

# PRODUCT DESIGN AS A VEHICLE TO INTEGRATE ARTS AND SCIENCES IN DESIGN EDUCATION

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## ABSTRACT:

Higher education in many parts of the world has traditionally considered arts and sciences as an odd combination and many institutions have avoided this particular mix. Historically, this has been the accepted view; however, with the emergence of a new discipline, Product Design, this view is changing. The paper provides a detailed account of curriculum development and strategies for enabling art and science disciplines to blend in a natural way. It shows how strong alliances can be built in line with the industry and the general design practice expectations through “Live Projects”. The case studies provided in the paper are based on the work carried out at the Product Design and Engineering department at Middlesex University in London, UK. The paper details how some of the engineering principles can be taught alongside other softer topics such as the pleasure-based design approaches and emotional ergonomics to a diverse range of student body.

**Keywords: Creativity, Curriculum, Design**

# 1. INTRODUCTION

Higher education in many parts of the world has traditionally considered arts and sciences in design education as an odd combination and many institutions have avoided this particular mix. Historically, this has been the accepted view; however, today, design educators are at least willing to explore the opportunities that these two, seemingly incompatible, disciplines could offer (Findeli 2001). With the evolution of market driven economies and the need to compete in global markets, many western governments have been calling for companies to become more strategy driven while using design and innovation as a business strategy to realise market advantage. This concern has also extended to creative industries and the education sector, particularly within design education. In the UK, clear evidence of this can be seen by the publication of high profile reviews such as the Cox Review of Creativity in Business (2005) and the Gower Review of Intellectual Property (2006), both conducted by the HM Treasury as well as the publication of the UK government's 10 year investment strategy framework in science and innovation by the HM Treasury (2004). More recent evidence includes the publication of the report on the design skills gaps in schools, colleges, universities and the design industry published by the Design Skills Advisory Panel (2007) on behalf of the Design Council, which was compiled over two years with input from some 4,000 designers. The report further indicates that although the UK design sector is respected worldwide, and over the past decade the industry has become the largest in Europe with an annual turnover in excess of £11.6bn, there are serious challenges ahead as well as opportunities. The report indicates that in the new global economy, businesses are no longer competing on costs but also on added value while design is seen as the key component in the creation of desirable products and services. The demand for design is predicted to be growing while at the same time going through a rapid change. Traditionally, design is perceived to be delivering products, packaging, graphics and logos, but increasingly companies are now looking to designers to take on more strategic roles to deliver innovation and establish strong brands and developing customer loyalty and ultimately contribute to the intellectual capital of businesses.

Design in the 21<sup>st</sup> century is likely to have a far stronger science base than ever before. Recent advances in the new human factors such as emotional ergonomics and pleasure based design approaches (Jordan 2002; Norman 2004), understanding the customer psyche and emotion, appreciating brand DNA (Bardill et al. 2007), new technological advances in manufacturing and materials as well as understanding business operations are just a few example of these changes that today's designers will have to deal with. These changes also spawn new disciplines such as Service Design within the design sector (Hollins and Shinkins 2006). While this new discipline is making some headway, it is still in its infancy, but displays

significant potential for tomorrow's businesses. On the other hand, Product Design, grown out of Industrial Design era, is now well established and understood (Ashby and Johnson 2002; Baxter 1995; Ulrich and Eppinger 2003). Product Design today has many new facets to what Industrial Design offered in the 60s and 70s. While maintaining its "soft" attributes such as product semantics and language, it also includes "hard" attributes such as materials, manufacturing and technology. In the recent past, new human factors such as emotional ergonomics have played a significant part in its evolution. Until recently the science of ergonomics has tended to neglect human situations such as feelings and emotions (Suri 2001). Other disciplines such as psychology, patient care and management science (in terms of emotional intelligence) have all been engaged in the subject of feelings and emotions (Higgs and Dulewicz 2002; Hochschild 2003). The literature in human factors had not explicitly addressed the creation of positive feelings in product use until Jordan (1996, 1998). From this point an agenda focussing on feelings and emotions in product design gained significant exposure. Designers such as Richard Seymour of Seymour-Powell, Richard Eisermann of the Design Council and Colin Burns of IDEO have all contributed to this exposure (Bennett 2003a, b). Seymour argues that emotional ergonomics promotes the integration of the aesthetic, ergonomic, tactile and functional aspects of products (Weightman and McDonagh 2003). However, trends indicate that users are expecting increasing levels of 'connection' with everyday products and show an inclination towards objects that inspire, enhance their lives and that trigger positive emotions. As Paul Hekkert, the chairman of the Design and Emotions Society says, "It is no longer sufficient to design good products or services; we all want to design experiences and generate pleasurable or exciting sensations (Demirbilek and Sener 2003)."

