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A HOLISTIC APPROACH TO PRODUCT DESIGN

Mehran KOOHGILANI, Zulfiqar KHAN and Brian PARKINSON
Bournemouth University, School of Design, Engineering and Computing, UK

ABSTRACT
The demand and expectations for manufactured products continues to grow whilst the level of technology employed in their design becoming more sophisticated and critical. As a result, in educating young designers the education philosophy employed in teaching product design demands an input from both technological and humanistic perspectives. Design demands compromise and only when due consideration is made to all relevant areas leading to optimal decisions being taken will good design result. It is imperative that engineering design students not only learn the importance of this but adopt into their design activities such a philosophy as second nature. Design output may be considered as delivering a "specification to manufacture" and accurate communication is imperative for all down-stream activities to occur. With a foundation in mathematics and sciences, the subject of technology is often shunned if not feared by design students. The challenge is to encourage and nurture appropriate skills and knowledge to enable development of the designers to meet future design industries demands. This paper discusses a project based teaching approach employing input from cross discipline sources that culminates in a major design activity in the students final year. Experience and benefits gained are described with particular emphasis being given to the way hard technology is integrated with human requirements and sociological considerations to enable optimal design decisions to be made.

Keywords: Design education, technology, creativity, humanistic

1 INTRODUCTION

This paper is primarily based on personal experiences of teaching various units at all levels within the Design framework over the last sixteen year. These experiences and theories have been developed through observations and assessments. The BA/BSc (Hons) Product Design, a course which is the template that many other courses across the country have been based upon, has been successfully running and recruiting since 1989. The course ethos and philosophy of a holistic approach to teaching and enabling design has never changed and it is the main reason, amongst others, for its popularity and success. As part of the UCAS admission and overall performance of all the students on the Design framework, we have always monitored the school curriculum, at least in schools in the university's conurbation.

A common comment over the last decade has always been that the A Levels aren't as hard as they used to be. Does it matter or will it matter? More and more students are opting for humanities based subjects for further study, even when applying for Design courses; they inadvertently choose the BA routes. The A-level pass rates have been increasing steadily, yet we do not see any improvement in the ability of students to tackle the mathematics of engineering design degree courses, primarily because very few are taking the subjects such as Mathematics, Physics and Chemistry. In fact, the situation is worse than this, but politicians are unwilling to admit the fact. This is not to decry the achievements of individual students, but to say that no one is served by continually falling standards. As W.S. Gilbert said in The Gondoliers, "When everyone is somebody, then no one's anybody" [1]. The situation is serious, and getting more so. Most university design and engineering departments now find it necessary to provide remedial teaching for students whose mathematical foundations are not adequate for university first-year mathematics. Indeed, one department provides such a course for all students; such is the level of entry. The problem does not diminish in later years, as students need to have absorbed the mathematics of the earlier year before they are ready to advance to more advanced material. The details of the mathematics needed for engineering degrees are described in references [2] and [3]. The majority of pupils do not choose mathematics and physics as the basis of their experience of GCSE. [4]. During 2001, an analysis on the then student intake was performed at our institution which assessed the entry qualifications and investigated the relationship of the entry profile of the students to the minority who chose to drop out throughout the programme [5]. The publication in June 2000 of the report "Measuring the Mathematics Problem" [6] under the auspices of the Learning and Teaching Support Network (Maths Stats & OR), the Institute of Mathematics and its Applications, the London Mathematics Society, and the Engineering Council. The report presented detailed evidence of the serious decline in students' mastery of basic mathematical skills and level of preparation for mathematics-based degree courses. It was reported to the IEE Degree Accreditation Committee, and proposed supporting the main recommendations of the report, specifically that students embarking on mathematics-based degree courses should (for the foreseeable future) have a diagnostic test on entry. The results of the tests will be of value in at least three ways: to the individual students (by identifying their specific strengths and weaknesses), to the department (so that the teaching can be geared to the cohort's level of ability), and to the IEE (by providing information about the changes in ability with the passage of time). According to McCarthy and Wright, user experience is now becoming central to our understanding of the usability of technology. Today many interactive technology companies describe on their Web sites their commitment to experience based design. There is also a trend in HCI communities to foreground experience centered approaches to technology, a movement reflected in several recent articles offering theoretical statements about the sensual and emotional conditions of interaction with technology [7]. In another study they presented a basis for thinking about and evaluating technology as experience. They show how technology can be seen in terms of experience with technological artifacts. This approach orients towards the felt-life of technology-toward engagement, enchantment, irritation, and fulfillment. But it also recognizes that the feeling-life does not begin and end with the immediate quality of an experience, rather it extends across space and time to the sense we make of experience in terms of ourselves, our culture, and our lives. To make these concepts usable, they have developed a framework for analyzing experience with technology [8].

2 METHODOLOGY

We made the initial assumption that Engineering is Reductionist whereas the Design is Holistic. An engineer breaks the product into its components and then analyses and engineers each component and their interface with each other. The designer, on the other hand, first thinks of the product, the concept of what it will do, and then will try to fit the technology to it. Of course a good engineer would be able to do that too. A good designer will, once the product is made, attempt to optimize the design.

