

ERGONOMICS IN THE SECONDARY SCHOOL CURRICULUM

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This paper addresses the extent to which ergonomics and ergonomics related subjects are present in the AQA (Assessment and Qualifications Alliance) Specifications for GCSE, Advanced, and the forthcoming Vocational GCSE Levels. Previous research has indicated that some aspects of ergonomics are taught in secondary schools, but this has been largely based on reports by first year design and engineering undergraduates. With the growth in IT and multidisciplinary subjects, it is believed that ergonomics is making a significant, but largely unrecognized contribution to a number of disciplines in secondary schools. A better understanding of this could make an important contribution to reappraising the strengths of our discipline and indicate the way forward to a more proactive and creative approach to the development of curricular support at this level.

Introduction

Previous investigations have shown firstly, that children, even in primary schools can have an appreciation of ergonomics (Woodcock and Galer Flyte, 1998), secondly that ergonomics is taught at 'GCSE' and 'A' Level (Woodcock, Galer Flyte and Denton, 1999) and thirdly that when it is taught, it may not inspire children to continue its further practice in their later careers, e.g. in the design profession (Woodcock and Denton, 2001). These results have been based on observations of children and questionnaires given to first year undergraduates. The results are not especially encouraging and in an earlier paper it was suggested that an appreciation of ergonomics was 'taught out' of children during their secondary school education.

Although the scope of ergonomics can be summed up broadly as "designing for human use" (Sanders & McCormick, 1992), it is still frequently equated with anthropometry and 'knobs and dials'. Whilst these are core areas of the discipline, they may seem unattractive to today's adolescents who are far removed from the world of heavy manufacturing and industry.

Other parts of the discipline may prove more successful as an introduction to the subject. For example, Applied Ergonomics places equal importance on improved system efficiency and individual health, considering all aspects of interaction (e.g. human, tool, task and environment). More recently there has been a renewed commitment to looking at how the science may benefit society. For example, Community Ergonomics has the 'goal to improve the fit between people and their environment to achieve higher levels of self regulatory control and individual effectiveness' (Cohen and Haims, 1999). Participatory Ergonomics has similar goals reflected in methodological considerations and organisational change. Whilst Cultural Ergonomics is exploring human factors issues in relation to the cultural settings in which they occur with special emphasis on 'how cultural factors influence and interact with human performance and human interfacing in work environments worldwide' (Kaplan, 1999).

The survey outlined in this paper both complements and extends the author's previous investigations by considering the extent to which ergonomics is present in all of the AQA Specifications. The overall aim is to inform the type of ergonomics material that should be produced for school children. Each specification represents the syllabus for a subject, although they do not stipulate how topics should be taught. Analyzing the GCSE, 'A' and Vocational GCSE Specifications will enable the current status of ergonomics to be established, with respect to the most relevant subjects. This in turn will help in the tailoring of curricular support material.

Method

AQA Specifications were downloaded from the AQA site (www.aqa.org.uk). The new Vocational GCSE Specifications were included but not the GNVQ's (see footnote). Using results of previous research, attention was given initially to those subjects where respondents had remembered being taught ergonomics.

The Specifications at each Award Level have a standard format with sections covering background information, scheme of assessment (rationale, aims and objectives), subject content, key skills, spiritual, moral and cultural issues, administration (e.g. awarding and reporting, center based components) etc. Priority was given to subject content and how different methods of assessment would encourage ergonomics thinking, in order to determine the extent of ergonomics content and the potential for more.

Results

This section summarises the results for each Award Level.

GCSE Level

These are usually taken by 16 year olds. Over 30 Specifications were examined, relating to single, double and modular courses. Ergonomics did not feature as a major component in any of the Specifications, or in any of their units/modules, and was barely mentioned by name. However, ergonomics content did feature in the Specifications as summarized in Table 1. This shows the extent of, and potential for the teaching of ergonomics for the most promising subjects. The final rating was mediated by an understanding of the wider

aims of the subject, its organization at the Award Level, and its relationship to ergonomics.

Table 1. Ergonomics at GCSE Level

Ergonomics *	Subjects	Potential
<i>None</i>	Physics, Psychology, Science, Biology (Human), Geography, General Studies, Human Physiology and Health	Discrete areas could be targeted e.g. biomechanics, cognitive psychology, metabolic rate
<i>A little</i>	Biology, Business Studies (A and B), Physical Education, Sociology, General Studies, Travel and Tourism	Minor enhancements possible, but ergonomics will never form a major contribution
<i>Some</i>	Art and Design, Business Studies (Specification B) Short Course, Design and Technology – Food Technology, Graphic Products, Systems and Control Technology	Support material could be provided for specific areas e.g. Health and Safety, documentation usability, inclusive design
<i>A lot</i>	Information and Communication Technology Specification B (short course), Business and Communication Systems, Design and Technology – Electronic Products, Product Design	Material could be produced to support current teaching in the form of textbooks and case studies.