In terms of academic provision, the UK has seen an explosive growth in undergraduate provision in Product Design and related disciplines. While there were only a handful of programmes available in the mid-90s, the current figure is in excess of 290 undergraduate programmes (UCAS 2007) offered in the broad subject area of Product Design. Although this provides a great choice for the students, it also creates other problems such as over supply of graduates for a relatively small sector and a wide range of content variation in academic programmes with little or no difference in programme title. Such issues are discussed in detail in a paper by Prior (2007). While recognising potential problems in coping with graduate supply and the employment opportunities in the UK, it is expected that this new discipline will have lasting effects.

## 2. DESIGN EDUCATION: AN EVOLVING SCENARIO

Following on the background presented above, it is clear that the role of a designer has become far more concerned with much wider issues than they were previously accustomed to. In order to prepare the designers of tomorrow, equipped to deal with these issues, educational establishments need to understand the needs of the individual, the industry and the nation. The issues are far more complex than ever before. It is also accepted that in dealing with these issues, educators in many part of the world may face similar problems, but their solutions would probably be different (Buchanan 2004). In an earlier publication, Buchanan (1998) argued that while trying to satisfy the bigger picture, the important task is “to design for the individual placed in his or her immediate context”. In this work, he also presents his four orders of design (communication, construction, strategic planning and systematic integration), suggesting that design practice is becoming increasingly complex, large scale and increasing in relevance to core social and cultural concerns.

As educators, it is important to realise that design is no longer a self-contained discipline. As shown above, the expectations from a designer have changed immensely over the years and the individual designer can no longer work on their own to deal with the issues of today and tomorrow. Further research published by Broadbent and Cross (2003) and Heskett (2001) also indicate that this change has been going on for more than a few decades . It is this ongoing change that is guiding design education and leading it to offer multi-disciplinary knowledge in design thinking. The debate about the appropriateness of the disciplines involved has not gathered momentum as yet, but this is likely to take a pragmatic approach in the first instance. In a typical western style, design education would start with a generic study of basic skills and abstract design principles and then lead onto some level of specialisation in a particular discipline. While this approach serves its purpose in developing a rational and instrumental knowledge, it does not offer any holistic understanding and knowledge of more complex systems such as creativity and innovation (Matheson 2006). Within the UK, Product Design is considered to be one of the design curriculum areas that can lend itself to a wider range of disciplines such as engineering, computer science, marketing, business, fashion and textiles, applied arts, graphics, media etc. However, whatever the outcome of the multi-disciplinary debate, it is clear that these other disciplines, such as the ones listed, will need to inform design thinking and prepare the way forward.

There have been several studies within the academia experimenting with and exploring the opportunities that problem-based learning (PBL) offers in creative disciplines. The studies are

indicating problem-based learning as an emerging teaching approach, shifting from the traditional didactic teaching methods (Backer and Bates 2005; Yeo 2005). While celebrating its successes, the research also acknowledges that PBL is not the only answer to providing total and wholesome education (Yeo 2005). The paper has already indicated that there is rapid change in design thinking. However, it is also clear that while there may be pockets of success, there are many departments in colleges and universities still trying to find ways of unlocking the design engineering potential that appears to have been trapped in the past for few decades. There are also other obstacles such as departments being confined to particular geographical restrictions that hinder working with other departments, such as arts working with technical disciplines. If progress is to be made by enabling different disciplines to work together for mutual benefit and also to respond to issues highlighted in the earlier part of this paper, then the institutions need to take a strategic direction in their policies that go beyond academic provision. The whole of the institution's estates policy needs to be strategically thought through. This, unfortunately, is extremely difficult to resolve in the short term and requires long term planning.

