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DEVELOPMENT OF AN INTERDISCIPLINARY DESIGN CURRICULUM: PREPARING THE STUDENTS FOR FINAL YEAR MAJOR DESIGN PROJECTS

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ABSTRACT

The creation of an interdisciplinary design course, the BSc (Hons) Product Design Technology had been reported in IEPDE04. The academic year 2004/2005 saw the first cohort graduating from this course. Generally speaking, favourable feedback has been received for the performances of this first cohort of graduates who had demonstrated their competency in the areas of engineering design and industrial design through their final year design projects. The individual final year design project is an important part of the final year syllabus in which sufficient time and other resources are made available to each final year student to realise a fully functional product prototype through complete design and manufacturing processes. However, a number of issues had also been identified. In addition, the important issue of product design in a global context had also been highlighted by the graduates who had benefited from overseas placements, principally those in Asia. This paper discusses important issues and briefly presents the developments and enhancements in teaching approaches and design curriculums which have been designed to address the various issues identified, including the influence of globalisation and improve the students' learning experiences and effectiveness.

Keywords: Interdisciplinary design course, development in teaching approaches, effects of globalisation

1 INTRODUCTION

Globally design courses have been evolving to meet the changing needs in areas relating to socioeconomics, aesthetics, functional, environmental, students learning experiences and other changes brought about through economic progress and advances in technology. Pedagogical issues relating to the design and delivery of design courses in the face of these changes have prompted a number of responses from academics in design education in both the industrial and engineering design disciplines. Wak's [1] approach to design education is a philosophical one. Utilitarian and ideological treatments of engineering and industrial design education issues have also been explored [2], [3]. Balaram [4] described the development of design education pedagogical development in India in which unification of past traditions, contemporary styles, science and technology has resulted in a project-based approach to design education. The problem-solving approach has also been proposed [5] as an alternative

for design in technology education. Hence, this continuous process of evolution ensures design education matches the pace of economical and technological progress.

Efficiency and profit optimisation has inevitably resulted in the phenomenon of globalisation which has effectively removed the hurdles of geo-political boundaries and affected almost all facets of global economic activities. The influence of globalisation on design and engineering education has been widely reported in the literature. Buckeridge [6] had seen a need in globalisation of engineering education whereas Childs' and Brodhurst's [7] view of design education integration is one that is conceived in part by the globalisation phenomenon. Woodham [8] has proposed a view to redraw the design historical map into local, national and global regions. Design is no longer limited by local or even national constraints [9]. Design educators in Latin America, America, Europe, Australia and other countries/regions have all responded appropriately to the effects of globalisation in their respective regions [10] - [13].

The creation, in 2001, of an interdisciplinary design course involving two major disciplines of industrial design and engineering design, the BSc (Hons) Product Design Technology at Northumbria University, UK, had been reported in IEPDE04 [14]. This paper briefly reports the progress of the course, discusses important issues relating to the final year major design projects and presents the developments and enhancements in teaching approaches and design curriculums which have been designed to address the various issues identified, including the influence of globalisation and improve the students' learning experiences and effectiveness.

2 PROGRESS OF THE COURSE

A different philosophy towards the design process is the main idea behind the design of this course, which has been set up as a joint venture between the School of Computing, Engineering and Information Sciences and the School of Design. A pragmatic approach is adopted in the delivery of this course with an aim to meet the needs of the industry in an efficient and effective manner utilising the strengths of the university in the disciplines of engineering design and industrial design. Broadly speaking, industrial design and engineering design, which form the core modules of this course, are delivered through projects and design briefs (i.e. problem solving) that allows the students to explore the design solution spaces associated with the given design briefs, satisfying the functional, ergonomic and aesthetics requirements of the briefs. The design briefs, which include competitions and live industrial briefs, progress from short exploratory types of briefs in the first year of the course, a comprehensive one-semester based design briefs in second year that allow the students to complete full design process cycles, to a one-year major design project in the final year. The individual final year design project is an important part of the final year syllabus in which sufficient time and other resources are made available to each student to realise a fully functional product prototype through complete design and manufacturing processes. Besides the core design modules, various other modules such as technology, ergonomics, aesthetics, models making skills, business of manufacture and contemporary influences in design, etc. are incorporated to achieve an all-rounded design education [15].

Since 2001, the course's recruitment has increased from 13 students for academic year 2001/2002 to 50 students in academic year 2005/2006 and this recruitment level appears to be sustainable. The course has been successful in achieving its aims and was cited by

James Dyson [16], the founder of the Dyson vacuum cleaner products, in a TV broadcasted lecture as being indicative of the changing nature of design courses to meet the requirements of global manufacturing environment. Applicants to the course are required to attend informal interviews conducted by the teaching staff members. Feedbacks from these applicants indicate that the course is well-received and relatively well-known amongst schools that offer design technology in GCE advanced level examination. The success of this course has prompted the development of a new course [14]. The first cohort of this new course, Computer Aided Product Design, is now in their second year of the new course.

