g. making sure that the LEGO 'person' fits into the house, that the layout of an emergency hospital is satisfactory for both patient and doctor.

In more formal primary school activities, such as the design and evaluation of a sun hat for children, children engage in a more structured approach - looking at where the sun falls on the head (top, neck and ears), mechanisms to stay cool (air vents, shadow, fans and water sprays) and incorporate this understanding in an annotated design sketch which will be attractive to the target user group.

Kimbell et al (1996) observed that at Key Stage 1 (start of primary school), children handle user issues "more than at any other Key Stage. They easily empathise with the users of their designs." They are indeed 'natural born ergonomists'. However, with the progression from primary to secondary school there is a marked change in the way in user issues are tackled, with users being far more important to the design work of younger children as the curriculum moves starts to emphasize design skills often at the expense of user requirements and evaluation

ERGONOMICS AT SECONDARY SCHOOL

Study 1: Survey of AQA Specifications

The overall aim of this study (Woodcock, 2002) was to use an examination of the AQA specifications (representing the syllabus for each course) to look for subjects where ergonomics was taught or where there was the potential for

its greater inclusion.

At GCSE level (the qualification for 16 year olds) over 30 specifications were examined. Ergonomics did not feature as a major component in them, or their units/modules, and was barely mentioned by name. However, it was mentioned in ICT, Business Studies and some Design and Technology courses. Notably, it was applied ergonomics that featured. Ergonomics had the potential for further incorporation in a wide range of subjects e.g. psychology, physiology. Additionally there seemed scope to embed it in the school ethos e.g. in health and safety practices for workshops and laboratories and disability provision.

For A levels (18 year qualification) a similar picture emerged from the 20 specifications analysed. A substantial amount of ergonomics-related issues were found in Business Studies, Design and Technology (Systems and Control Technology), Computing, Design and Technology (Product Design), and Information and Communication Technology (ICT), with the latter three having the greatest content. Additionally other pathways in Art and Design, Design and Technology could include some ergonomics-related content.

The implications of this for the design of material to support TLA (teaching and learning activities) is addressed after the investigation of what undergraduates remember from school.

Undergraduate student reminiscences

In 1998 a questionnaire survey of first year undergraduate students at Loughborough University was used to ascertain their experience of the teaching of ergonomics in primary and secondary education (Woodcock and Denton, 1999). The results based on over 350 responses again showed that ergonomics was remembered as being taught in Design and Technology related subjects and occasionally in other disciplines notably IT, sport and geography. The analysis of the specifications (in the above section) provided more insight into this.

The survey also looked at other issues related to the teaching of ergonomics and found the following; teaching of ergonomics using multiple-methods (e.g. lecture, handouts) produced students with a higher level of understanding of ergonomics; younger respondents had slightly more knowledge of ergonomics than older ones; an encouraging 85% (notably not civil and mechanical engineers) felt that ergonomics would be of value to them in later careers with females having a higher regard of ergonomics in respect to their future careers than male respondents; few students

could remember back to work undertaken at GCSE level (i.e. when they were 16).

A later survey (reported in Woodcock and Denton, 2001) of 66 industrial design first years at Coventry University showed that 83% would have liked more ergonomics at school. The 17% who did not, thought ergonomics was either boring or uninteresting, restricted creativity, detracted from the main course content, and did not alter the design outcome. In terms of subjects where ergonomics was taught and remembered a similar pattern emerged to that described previously, but there was a wide variation – so even students taking the same course might not have experienced the same level of tuition in ergonomics. Of the students who had been taught ergonomics, only a third thought they had been taught well, with one third thinking they had been taught poorly and one third not at all. Teaching had been through multiple methods e.g. practicals, design journals, tutorials, tv, with the most preferred method being hands-on in large (e.g. transport and product design e.g. scooter, multi-gym) and small project work. Topics remembered included anthropometry, hmi, vision, comfort, texture, and psychology.

INCREASING THE AWARENESS OF ERGONOMICS IN SCHOOLS (UK)

The Ergonomics Society, UK have designed a site for children at <http://www.ergonomics4schools.com/index.htm>. This contains information and definitions about core areas of ergonomics, careers advice and a frequently asked questions section where children can write in for advice on their projects, and get replies from society members and also request school visits. The site is visually attractive and written in a manner appealing to children.

Woodcock and Bartlett (2003) developed a set of web based teaching and learning activities for primary school children upwards to stimulate the development of ergonomics related projects in a number of subjects e.g. biology, IT and design and technology, with related links, tutorials and learning outcomes. The site has also been designed to encourage the sharing of knowledge (results from investigations with students, teachers and fellow ergonomists invited to contribute material. The site is at <http://vide.coventry.ac.uk/learning-about-ergonomics/home/home.htm>.