Given the current global economic conditions, with the ever increasing demands put on design professionals to be more sophisticated, naturally leads us to think that there will have to be smarter solutions found so that progress in design thinking and design education could be made. For example, the term "innovation" has become a regular feature in many company strategic plans and numerous government policies, particularly in the West. It is often interchangeably used with "Creativity" (Bessant and Tidd 2007; Von Stamm 2003). These issues are not unique and are certainly not necessarily confined to particular regions of the globe. In Hong Kong, for example, these issues are also pertinent. In recognising that we are living in a rapidly changing society, as with many post-industrial cities, Hong Kong is also responding to these concerns (Siu and Lam 2003). Further work published by Siu promotes nurturing all-round engineering and singles out Product Design profession as one of the disciplines to champion (Siu 2003a; Siu 2003b). In his paper (Siu 2003a) he is also critical of the current curricula in Hong Kong as being inappropriate for meeting today's changes in society and industry. However, he does offer a proposal to deal with these deficiencies by offering a concept named as 'Eight Cs' to guide the development of design curricula. While agreeing with the overall principles of the proposed concept, the authors provide an alternative and perhaps a more pragmatic approach to curriculum design which is concerned with tackling the same issues. This is presented in the next section.

### 3. A CASE STUDY – CURRICULUM DESIGN

In an effort to explain how the above concerns could be addressed within a design based curriculum, the following case study example is offered. The primary focus of the case study is to illustrate how an academic programme structure could be developed to allow sufficient freedom to build a curriculum based on arts and sciences to promote high quality design education with a strong commercial focus and relevance. The study also makes reference to gradual change in assessment strategy needed in order to facilitate efficient programme delivery in terms of staff resources.

#### 3.1. BACKGROUND

The academic programme used in the case study example is BA Honours Product Design programme currently on offer at Middlesex University in London, UK. The programme was first validated in 1996 and delivered jointly between the School of Engineering Systems and School of Art, Design and Performing Arts. This was one of the few programmes available at the time to offer the title of Product Design in the UK but this rapidly changed at an explosive rate. Within a decade, the Product Design programme title grew from less than 20 programmes to over 290 programme titles (UCAS 2007). This sudden growth in provision was a result of a number of factors. In the early 1990s, UK was losing its manufacturing base and the undergraduate university applications in engineering took a downturn. Many engineering departments, particularly those in the London area, have closed down or were forced to diversify their business operations. At the same time, the rapid growth in technology products within the consumer goods sector contributed to a significant interest by college and school leavers.

As part of the admissions policy for the Product Design programme, all suitable applicants are interviewed. For the course at Middlesex, close to 300 applications are received for 40 places and around 200 interviews are conducted. One of the key findings of these interviews is that Product Design was seen as a very seductive title by the applicants and they all aspired to be “Designers”. The challenge for the universities was to respond to this demand while aiming to offer a provision that suited both the individual applicants and the industry.

In 1999, Middlesex University took the decision to phase out its traditional engineering provision and replace it with new a subject area, Product Design and Engineering (PDE). This new department was expected to continue to make use of academic staff from both the arts

and the engineering disciplines to deliver its provision. The programme structure included discrete modules from engineering that were largely manufacturing and design engineering focused. The programme also included modules from the arts subjects, such as graphic design, studio practice and exhibition design. Although the programme was recruiting well, it was not succeeding in uniting the two disciplines as much as it ought to.

### 3.2 NEW CURRICULUM – NEW ERA

Apart from the above issue, the programme team was concerned with the sustainability of the programme on offer and the mismatch of the assessment methods used. The student feedback received through the Subject Board of Studies from the two cohorts indicated that the student body felt that they were on two different programmes. Although the academic staff from both camps were involved in team teaching across several modules, this did not seem to have made much difference. The main reason for this was that the modules were developed with no or very little overlap and were based on the traditional programmes in both art & design and engineering. The programme team realised that a serious re-think was needed if the two areas were to be integrated together to serve a meaningful purpose. It was also clear that this new subject area had to be conceived in a different way than it was previously thought. The new programme had to take into account of the emerging practices and thinking in design education and provide a supportive structure to naturally blend the two areas of art and science together that was essential for the success of this new subject.

The aim of the programme was to prepare students to respond to functional, technological, human and market driven requirements of product design opportunities in an inspired way and to demonstrate these abilities at a professional level within the University and whilst on industrial placement. All students were to develop their skills in a range of 2D and 3D design development, prototyping, testing and communication techniques. These techniques were to include traditional workshops and studio based design processes along with cutting edge CAD, manufacturing techniques and materials. It was also essential to include a design discourse strand to enable students to understand design in a wider context and its place in the cultural context. A big shift in the programme delivery approach was that a careful balance was to be maintained between theory and practice and the teaching and learning strategy was to be based on industry led projects, problem based learning and assessment by coursework. The latter part was a big step for those staff that had always been assessing by written examination but it was accepted that those methods were no longer appropriate for this discipline.

