TEACHING INDUSTRIAL DESIGN TO UNDERGRADUATE ENGINEERING STUDENTS THROUGH INDUSTRY BASED PROJECTS

Amarendra Kumar Das
Department of Design, IIT Guwahati

ABSTRACT
India is one of the fastest growing economies in the world. Its emphasis in Science and Technology, led to self reliant in these areas but its benefits have not been translated in terms of improved standards of life through better products and services in absence of a policy for design education and design industry until recently. Design education programmes are nascent and limited in India. In contemporary undergraduate engineering education, although an elective course in Engineering Design is offered by a few institutions, it also does not offer exposure to industrial design. Engineering students show keen interest in industrial design and have shown excellent results when they were provided even with short-term exposure. In spite of their interest, it is challenging to create awareness of design and provide appropriate exposure and orientation in a short period of time due to the educational background of these students and non-availability of fund for conducting exposure programmes, even though these are conducted during vacations. Advantages in working with these students are due to their inherent inclinations towards core engineering knowledge and practice and their keenness on emphasizing engineering aspects. Essential design inputs in terms of aesthetics, ergonomics and usability etc., can be provided through formulation and execution of need based design projects. Funds can be generated through sponsorship from SMEs. This process created awareness of industrial design amongst the engineering students, evoked keen interests in the SMEs and also enriched the undergraduate design programme through the realization of the importance of engineering knowledge to take a product to the market amongst the students of design.

Deleted: disciplin

Deleted: .

Keywords: Exposure to Industrial design, SME, need based design project, Human Powered Vehicle

1 INTRODUCTION

In spite of India being one of the fastest growing economies in the world it is considered as a developing country. India has completed 59 years of Independence. Based on its emphasis in Science and Technology, it stands self-reliant in these areas. However India does not have a policy either for design education or design industry until now and in its absence, benefits of science and technology have not been translated in terms of improved standards of life, in absence of better products and services.

India has the distinction of having the largest technical and scientific manpower in the world. Indian engineering and technical education system is recognized globally as one of the best. India also has a well-established engineering industry as well as consumer

durable industry and industrial growth is commendable. Against this background of industrial growth, these achievements failed to improve the living standards of people within the country. This can be related directly to its effort for building its industrial structure rapidly since its independence. Import of technical know how is imperative to catch up with the latest advancements in Science and Technology. The technological transfer to India from abroad has led to design transfer as well, resulting in low indigenous development in design abilities. This 'design dependency' has made Indian products less competitive in the world market and has adversely influenced the export performance. Due to its failure to develop indigenous design & development capabilities, Indian market continues to be flooded with foreign products that in many cases meet consumer aspirations but not their needs and self reliance.

To ensure industrial growth, along with improvement in the living standards of its citizens, it is important that we choose the priorities properly. Industrial Design in particular can play a significant role in this growth and economic development, employment generation and exports in future. Academic intervention and research in industrial design is taking a preferential shape.

Compared to industrial development, formal industrial design education activity started quite late in India. It is only in early sixties that design education programme started with establishment of National Institute of Design (NID) in Ahmedabad and later in the same decade with the establishment of Industrial Design Centre (IDC) in Indian Institute of Technology Bombay (IITB) in Mumbai. NID offered diploma level programmes initially and then started offering postgraduate programmes with specialization specific to various applications. IDC being part of an IIT system of technical education catered to the post graduate levels and that too in industrial design and visual communication only. Till 1994 India had only these two institutes offering design education: Situation has changed in the last decade with few other institutes offering design courses in master level stressing product design. In the nineties, Centre for Electronics Design and Technology (CEDT) in Indian Institute of Science, Bangalore (IISc) and Instrument Design and Development Centre (IDDC) in Indian Institute of Technology Delhi (IITD) as well as Indian Institute of Technology Kanpur (IITK) followed suit at different times.

In 1997, Department of Design (DoD) was established in Indian Institute of Technology Guwahati (IITG) to offer undergraduate level programme leading to BDes in Product design and Communication design. This is the first bachelor degree offered in design in India and is starting Master programme in July 2007 aiming to cultivate need specific specialization. Indian industry wants designer with strong engineering background. Thus a designer must be able to design as well as detail out the product completely to take it up for production. Gradually Indian design education is taking shape towards achieving this goal and many private institutions are also sharing this responsibility in building design reliance in India [1].

To derive the benefits of science and technology in terms of improved standards of life, through better products and services and also to meet the expectations of Indian industries it is essential that, more and more undergraduate engineering students must be provided with exposure to industrial design. However contemporary undergraduate engineering education curriculum does not offer much exposure and scope to learn industrial design even as a secondary or elective subject. A few university and institution offer an elective course in Engineering Design, but this does not provide any exposure to various elements and factors associated with product design. Students from these institutions not only show keen interest in this area, but in a few cases have shown

excellent results when they were provided with proper exposure. Thus an attempt was made to provide exposure in industrial design to these students albeit in small numbers from the year 2003. The methodology followed, results obtained and recommendations are covered in the following sections.

2 METHODOLOGY

2.1 Aim of the exposure programme

The basic aim of the exposure programme is to provide insight of industrial design to the engineering undergraduate students so that they can appreciate its various aspects through hands on projects. Once they are aware of these aspects, they will be able to solve a problem in their own area creatively and deliver a marketable product. These students may also opt for higher study in design area. The students after undergoing the exposure training programme should be able to differentiate between product design and engineering design. They should be able to comprehend morphology of design [2], various product conceptualisation process, data collection and analysis process, documentation of design processes at various stages, report writing etc.