* Space does not permit a full content description here. Contact author for the detailed analysis.

Vocational GCSE

Vocational GCSE's are two year courses commencing in 2002 and are equivalent to two GCSE's. Of the six draft Vocational GCSE Specifications available for inspection, attention was focused on Art and Design, Business Studies, ICT and Science.

Table 2. Ergonomics at Vocational GCSE Level

VGCSE	Units	Ergonomics
Art and Design	2D and 3D visual language	<i>None</i>
	Materials, techniques and technology	<i>None</i>
	Working to project briefs	<i>A little</i>
Business	Investigating businesses	<i>Some</i>
	People and businesses	<i>Some</i>
	Business finance	<i>None</i>
ICT	ICT tools and applications	<i>None</i>
	ICT in organisations	<i>Some</i>
	ICT and society	<i>Some</i>
Science	Developing scientific skills	<i>A little</i>
	Science for the needs of society	<i>None</i>
	Science at work	<i>A little</i>

Table 2 shows a similar pattern to that found in other Awards, however the overall depth of analysis of ergonomics related topics is less than at GCSE and A Level but with a slight increase in ergonomics teaching in Science.

Advanced Subsidiary (AS) and Advanced (A) Level

These are post 16 year old qualifications, with the 'AS' Level forming the first half of the study towards an 'A' Level, different pathways are also open to candidates. Over 20 specifications were examined. The results were derived in a similar way to that indicated above and may be summarized as follows:

- Subjects with a substantial amount of ergonomics-related study were 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.
- Art and Design had some content (depending on the pathway selected), as did Design and Technology (Food Technology), Sport and PE.

For all Award Levels different types of information are needed to support the different disciplines.

- 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).
- The computing domains cover the system development lifecycle with explicit mention of human computer integration and interaction, maintainability, usability, user support, documentation and evaluation.
- In addition to this subject specific material, all subjects, whether they 'teach' ergonomics or not require information and advice on health and safety issues.

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. The exact requirements of such material will form the next stage of the research, but may include videos, web sites, work sheets, posters, design guidelines and interactive 3D packages.

In terms of teaching and assessment, most of the work students undertake with regard to ergonomics is of a practical nature (e.g. designing a product/software to suit specific requirements), or in the form of a case study (e.g. considering problems in an organization and proposing solutions). There is a real opportunity in the Specifications 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.

Discussion and Conclusions

A cursory inspection of the AQA specifications reveals little mention of ergonomics per se. However, a more in depth analysis revealed aspects of applied ergonomics (user centred design, job design, evaluation, case studies etc) in an array of disciplines at both GCSE and 'A' Level, so confirming previous work. Design and Technology related disciplines again naturally emerged as the champions of ergonomics. Previous investigations have tended to ignore other subjects taught at secondary schools. This research extends the work by providing a more thorough investigation of other subjects and has found that business related studies, ICT and computing provide 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.

What this research has not shown is how the subject is actually taught or assessed. This is the next stage for the research and one that will help to more clearly define the requirements of the teaching material. The Specifications indicate that an action learning approach is taken – with case studies, activities and reflection on proposed solutions.

For example, in the first year of Design and Technology candidates 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), candidates 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 improved, and measuring or evaluating the impact of the solutions. This is not just theoretical. For example, at AS Level Design and technology students undertake projects concerning disability. This includes looking at 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, visiting schools which are known to have better facilities, 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.

A preliminary interview conducted as part of this research suggested that 'ergonomics' had an image problem and that there would be little support for the development of an 'A' Level at least at present. It was suggested that a starting point for the wider teaching of ergonomics would be to lobby for its inclusion in the National Curriculum Orders for Key Stages 2 and 3 thereby ensuring that it was taught and providing a market of students who might be interested in studying it at an Award Level. The analysis of the Specifications has shown that there may be some truth in this assertion, for although the term ergonomics hardly features in any Specification at any Award level, there is a great deal of ergonomics present. Also, given that elements of ergonomics are found in different subjects, it may well prove attractive to a number of students as a discipline in its own right.

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.

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Footnote

The analysis of GNVQ qualifications has been omitted from this paper for reasons of clarity. Candidates may follow different routeways through these qualifications, which makes it very difficult to provide a succinct overview. The overall trend in the coverage of ergonomics is similar to that found at A Level, but is at a greater depth. More details on this and the other analyses are available on request from the author.

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