The programme structure was based on three strands as shown in Figure 1. The two outer strands, technology/skills strand and design discourse strand, served as pillars to support the practical and contextual work which forms the central strand. The technology and skills strand starts with equipping the students in basic skills such as communication in graphical, written and oral, CAD and visualisation, human factors and product semantics and digital modelling and prototyping. The design discourse strand provides a wider context and understanding of design history, the effect of culture on design, emerging trends, both in terms of consumer behaviour and new technologies. It leads on to career planning and managing design projects with the aim of launching their products into the marketplace. The central strand provides opportunities to engage with the design practice and contextualising the knowledge gained in the two outer strands. These opportunities are managed and are always drawn from industry through the use of “Live Projects”. These are projects negotiated through a client, normally a manufacturer or a design consultancy. Typically the student group would be briefed by the “client”. Part of the commitment we require of the “client” is that they provide a critique of the students’ work at appropriate times during the project and also at the end. This is in addition to other agreements such as prizes and product royalties. This aspect of assessment will be discussed later in the paper.

Another feature of the curriculum is that the skills strand is always one step trailing behind the module in the central strand. For example, PDE1010 – Communicating Design Proposals provides the necessary CAD skill to produce the necessary CNC driven machinery such as laser cutters and routers, to produce product prototypes. The reason for this is that it avoids the scenario where two modules are running alongside and they interfere with each other. For example, in order to teach some of the technology and skills based strand (modules on the left column in Figure 1), small projects would be issued. While these skills are being acquired, it would be unreasonable to expect those skills to exist so that a more substantial project running alongside could be supported. Therefore, staggering the learning, and allocating the correct project to the central strand, is key to the success and smooth running of the programme.

The three Design Project modules offered as part of the central strand provision, have generic content but very distinct learning outcomes. These enable the programme team to negotiate the right project for the right group of students, within a given timeframe to ensure a managed live project execution. It is critical that the project is matched to the level of the student capacity and capability. The nature of the projects are deliberately kept diverse and do not always follow the same pattern. They involve both individual working as well as working in teams of two or three, depending on the project brief.



