Steps towards the development of a 'culture of innovation' amongst undergraduate industrial designers

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Abstract

Developing innovative solutions to problems is no easy task. Firstly, there has to be a desire within the individual to seek out the innovative solution; secondly, there is the problem of how to identify what constitutes an innovative solution; and finally, one has to combat the natural tendency toward risk aversion. Successful industrial design is by its very nature innovative. Therefore, generating a culture of innovation is a vital requirement in the development of a successful designer. Do we know how to stimulate, incubate and nurture innovation? What are the factors that give rise to an innovative mindset?

This paper describes the experiences of an industrial design programme that for five years operated with a degree of success. However, on review, the programme was deemed to be lacking in innovation. Changes were made and after three years the impact was assessed and quantified and the results are now reported. Through the review, strategies were developed which led to the creation of an environment for the promotion and nurturing of innovation appropriate to an undergraduate industrial design programme. Following the three-year review, further refinements to the model have been implemented – this will be the subject of further study.

Keywords: innovation, industrial design, pedagogy, intellectual property

Introduction

Defining innovation

The word 'innovate' is a verb, which therefore implies an action or activity. In this case, the action is to 'invent or begin to apply (methods, ideas etc.)' (McLeod, 1989). Its origins can be traced back to the Middle French word 'innovacyon', meaning renewal or a new way of doing things. Though innovate and innovation, 'the act of innovating' (McLeod, 1989) are easy words to define and fairly easy to digest as abstract notions, they are not so easy to identify and classify in practice. The degree of innovation depends very much on its context and how it is perceived by the end user or by a third party. Possibly the most exhaustive attempt to classify levels of innovation was made by the Russian researcher Genrich Altshuler. His research involved the study of over two million patents, which he classified on the basis of five levels of innovation (Altshuller, 1988):

- Level 1 – a simple improvement of a technical system
- Level 2 – an invention that requires the resolution of a technical contradiction
- Level 3 – an invention containing the resolution of a physical contradiction
- Level 4 – a new technology is developed containing a breakthrough solution requiring knowledge from different fields of science
- Level 5 – discovery of a new phenomenon.

Altshuller concluded that 77% of patents belonged to Levels 1 and 2. The majority of these being Level 1, which were not really innovative at all (Altshuller and Shulyak [Tr], 1997).

Defining a culture of innovation

The project described in this paper was driven by the vision to create a community of undergraduates whose design proposals would contribute to the body of knowledge and ascribe value to the generated intellectual property. Since the launch of the industrial/product design programme at Swansea Institute in September 1992, much work

had been undertaken to stimulate the creativity of the student body. By the summer of 1997 it was recognised by the programme team that whilst academic results were satisfactory, there was a need to increase the students' level of innovation. Much of the work was conservative and failed to address opportunities that were present to challenge the technological or physical status quo. Using the Altshuller classifications as a guide, most of the projects were level 1 innovations (Figure 1). The major project was chosen as the only means by which the effect of the entire programme of study had impacted on the students' capacity for innovation.

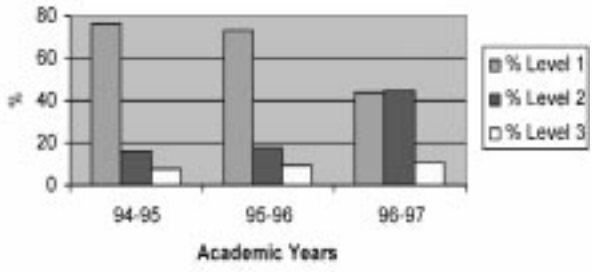

Figure 1: Major project innovation 1995–97.

The first step in developing a culture of innovation was to review current thinking on how to enhance creativity and innovation. The review raised the following questions:

1. What constitutes an innovative mindset both in the programme, the undergraduate and the academic?

An innovation mindset is an attitude which should permeate the entire institution. The hallmarks of this mindset can be seen in the way individuals at all levels in the organisation interface with each other (Kuczmarski, 1996). In this case the organisation is the entire programme team comprising students, academics and professional support staff acting as a unified body. This team works to a course document and the learning experience leads to a final assessment, which is then validated by the external examiner(s). Innovation does not only embrace the entire course team but must also be reflected in the documentation and is a spirit that should be shared by the external examiners. Certain imposed features such as modularity and semesterisation tend to suppress innovation by creating artificial barriers in what should be a holistic educational experience.