Additionally Woodcock et al (2003) developed an activity pack, using animal metaphors to encourage user centred design in 4 to 6 year old children to explore issues

which need to be considered in the design of material for this age group.

DISCUSSION AND CONCLUSIONS

This section will address two issues that have developed from this work. Firstly how we can support the teaching of ergonomics in schools, and secondly looking at some of the wider implications of the research.

Teaching ergonomics

A cursory inspection of the AQA specifications reveals little mention of ergonomics per se. However, more in depth analysis revealed aspects of applied ergonomics (user centred design, job design, evaluation, case studies etc) in subjects at both GCSE and 'A' Level, so confirming previous work. Design and Technology related subjects emerged as the champions of ergonomics with business related studies, ICT and computing providing considerable ergonomics content. There is also potential for ergonomics to feature more widely in some subjects, such as human biology and physics. However, if we are going to provide information targeted at secondary schools it would perhaps be most appropriate to concentrate first on those courses where recognition of the discipline already exists.

The specifications and work with undergraduates indicate that an action learning approach is required – with case studies, activities and reflection on proposed solutions. For example, in their introduction to Design and Technology at secondary school, students have to understand health and safety issues of their studio and working environment, design posters to highlight these issues and how accidents can be avoided.

Although the Design and Technology curriculum emphasizes the need to 'make' an artefact (electronic product, teaching aid, dish for a vegetarian), students are expected to conduct research and understand the ways in which their product will be evaluated. In some cases it is expected that they will attempt a user evaluation. Other case study approaches, for example in Business Studies and ICT consider analysis of the present situation, looking at ways in which it can be approved, and measuring or evaluating the impact of the solutions. This is not just theoretical. For example, at 'A' Level Design and Technology students undertake projects concerning disability including research on the design of artificial limbs and what it means to be disabled. One project from this involves improving the

school environment for disabled children, which draws on interviews, looking at the needs of children, school audits, putting forward proposals for changes, and assessing their costs and benefits. These results are extremely encouraging, with the assessments indicating that candidates are expected to analyse workplace problems or design briefs, implement and evaluate their solutions and reflect on their relative merits.

To support secondary school education, ergonomics teaching and learning material needs to be tailored to meet curriculum objectives. Design and Technology areas require support in terms of child-friendly, interactive anthropometrics packages, instruction in the use of capturing user requirements and evaluation techniques; additional support is required in the form of case studies. Business Studies focus more on organizational issues, change management, factors affecting the efficiency of the workforce (e.g. remuneration, training, motivation, management style, introduction of new technology, changing working patterns, communication and information flow).

Any such material has to support key skills (such as numeracy and literacy) and wider key skills (e.g. citizenship and group working). The review of the specifications showed that there was ample opportunity for material to be developed which would service courses already on offer and that ergonomics was being taught (but not under that name) e.g. HCI and usability, case studies of IT impact on organisations, comparative studies of disabled access around schools. This seems like a missed marketing opportunity. For example, teaching resources are gleaned from television programmes. There is a real opportunity in the Specifications themselves to direct teachers to resources produced by the Society. Such resources could include guidelines/best practice in conducting case studies, specimen case studies, videos or the availability of members to talk of their practice.

In addition to this subject specific material, all subjects, whether they 'teach' ergonomics or not require information and advice on health and safety issues ranging from best practice in workshops, rucksack design, to school furniture and safe computer use.

Some of this information especially for over 16 year olds may best be communicated in the form of standard textbooks. However, more attractive, usable and task related teaching resources should also be considered e.g. videos, web sites, work sheets, posters, design guidelines and interactive 3D packages.

In summary, this research has provided evidence that ergonomics has cross-disciplinary potential within schools reaching across Computing, Business Studies and Design and Technology. It also has the potential to be linked to new curriculum developments in the areas of citizenship and social responsibility, and in the newer vocational courses. Unfortunately no evidence has been found to suggest that ergonomics is taught in those disciplines that provide its core foundations such as physics, psychology and physiology. Lastly, the analysis of the Specifications has indicated ways in which material might be developed to support teaching.

Understanding the use of ergonomics in practice

The work outlined here when positioned alongside other research on the use of ergonomics in industry seems to indicate that ergonomics still has some way to go in asserting its position and usefulness. This may, quite simply be a marketing problem. Designers, engineers and teachers shy away from 'ergonomics' but do draw on certain aspects of it in their work. A Design and Technology teacher commented that children would not be interested in 'ergonomics' as it sounded too intellectual, and yet when suitably disguised and applied it can be used effectively by children.

To remove the barriers preventing the use of ergonomics methods and information we need to better understand the way in which this information can be applied in everyday life and design/engineering practice, build on the elements that are used already, and encourage trial, exploration and reflection. We may, in effect, learn how to further integrate our discipline, by looking at the way in which it is being used in child education and design practice.

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