# BA Honours Product Design

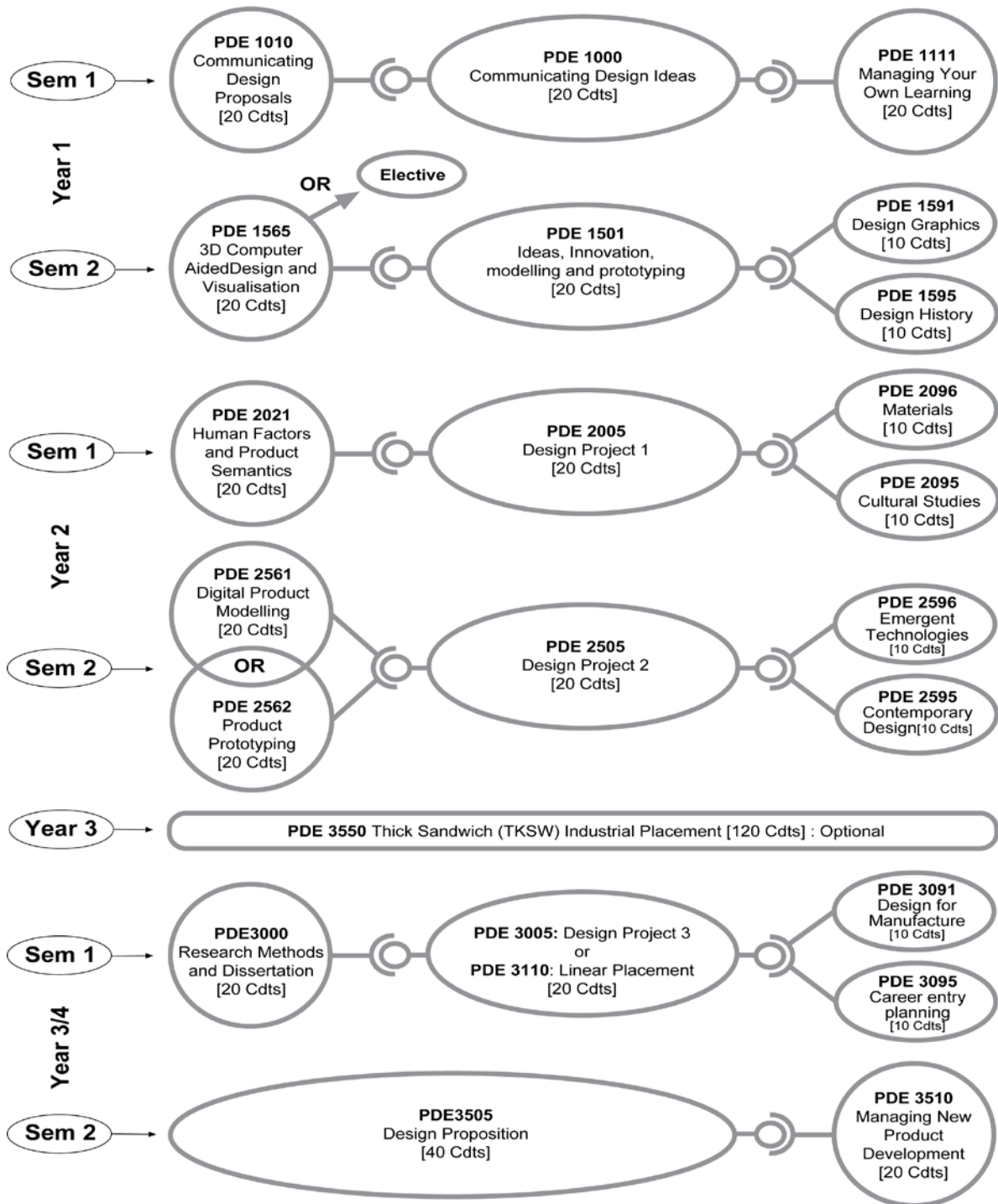


Figure 1 Programme structure for BA Honours Product Design at Middlesex University, London, United Kingdom (2003 – 2007).

### 3.3. ASSESSMENT STRATEGY

Following the programme's initial proposal and its subsequent natural evolution, one of the fundamental changes made to the assessment strategy was to drop the written examination components and devise some suitable instruments to carry out assessment for what has largely become a problem-based learning environment. Formative assessment along with summative assessment is use throughout the programme.

Example 1: In module PDE1010, one of the first things the new students have to do is to become proficient in the use of technical drawing standards and produce accurate drawings using CAD in a short space of time. The whole process takes 12 weeks of 3-hour sessions. The delivery of the fundamental CAD skills is normally completed within 6 weeks using demonstrations and exercises in a controlled CAD room environment. The next two weeks are spent on working on a problem that is used to test CAD competency that takes place in week 8. This would typically be a one-hour session in reproducing the solution to the set task. As a result of this in-term test, weaker students are identified as "students who need further assistance and tuition" rather than labelled as "failures". These students continue to follow their original scheduled CAD classes but are offered an additional session for the following four weeks. To complete the module assessment and grading, at the end of the module, all students submit a technical drawing portfolio which is produced through CAD. This is used to determine their module grade. In the previous incarnation of this module the competency test was done at the end of the module and had always resulted in some students not being able to meet the expected level of competency. Based on three cohort sizes, the progression level was 75%. Following the change of the timing of the competency test and the introduction of the remedial CAD sessions for four weeks, the progression rate has never dropped below 95% since 2004. This has also impacted positively on the progression levels in the subsequent module PDE1565, focusing on 3D CAD. The programme team received an interesting feedback from the students that resulted from the early introduction of the competency test. They felt as if they were being "positively encouraged" to get on with the content of the module and pass the "test" even though it carries little weight in the overall assessment. It was very interesting to observe that the idea of having a "test" seems to have been interpreted as a motivational tool in this context. The students were also aware that they could have re-taken the test at the end of the module had they do not reached a satisfactorily high level of competency which was set at 60%. Another observation made was that, as the test problem was issued few weeks in advance of the in-class test, students were self motivated to practice more. The student group in every cohort so far has turned this

preparation period into a competition in terms of who is to complete the task the quickest, and with the highest score, even though this has not been suggested at any stage.

Following the decision to adopt the practice of coursework-only assessment throughout the complete degree course, the programme team has devised a profiling assessment form for assessing the module work. In each of the module descriptors, the learning outcomes of the module is explicitly identified. Each assessment component is directly related to one or more learning outcomes and each learning outcome is only assessed once. The final mark or grade is then arrived at by observing the profile indicated on the form. This is illustrated in Figure 2.

