

# THE ROLE OF ENGINEERING COURSES IN INDUSTRIAL DESIGN EDUCATION: A CASE STUDY AT THE UNIVERSITY OF BOTSWANA

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## **ABSTRACT**

The University of Botswana offers a five-year degree programme in Industrial Design. During the first two years students are offered relevant basic science and engineering courses. Design concepts are introduced from the second and they predominate the programme from years three to five. From this multi-disciplinary nature, Industrial Design is informed and complemented by other disciplines such as science and engineering. The nature of the delivery of the service courses from Engineering Departments and their design focus are important to the effectiveness of the design learning experience. This paper explores approaches currently in place at the University of Botswana. It also examines their effectiveness and suggests possible improvements based on the programme review conducted by various renowned experts on the Industrial Design programme at the University of Botswana. The conclusion of the findings from the report indicates that these courses need to be reduced and they offer little sensitivity to the needs of industrial design students.

*Keywords: Industrial Design, Engineering (service) courses, Interdisciplinary design, Programme review, University of Botswana,*

## 1 INTRODUCTION

Industrial Design as a multidisciplinary profession has always had to accommodate variegated courses in its curricula from other specialities to augment the knowledge and skills of its students. The type of other courses, the degree to which and how these are integrated into the Industrial Design programme influences the character of the programme as well as the profile of the graduating designer. The Industrial Design programme at the University of Botswana anchors its programme on a variety of engineering courses taken from the civil, electrical and mechanical engineering disciplines at the second year level of the five-year programme. This paper examines the use of such courses and their impact on the programme and students. The discussions are based on experiences by the authors in their running of the programme over a number of years, as well as observations made from an independent evaluation of the programme that was conducted by external examiners.

## 2 INDUSTRIAL DESIGN AT THE UNIVERSITY OF BOTSWANA

The University of Botswana offers a five-year degree in Industrial Design programme which was started in 2003. The programme was started after an extensive feasibility study. The results from the study gave the University of Botswana the green light to

offer such a programme. The programme structure is made up of three main areas. In the first year for those students who want to venture into science, engineering and technology related careers are admitted into the Science Faculty to upgrade their post-secondary school science and mathematics. In this year students study the following courses: General chemistry; Introductory Mathematics; Geometrical Optics, Mechanics, Vibrations and Waves; Physics; Electricity and Magnetism. Upon successful passing these courses, students can then opt for their chosen careers.

For those intending to study Industrial Design and Engineering related courses, they enrol for another common year at the Faculty of Engineering and Technology. In the common year, students study the following Engineering courses: Workshop Technology; Engineering Drawing; Engineering Materials; Statics; Electrical Principles; Computer-Aided Drafting; Dynamics and Strength of Materials. In addition to the aforementioned courses, Industrial Design students are introduced to Design concepts through these courses: Elements of Design, Designing Artefacts and Design Graphics.

From the 3<sup>rd</sup> to 5<sup>th</sup> year Industrial Design students concentrate on Design-related courses and it is anticipated that they will creatively use their Science and Engineering background to solve challenging design problems.

### 3 INTEGRATION OF ENGINEERING COURSES IN INDUSTRIAL DESIGN BY OTHER WORLD UNIVERSITIES

Experiences from other universities around the world have shown that Industrial Design students do study Engineering-related courses at the foundation years but not to the same proportion as University of Botswana Industrial Design programme. For example, the University of Western Sydney have two-engineering courses per academic year thus Engineering and Industrial Design Practice and Engineering and Design concepts. Loughborough University has two that is Electronics/Mechanics and Mechatronics. Technology University of Delft has one: Engineering Mechanics. Monash University has three: Engineering Structures, Electrical Systems and Engineering Dynamics. Brunel University offers one course that is, Creative Engineering Practice.

In comparison with other Universities, it seems the University of Botswana Industrial Design students are doing a lot more Engineering related courses at the expense of Design courses. Of the 30 credits at second year level, the students take only 13 credits worth of Industrial Design courses, the rest being engineering courses. In any course, work entailing one lecture hour or one lecture hour equivalent per week throughout the semester has a credit value of 1. This does not build a solid foundation for Industrial Design in the subsequent years.

### 4 INTERDISCIPLINARY DESIGN

Perhaps one should address why Industrial Design need to be interdisciplinary? There are two main schools of thoughts with regard to interdisciplinary design. Some scholars argue that interdisciplinary curriculum creates 'generic' designers who lack deep skills and knowledge in their field (ICSID News, 2008). However, some argue that such a curriculum would produce designers who are able to synthesise different kinds of knowledge and skills and work well in collaborative teams. Pure disciplinary can result in professional and creative isolation, preventing students from realising the creativity and innovation that comes from borrowing and translating from other disciplines (ICSID News, 2008).

Most Industrial Design programmes are a hybrid of the Arts and Design content as opposed to Engineering Design, which is a combination of engineering and design areas. In Industrial Design, emphasis is paid to product styling as well as other areas such as users psychology, culture, aesthetics, teamwork etc. However, in Engineering Design one needs a thorough understanding of value analysis approaches or statistical quality control and a deeper knowledge in various engineering areas. Both professions have common features such as an understanding of project management, marketing, ergonomics, usability, production and brand development.