2. What are the fundamental principles of innovation that could be nurtured in the education experience?

Key principles of innovation within an individual and an organisation include curiosity, questioning, experimenting, self-motivation, vision, passion, flexibility, commitment, resilience and perseverance. These principles or qualities can occur 'naturally' but more often require nurturing if they are to become fully employed. The question of how to nurture innovation within an educational environment must be preceded by the question 'why do we need to be innovative?' This can be summarised in the phrase 'to survive'. 'Innovation is the key to competitiveness, and businesses need to innovate if they are to succeed.' (Battle, 1998) To the academic institution, innovation is vital if it is to remain at the forefront of its discipline. To the undergraduate designer, innovation is vital if he/she is to produce a successful major project and portfolio, and compete in what is an increasingly global job market. The question then arises of 'how can one recognise an innovative idea?' This involves benchmarking against indices of innovation. The principal indicators used within this project are Altshuller's five levels of innovation (Altshuller, 1988). An additional indicator included patents generated and awards won. The final question relating to the nurturing of innovation within an educational environment is that of risk tolerance. In an industrial design programme a unique blend of engineering and art coalesce. For the undergraduate, it provides a challenge in balancing rational calculated scientific development with intuitive creative expression. Students are often unwilling to go out on a limb for fear of jeopardising their grades. The role of the academics in assessing innovation is vital. The programme structure and assessment criteria need to be conducive to the encouragement and reward of innovation.

3. Once established, can a self-sustaining culture of innovation be maintained and developed within a dynamic academic environment?

Maintaining a culture of innovation depends upon all parties being fully committed. The challenge of an academic programme where students study for three years then move on is how to maintain continuity. It is vital to perpetuate the culture by encouraging interaction between year groups and constant communication amongst academics. It would be wrong to conclude that once established, this culture of innovation must be maintained as a status quo. Indeed, the very nature of this culture is that it is constantly changing. The role of the academics is to ensure that teaching, learning and assessment strategies constantly

evolve so as not to frustrate the innovative spirit. Undergraduates need to be able to experiment and challenge the boundaries. 'You have to kiss a lot of frogs to find the prince. But remember, one prince can pay for a lot of frogs.' (Fry, 1999)

Review of teaching, learning and assessment strategies

From the outset, this project was aimed at establishing an environment within which both undergraduates and academics would be encouraged and given opportunity to innovate. It was essential, therefore, to create a formal structure for teaching, learning and assessment, which met the rigorous academic requirements of the university and QAA, which also provided scope for an innovative experience. The aim of the review was to improve the level of innovation by identifying the factors that played a positive role and those that had a negative one. Those were identified as:

1. Negative factors

a) Programme structure

Modular programmes of study can have a negative effect on innovation. Modularity creates discrete independent 'ghettos' of programme elements that cause the undergraduate to lose sight of the big picture. This was true in this case. There was too much fragmentation in the third year which led to over assessment of secondary supporting modules to the detriment of the core design and project work.

b) Study environment

As a relatively new area of study, the industrial/product design programme occupied spaces which were distributed around the faculty buildings. As a consequence, the programme lacked a home, an environment where the staff and students could work together.

c) Communication

Problems of communication were caused by the lack of a common environment. Little interaction occurred between year groups or between academics and students out of timetabled sessions or between academics due to the distribution of accommodation.

2. Positive factors

a) Committed academics

This was key to initiating the entire review and restructuring process. The faculty possessed a body of academics with a strong belief in the programme and a commitment to innovate. As in any organisation, there were variations in enthusiasm for change but these were overcome.

b) Committed students

The support of the students ensured that the review proceeded smoothly and quickly. Discussions were held with student representatives to discuss the common vision for the programme. This ensured that changes to the structure took full cognisance of students' needs and aspirations.

c) Support from the faculty

Faculty support was assured and resources made available. The resources facilitated a relocation of student studios, staff offices, workshop expansion and an additional staff appointment.

d) Support from external examiners

The external examiners encouraged the review team and supported the changes that were initiated.