## Product Design and Engineering

### PDE3000 Dissertation (BA). Year 2006, semester 1

#### 2: Dissertation

A dissertation of around 5,000 words resulting from research into a topic aligned to product design of the student's own choosing. The dissertation will be accompanied by a logbook and/or other evidence of research and development of ideas.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Assessment Criteria	
						X															Description of the topic and associated area(s) as embodied in a correctly referenced literature review
						X															The analysis of previous work in the area including critique
							X														Synthesis including development of the topic area from the author's own perspective contributing to original thought
					X																Structure of the dissertation including layout, spelling, grammar, professionalism of style. References and bibliography
<b>Outstanding</b>			<b>Good</b>			<b>Average</b>			<b>Satisfactory</b>			<b>Bare Pass</b>		<b>Fail</b>							

#### Comments:

An interesting topic, however, the main focus of the dissertation appears to have been lost. The two case studies that are reported on could be further expanded. The authors reports in her Discussion that a more systematic and a thorough analysis is required to fully exploit the questions raised at the start of this dissertation.	<b>Student Name</b>	X YYYYYYYY
	<b>Number</b>	XXXXXXX
	<b>Provisional Grade</b>	7

Figure 2 Sample assessment form used at Middlesex University

The Design Project modules are the key instruments in blending arts and sciences. The teaching and learning strategy in assessing design project work is based around critique of the work. This is normally takes place weekly, where the students display their work and report on progress as well as the difficulties encountered. Although the teaching team provides guidance it is quite common to see active involvement and interaction between the student and the pier group. As indicated earlier, the "client" always participates during the course of the project and often the client is the managing director of an SME (Small Medium Enterprise)

who provides very useful, direct and often robust feedback to the students. Over the years this approach has worked very well within the context of “Live Projects”.

#### 4. A CASE STUDY – A SAMPLE STUDENT PROJECT

The paper argues that Product Design discipline is a natural vehicle to blend Art and Science. This is particularly apparent given the emerging practices and developing design thinking reported. The following case study is about a student who has graduated from the above degree programme in 2005. The case study here is being used to demonstrate how the claim made by this paper regarding the use of Product Design discipline as a vehicle to integrate art and science. For the purpose of this case study and in an effort to protect the student’s identity, we shall refer to him as Student-S.

Student-S joined the BA Product Design programme as a four-year Thick Sandwich mode of study. Following his two years of undergraduate study, he developed an interest in product language. As part of his industrial placement year, he joined Company-X specialising in medical products concerning patient airway management systems. His main reason for joining this company was to develop his skills in product semantics and brand identity. He planned to do this by studying the company’s product range and produce a unified product language which was absent within the product families of this international manufacturer. Following a 10-month placement with Company-X, he managed not only to influence the company in their designs regarding product language and product semantics, he also developed a keen interest in Heat and Moisture Exchanges (HMEs) for paediatric patients.

On his return to the University, he decided to investigate HMEs for this dissertation work and followed this through his proposition module where he aimed to redesign a more efficient system for paediatric patients. Although he had not joined the programme with any significant prior technical knowledge, the programme did enable him to engage with the technology and be able to communicate with the engineers from the company to gain sufficient know-how to be able understand what is involved and how it all worked. Following successful completion of his programme, he achieved an excellent degree and has been offered a post with the company to work as a Design and Development Engineer. At the time of writing, he was still employed at Company-X and is the holder of three patents. This case demonstrates that given the right environment and the supporting structure provide by the academic programme, it is possible to blend the arts and the sciences and there is plenty of merit in this.

## 5. CONCLUSIONS

This paper highlighted the issues facing today's society and industry based on the changes in the global economy and how these changes are manifesting themselves within the academia with respect to design thinking and design education. The curriculum structure described in the paper shows an efficient and a pragmatic approach to design a curriculum structure that lends itself to Product Design provision at an undergraduate level. Product Design is shown to be fundamentally concerned with designing, prototyping and manufacturing innovative products for a wide range of purposes. These are the common themes and binding features of a subject which spans the intellectual and practical space between Art and Science. The programme described in the paper encompasses the spectrum of activities concerned with progressing products from concept to market and, as such, provides a rare opportunity to students, as it enables them to work with a broad range of individual subject specialists who share this common aim. The paper argued that Product Design is one of the new disciplines that have emerged in the past 15 years or so and has become the core activity in some of the curriculum developments in the post industrial era. The authors demonstrated the importance of creativity in addressing some of the issues discussed and the importance of multidisciplinary approaches to design education. It is also shown that Product Design is a natural discipline to integrate the aesthetic qualities and the softer issues surrounding the human need, often found in art and design education, as well as the innovative, technological and manufacturing solutions offered by the engineering disciplines.

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