3 FINAL YEAR MAJOR DESIGN PROJECTS

The academic year 2004/5 saw the first cohort of graduates from the product design course, whose final year major projects had been publicly exhibited at the university campus and the "New Designers" design show in London. Generally speaking, favourable feedback has been received for the performances of these graduates who had demonstrated their competency in the areas of engineering design and industrial design through their final year design projects. A number of issues relating to some problems experienced by the students have been identified. In addition, the important issue of influence or effect of globalisation on product design education in a global context had also been highlighted by the graduates who had benefited from overseas placements in Asia and Europe. For academic year 2004/2005, one final year project was the direct result of design ideas conceived and affected by demands and requirements from the Far East markets. For this academic year of 2005/2006, the number of final year projects influenced by global/regional demands has increased to four, including one collaborative project that addresses the demand from markets in China in which the student works closely with a Chinese commercial organisation.

Figure 1. Two final year projects: all in one cooker and gritter.

To illustrate the range of these final year projects, two projects, an all-in-one compact stowage cooker and a self-propelled motorised one-man gritter, are shown in Figure 1. These two final year projects illustrate two very different products designed to satisfied needs of two very different markets. The all-in-one cooker was designed for urban living condition in densely populated cities like Hong Kong in which the floor space of a typical two-room flat is less than 70 m^2. This compact cooker, which uses induction heating, is designed for healthy cooking which involves steaming, grilling, stir frying

and boiling. The cooker can be stowed away when not in use to fit a compact size living condition. This design has the potential "to go global" [9]. The fully operational motorised gritter was designed to fill the current gap in the gritter market in the UK by increasing the productivity of the gritting operations during winter in path ways and car parks. A city council and a gritter manufacturer have expressed interests in further development of this prototype into a commercial product.

3.1 Issues

A number of issues relating to student learning experience when they undertook their final year major design projects have been identified by the academic staff members during 2004/2005.

3.1.1 Students' misconceptions

- Graphic representations of products as final designs. Despite of the prior two years of design training, a small number of students had this misconception that final designs are nothing more than graphic representations of products. A "tick-box" mentality" was adopted that prevented them from relating various stages of their work to various phases of design processes.
- Presentation models taking precedence over functional prototypes. Over emphasising the industrial design and aesthetics aspects of the design and neglecting the functional, i.e. technical difficulties, aspects of the design projects. The end results were prototypes that failed to fulfill all the functional requirements stated in the design specifications.
- Over zealous in achieving higher grades tended to stifle creativity and innovation. This behaviour is similar to risk aversion behaviour of commercial organisations when immediate concerns in profit optimisation may impede development of creative and innovative products.

3.1.2 Lack of professionalism

- Quick-fix approach to design process. Insufficient attention being paid to the details of the design during embodiment and detailed design stages resulted in a series of quick fixes, design modifications, adjustments and reworks needed during the manufacturing stage. These are costly operations especially when the designed product is manufactured in factories overseas.
- Incompetency in building and maintaining productive professional relationships with clients, manufacturers, and market demands. Maintenance of this professional relationship is particularly important when dealing with overseas clients or manufacturers with additional problems of geographical and cultural and linguistic separations.

3.1.3 Avoidance of knowledge and skills

- Functional design requires knowledge and skills in technology. Final year students who had been resistant to the disciplines of science due to their limited mathematical skills [14] had come to a realization that knowledge in technology is crucial to functional design of products. Requests for more mathematics and technology contents to be taught have been made, which contrasted to they initial attitudes of avoidance to these modules.
- Design for manufacturing. Designing for one-off manufacture of prototypes is a common flaw in students' designs. Products are designed to be mass produced.

Globalisation drives the manufacturing activities to parts of the globe with lower or lowest manufacturing costs and it is uncommon for components of a product to be manufactured in a number of production plants in different countries.

3.2 Dealing with identified issues

These issues can be resolved through revisions in teaching and learning approaches to engineering design and industrial design through the first, second and final years of the course. These revisions, which are being implemented in 2005/2006, are designed to allow students to tackle major design and manufacture projects competently.

3.2.1 Insist on solving the details of designs

Misconceptions about product design can be tackled with insisting students solving and documenting the full details of their designs, forcing the students to focus on every aspects of their designs down to the "bolts-and-nuts" details. This measure would prevent students from taking a quick-fix approach to solving their design problems through engineering analysis.

3.2.2 Awareness of the creativity and innovation components in the assessment criteria

Good and capable students are sometimes too anxious about their performance in terms of grades and tend to shy away from the perceived risk associated with creative and innovative designs, although assessment criteria incorporate the creativity and innovation components. There is a need to raise the students' awareness to the importance of creativity and innovation in their designs and award them handsomely accordingly.

3.2.3 Technical/production drawings and rapid prototyping of designs

Detailed technical drawings that enable mass manufacturing are part of the requirements for submission of design work. A rapid prototyping equipment (envisiontec Profactory) is being used to produce prototypes from the designs. Hence, geometrical properties of the products, both from aesthetics and manufacturing perspective are fully defined.

3.2.3 Establishment of milestones/penalty clauses in design briefs

Professionalism needs to be impressed upon the future product designers, and this impression is being made with the incorporation of contract like milestones and penalty clauses into design briefs.

4 CONCLUSION

Some issues arising from the first cohort of graduates' learning experience in their final year major design projects, including influence of globalisation, are discussed. Product design educators must react to the effects of globalisation, take account of this tremendous change and seek a balanced and responsible way to exploit the associated benefits so that future product designers can benefit from the resultant opportunities.

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