Ann Marie Hill in an article focuses on one way to study technology, through technological problem solving situated in real-life contexts. In problem solving for real-life contexts, design processes are seen as creative, dynamic and iterative processes that engage exploration; join conceptual and procedural knowledge-both thought and action; and can encourage considerations to technology, human and environmental interactions. This approach is a demarcation from what is typically found in schools; design, make and appraise cycles based on closed design briefs that are teacher assigned and unrelated to the students' world. An interpretation of technology education as problem solving for real-life contexts using design processes as tools for creation and exploration offers an alternative approach to design in technology education. Alternative curriculum and instruction then emerge [9]. Seemann states that a school that adopts a curriculum, that aims for a holistic understanding of technology, does so because it produces a better educated person than a curriculum which does not. How do we know when we are teaching technology holistically and why must we do so? Increasingly, more is asked of technology educators to be holistic in the understanding conveyed to learners of technology itself in order to make better informed technical and design decisions in a wider range of applied settings. The ability of the learner to naturally consider social and environmental factors, for example, when seeking solutions is seen by some State education systems as fundamental to a genuine education in technology. In philosophy, the holist position asserts that to understand the particular one must understand its relation to the whole and that only through reflection of one's sensation based applications can genuine knowledge be critically affirmed. The combined apparently independent paths of the State and the Holist positions set a compelling scene not only for the socio-economic necessity for holistic technology education in the curriculum but also for Technology's status as a key curriculum agent in the knowledge formation process of educated individuals [10]. The notions of holistic education are in themselves not new. Work on the importance of holistic education in the West dates back to as early as 1750. There are many approaches to understanding the phenomenon we label technology. Presented here are our methods to offer the reader a deeper grounding into why certain conclusions are drawn and proposed. The techniques and processes give lecturers a way to evaluate just how holistic a lesson or curriculum can help decide what educational tasks to be included and how to construct the educational context and experience that will foster holistic understanding in technology and design. We started the original Product design course with the premise that holistic technology education was necessary, rather than desirable. According to Matthews, the classical holist position in education may be illustrated as follows: To know things is to know things in relation; to know a part is to know how it connects with the whole. In the process of codification, different impressions of the same object or process are utilized so that interrelations might be recognized. It is the total vision which we call knowledge [11]. All our design courses are project based from onset, even during the first two weeks of induction for the level C, first year students, in which they will have to design a product very quickly whilst given deliberate restricting conditions. Many unit leaders especially on numeric topics argue that they already teach technology holistically. However, the question we must pose is, how do we know? The pathways within the design group all have central columns of projects in every level in all years. These central, heavily weighted project units are fed and supported by the satellite units such as Design for Product, Design Management & Commercialization, User Centered and Interaction Design, Advanced Computing, Advanced Technology & Innovation, etc. In order to be able to assess our performance, it was necessary to consider the following questions which are also asked by others: How can you that know you are teaching technologies holistically and what should be interconnected in our teaching of technology [11]?

3 RESULTS & DISCUSSION

As expected all units including the project units all have their Intended Learning Outcomes which would be met through the unit assessments. The contents of each unit has been designed to reflect the ethos and rational of the course. For instance, BA/BSc (Hons) Product Design's Project unit is called Design Methods and Prototypes whereas in BA (Hons) Industrial Design it is simply called the Design Projects. There are common units such as Materials & Processing as well as Business Development to course specific ones such as Engineering Simulation and Engineering Application. The projects are always about designing a product for a particular customer and involves, typically elements such as costing, product design specification and in most cases manufacturing a prototype depending on the courses. For instance, in Design Business Management the onus is more on marketing, costing and managing the design than prototyping. Holistic approach is preserved in units such as Materials and Processing and Applied Technology through product analysis exercises and assessments. The students are required to apply what they are taught in the lecture to various products through the product design specification, costing, materials selection, the mechanism, the electronics, marketing etc. The products become progressively more complex to the point that they become group projects with rotating project managers. The approach also owes its success to the fact that units such as Materials and Processing which is common across the framework can run product analysis sessions in which everyone can participate. Course specific projects are pulling support from the units by syncing the projects milestone with the teaching schemes of the units. For instance, a Product Design project just after Christmas was on designing a snap fit bag clip for a small shoulder bag. The students were given design freedom with their aesthetic but had to pay attention to the ergonomics, costing, materials and manufacturing. The prototype has to be able to support a 1 kg mass for a minimum of 15 seconds. This therefore requires that in the Applied Technology unit, the concept of bending moment and deflection be covered prior or during the project and the concept of injection molding be introduced in the Materials & Processing unit early enough to prepare the groundwork. The other units such Design Media help with simulation whilst Design Commercialization helps with costing etc. The concept of product analysis is even carried into the written exams of these units where students are given cases studies. All design students have to do a big individual project in the final year, together with a group one as well as a Business Development Dissertation. The big final project is over 8 to 9 months and they will have several millstones to achieve culminating in displaying their fully working physical or virtual prototypes during the Festival of Design and Innovation. It all starts with an idea and the project approval process. They have the concept viva in which they will show their development of the concept. There are four vivas at various stages during the academic year finishing with a fifth one during the Design Show whilst standing next to their stand showcasing their product. They will display at least three full GA drawings. The final report that the student will produce shall be detailed enough that a manufacturer will be able to produce it, a marketing department promote it and the customer know how much he is expected to pay for it etc.

4 CONCLUSION

A holistic understanding of technology develops through a structure or enabling-learning experiences that make explicit, in detail, the interconnectedness of human, tool, and environmental factors, where these three factors mutually require and define each other and act as both resources and constraints in the applied setting. Our holistic Design approach has required us to navigate the necessarily complex interplay between tools, artifacts, individuals, and contexts. This has allowed us to explore the educational technology and develop flexible ways of thinking about technology, design and learning. We wanted to write about and disseminate our approach to technology education to provide a better understanding of the complexity of real-life design and the advantages of teaching technology. Our experience of teaching design through a holistic approach has been successful as it is reflected in our continued recruitment even in a saturated sector where there are many design courses offered both in the UK and overseas. We still attract foreign students both at undergraduate and postgraduate levels. Our experience has helped our research into creative design and design process. We currently have five PhD students conducting research with five more about to start. Their results and finding will inform the teaching.

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