Changes implemented as a result of the review

1. Revised modular structure

The modular structure was revised. A number of supporting, non-core modules were withdrawn and replaced with additional design modules that utilised new technology in their delivery. The third year was completely re-designed. The previous collection of half modules, single modules and double modules was replaced by two new research-based modules, a conceptual minor project module and by a seven module, 84 credit, major project. The concept behind the new expanded project was to seamlessly integrate a number of valuable but discrete units into one unified project.

2. Teaching innovation

Team supervision of the major project, underpinned by a system of pastoral tutors, allowed the

individual student to seek out the specific support he/she required. Each project attracted a unique team of supervisors. This removed any prospect of personality clashes or academic prejudice inhibiting the development of the project. The new research-based modules in the final year involve a team of staff delivering a rolling programme of lectures that the undergraduates take as a basis for further research. The outcome is a paper written within tight academic guidelines and presented in a conference format. The benefits of these modules is in the raised prominence given to research and in the greater value that each student attributes to his/her personal intellectual property.

3. Industrial involvement

The model for industrial involvement chosen was that of student mentor. 'Memoranda of understanding' were signed with three companies who provided information and advice to undergraduates in exchange for receiving input at a research or practice level into their research and development projects. The success of this aspect has been profound and has led to valuable contributions from the industrial partners on matters as diverse as IPR advice to suggestions for material selection.

4. Learning environment

The reorganisation of student and academic accommodation initiated by the review process has made a major contribution to the culture of innovation. All students are now located on one floor with integrated seminar spaces and academic offices. Informal communications have improved and bonds forged between various student groups and academics. The attitude amongst the undergraduates has shifted from that of receiver to that of stakeholder. They now believe themselves to be contributing to something bigger than just their own qualification. This leads them to share information more freely with their peers and to actively support other students through the sharing of knowledge.

The impact of these changes has been reviewed continuously and reported in successive annual programme reports. Incremental changes have continued as experience is gained and the views of graduates are considered, discussed and, where appropriate, implemented.

The results of three graduate years under the new structure indicate strong evidence that the level of innovation has increased significantly. The increase in Level 3 innovation is particularly encouraging. This indicates undergraduates are researching solutions outside the immediate realm of the problems or opportunities they are investigating (see Figure 2).

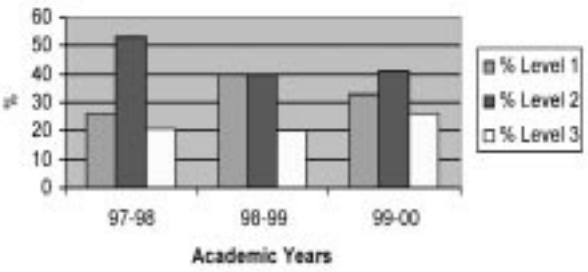

Figure 2: Major project innovation 1998-2000.

Intellectual property initiative

With increased levels of innovation comes an increased opportunity for protecting and exploiting the generated intellectual property. The protection of intellectual property rights (IPR) amongst industrial designers has been limited. Traditionally, industrial designers are employed or commissioned by organisations that retain rights to the work. In an academic institution undergraduates often sign away the rights to their work simply by enrolling on their programme. The institution retains the rights to the work but rarely invests the necessary time or resources to cultivate the IPR into wealth creating opportunities. Swansea Institute chose not to retain the IPR of its undergraduates. The opportunity therefore existed for the students to protect their own IPR. A strong emphasis was placed on the protection of IPR and undergraduates were encouraged to register their designs and apply for patents. As can be seen from Figure 3 (see overleaf), few students took up the opportunity. In 1999, the City and County of Swansea launched its Intellectual Property Scheme. The aim of the scheme was to support and fund the protection of IPR within the county. Based at the Institute, the scheme gave the programme the ideal vehicle for raising the number of patent applications. In 2000, a total of 10 undergraduates from the industrial design programme took advantage of the scheme. In 2001 it is anticipated that 15 undergraduates will submit applications. This is a remarkable increase and has been facilitated by the provision of guest lecturers supplied by the IPR Centre at Swansea Institute. There remains much more to be done if the ultimate objective of all undergraduates submitting a