The whole concept of having come with an interdisciplinary programme at the University of Botswana was to produce dynamic designers with an enhanced experience from other disciplines (Science and Engineering). In design, there is an increasingly use of team-based approach to product development and this has led to broadening of roles. Press and Cooper (2003) that individuals are no longer seen as specialists with narrowly defined responsibilities, but as generalists with a particular area of expertise. In addition, Fleming (2004) asserts that teams with very different disciplines produce fewer innovations, but of greater value. It follows that to design a team made up of highly differentiated disciplines incurs greater risk but also potentially greater reward: they are more likely to fail, but their success will be more dramatic. The programme is premised to offer interdisciplinary design which excites and reward students, offering new ways of thinking and the potential to produce innovative outcomes.

## 5 INDUSTRIAL DESIGN PROGRAMME REVIEW

As part of quality assurance and benchmarking with other University around the world, the Industrial Design and Technology Department, University of Botswana commissioned a programme review in 2007. The experts from Technology University Delft, Loughborough University and Cape Peninsula University of Technology to critical review the programme. During the review process, the reviewers had a meeting with members of academic and support staff, students and were provided with all the necessary programme documentations such as programme structure, course outlines, past examination papers, design projects, assignments, teaching portfolios etc. The main thrust of the review process was to look at the following seven standards:

1. Quality of programmes and courses;
2. Quality of academic staff;
3. Quality of teaching and learning;
4. Quality of student assessment;
5. Quality of support services;
6. Quality of resources, equipment and support services and
7. Quality of research.

For the purpose of this paper, more concentration will be paid to standard one: quality of programmes and courses. Reviewers made interesting observations with regard to the integration of Engineering (service) courses offered by other departments to second year students.

## 6 ENGINEERING (SERVICE) COURSES

The reviewers recommended that the Industrial Design and Technology Department must review and reduce the engineering courses. Their main argument was that by reducing the courses, it will create room for students to study design related courses to enhance their experience of design project work. They opined that it was better for students to cover a narrower range of engineering course and achieve real competence

than attempt to cover too broad a range of courses. This is particularly true because other Universities around the world for example, University of Western Sydney, Monash University, and Brunel University offer a combination of engineering and design courses. Their engineering courses are limited to two or three per academic year especially at first year level.

From their interviews with students, it was found out that by undertaking a lot of engineering courses, students gained insufficient experience of practical design activities. Lack of practical design experience would ultimately impact negatively on students future careers because the portfolio plays a significant part in gaining employment. Therefore, it is important for students to start building their portfolios at an early stage of their study so that they can compete well with other graduates around the world.

The reviewers further recommended that the host and delivering department should jointly design the courses. They observed that at the moment, it appears that some courses are 'off-the-peg'. The reviewers maintain that the "aims and methods of teaching and learning need to be appropriate for the students concerned. The design component of the entire Bachelor of Design Industrial Design seems forced with the confines of previously existing structures whereby the programme appears to be composed of a collection of isolated packets". Therefore, the relevance of different courses is not always clear to students. The Department has successfully managed to negotiate and change one course that is 'Digital Electronics' offered by the Department of Electrical Engineering to 'Electronics for Designers'. This was meant to make the course more relevant to designers. More work still needs to be done in relation to second year courses. For example, University of Western Sydney has two courses on Engineering and Industrial Design Practice and Engineering and Design Concepts. This was done to link engineering and design to make the courses more relevant to students needs. The University of Botswana Industrial Design and Technology Department is currently exploring developing their second year engineering course along these lines.

What has come out clearly is that the services courses were made relevant for the host departments and this is impacting negatively on design students. This has been shown in the design projects students undertake in years three to five because they fail to link or relate to their previous science and engineering knowledge to the design problems they tackle. Lack of relevance of service courses makes students fail to use the knowledge and skills they acquired during the foundation years. Are these two foundation years relevant to Industrial Design programme? This is one question which the Department is currently addressing. Should the relevant science and engineering knowledge injected in design courses where relevant and do away with the foundation years? The answers to these questions are critical and some members within the department are for the idea whilst others still feel the status quo is working well and it needs to be strengthened.

The reviewers observed that the teaching and learning experiences of engineering courses was too difficult for students to comprehend. This lowers students confidence and their ability to apply the knowledge they learnt from the service courses into designing projects. The reviewers recommended that such service courses, either core or optional, should be reduced. They emphasised that the hosting and delivering department should agree on the content and modalities of delivery, which would be appropriate and sensitive to Industrial Design student's needs. This may lead students to gain confidence in these areas.

## 7 CONCLUSION

The experiences and studies made indicate that the Industrial Design course needs inputs from other disciplines to enhance its content and focus. Since these other courses, in this case engineering, are service or complementary courses, their role should be guided by the expectation of the exit profile of the Industrial Design graduate.

Programme Evaluation has shown the Industrial Design programme to have a lot more engineering courses than necessary.

These engineering courses are mostly taught from the perspectives of the engineering disciplines, and no attempts are usually made to relate the concepts to Industrial Design. This results in courses not being useful to design students, and them not acquiring the integrated approach to designing initially sought.

The general conclusion is that the engineering courses should be carefully chosen to be appropriate in content and approach, to be of use to the Industrial Design programme and add value to the profile of the design graduate.

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