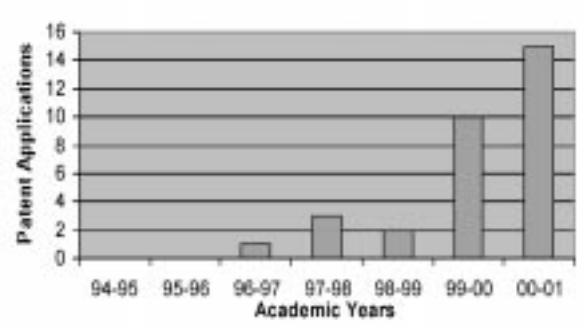

Figure 3: Undergraduate ID patent applications 1995-2001.

patent application is to be achieved. The next stage will be the incorporation of a patent application into the major project's business plan.

Conclusions and discussions

Conducting the sort of 'root and branch' review as was the case here is not without its problems. Significant challenges have to be met and overcome. However, in overcoming these challenges, the team became stronger and the benefits to the educational experience of the undergraduates were significant. The initial success of the project was tangible and immediate with four students winning Welsh Development Agency technology awards in three years. This has been followed by an increase in the number of identified Level 3 innovations and a dramatic increase in the number of patents applied for.

The major challenges faced were:

- programme management: the management of the timescales and deliverables to ensure that students had flexibility within semesters but still met deadlines for academic assessment
- management of perception: the mutual benefits to the entire academic, undergraduate and professional team can be significant, however, dissemination of information to each party within the organisation needs to be managed carefully. If colleagues are not kept appropriately informed then a number of problems may emerge such as:
  - academic prejudice by colleagues accustomed to a traditional model of teaching and staff/student relations
  - concerns of some undergraduates who are uncomfortable with being 'out of step' with their peers and who fear making mistakes
- dissemination of information: in order that the value of the intellectual property remains intact systems have to be established to control the dissemination of project information. This must not conflict with the need to maintain openness and transparency in assessment.
- confidentiality: academics have to maintain strict confidentiality when discussing projects which are party to the scheme and avoid the temptation to discuss developments with colleagues and visitors.

The benefits of creating a culture of innovative are profound and include:

- creation of a progressive and dynamic environment for study – which creates an open environment for sharing information and ideas
- a greater emphasis on research – leading to greater respect amongst undergraduates for the academic endeavours of others
- encouragement of risk amongst undergraduates – resulting in projects which challenge barriers and lead to an innovative mindset
- greater creativity – which permeates the entire department and ensures that the entire team constantly reviews and reflects upon its practices.

The benefits from participating in the IPR scheme are many and varied and are as follows:

- greater legitimacy for design proposals
- stronger, more robust and better-defined projects
- access to a range of professionals not normally available in an educational establishment
- potential for exploitation of the generated IPR for postgraduate and commercial purposes.

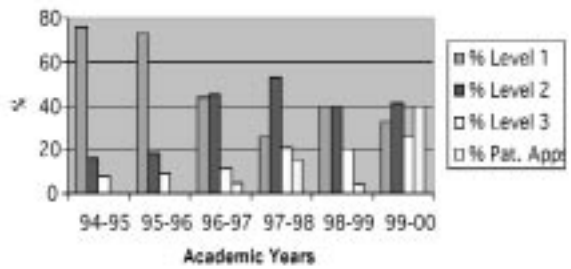

Figure 4: Innovation trends and percentage of undergraduates making patent applications.

The benefits of undertaking such a review and subsequent restructuring are deep and far reaching. The impact on an industrial design department has been to raise aspirations and create a

shared vision. This vision has led to a culture of innovation that extends beyond the bound of the undergraduate programme. Graduates continue to be involved and regularly return to share their experiences. The recommendation of the authors is therefore that whilst demanding and often fraught with difficulties the results more than justify the effort made.

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