2.2 Deliverables from the students

Student undergoing the exposure programme is expected to deliver a developed concept of a product based on the design brief formulated, a functional prototype or a rolling prototype with all details ready for manufacturing. They are also expected to undertake trials and testing of these products. The actual work the students carry out also depends upon the stage of the industry-based project at which they are inducted to the exposure programme. However irrespective of the stages and work done, each student is required to prepare a detailed report of work done by him, both as a hard copy and a soft copy.

2.3 Selection of the students

First step involved in the methodology followed for the exposure programme formulated for providing exposure to undergraduate students of engineering institutions is selection of the candidates. For any programme to be successful requires involvement from the participants. In Indian engineering education, training through internship in educational and industry is a mandatory requirement. Therefore all students studying undergraduate courses undergo internship training. Many of these students desirous to gain exposure to industrial design request for summer and winter internships that normally last 4-6 weeks in institutions offering design education, such as Indian Institute of Technology Guwahati. Department of Design in IIT Guwahati stipulates few requirements for students intending to undergo exposure training in industrial design as a part of their internship programme. These are, that the students must be recommended by the training and placement office of their respective institution, should have completed 2 years/ 4 semesters of engineering education and also have completed basic engineering courses (also referred as core courses) prescribed for undergraduate engineering students. This is to ensure that working knowledge of materials and process, workshop practice, Basics of Mechanical Engineering, Engineering Mechanics, Strength of Material, Basics of Electrical Science are readily available with the students. They also should have adequate knowledge of using at least one CAD software, minimum being AutoCAD in addition to their disciplinary courses. To the extent possible, the students are required to stay in residential accommodation within the campus. This is to impart flexibility to the training programme. Since the programme

module is very short, students can work in the workshop or studio during the day time and they can study in the evening in the library as well as continue their documentation and report writing in the computer centre. They can also convert the concept sketches to digital data through CAD.

2.4 Funding of the programmes

The second aspect is arranging funding for these programmes. Since there is no provision for running these programmes institutionally, students participating in these programmes are required to bear their own lodging and boarding charges. Institutional facilities are extended for the programmes otherwise. However in addition to the lodging, boarding, library, computer facilities, there are other aspects associated with these programmes. These are cost of materials for design execution starting from stationeries to input materials such as hardware and consumables for fabrication of prototypes. This is one of the major expenses to be incurred. To fund this aspect, Small and Medium Enterprises were roped in. Existing and interesting design problem relevant to them were identified and they were requested to fund the programmes requirement in terms of consumables and hardware. In return, they were charged a minimum amount as royalty for implementing these designs by them in the market. After initial reluctance, this was readily accepted as very positive part of their involvement and several products came into the market. Presently there is tremendous demand of this programme from the both the students and the SMEs.

2.5 Structure of the exposure programme

The exposure programme starts with an induction phase. This is to explain the students regarding various aspects of product design. During this stage itself, students are introduced to a industry based design problem. This problem is normally taken from ongoing projects available with the faculty member imparting this exposure programme. The induction phase is through lectures, interactions and study materials. This phase is normally planned for three days only.

The second phase is to introduce the students to conceptualisation processes and visualisation techniques. Since most of the students are without desired skills for preparing sketches and renderings, to suit their background, normal line sketch in scaled dimensions followed by physical wire model is encouraged.

Students are also simultaneously introduced to Human Factors / Ergonomics relevant to the project at hand.

Along with the physical modelling, for optimisation and to check fit and functions, virtual prototyping with CAD is initiated. This phase is completed at the end of 2nd week. However, this can be shortened based on the actual progress made by the students.

Physical prototyping in full scale to fabricate a functional prototype is started in the third phase. Along with this activity, report writing is also initiated.

Once the physical prototype is ready, its trial and testing is started. Based on the feedback, any redesign is carried out.

3 ADVANTAGES OF THE APPROACH

The above methodology of providing design exposure and inputs to undergraduate engineering students were tried out for over a period of 5 years. This has various advantages to various stakeholders.

For the students, they were able to get an exposure in the product design field to enhance their knowledge and capability through hands on programme.
For the faculty member offering this programme, he received, enthusiastic young mind ready to experiment and work hard to learn and this actually accelerated the project undertaken by the faculty member and cost of these project could be reduced to affordable level by SMEs. The specific advantages to the SMEs are that, they can obtain complete design inputs including prototypes at a substantially lower development cost by sponsoring these programmes compared to design inputs obtained by engaging consultants for these work. Normally, SMEs are reluctance to engage professional designer in the first place and working through this mechanism removed their inhibition. They felt that they are also member of the design development team and could participate in this process. The technology transfer for the product developed was found to be much easier due to the involvement of the SMEs from the initial stage.

4 RESULTS AND RECOMMENDATIONS

The results of this experiment, i.e. Teaching Industrial Design to Undergraduate Engineering Students through Industry Based Projects was multifaceted.
Majority of the students who have undergone this programme improved tremendously in various aspects, whether it is in their academics, or in their personality. Many of them have won awards in national levels design competition. The students themselves attribute this to their exposure through this programme. Many of them were either qualified for higher studies or were hired by excellent companies with a higher pay packets compared to those who did not had this exposure. The response for this programme is so high that, the faculty member had been invited to conduct a national hands on workshop in automobile designing at one of the premier national institute of technology in India. Students from foreign universities have also undergone this exposure training. In terms of physical output, a few Human Powered Vehicles were designed and prototype made through these programme. These were put to regular production with immense success due to the completeness of the design in its prototype stage itself and was possible for the enhanced learning on part of the students undergoing the exposure programme. In addition to the HPVs, a rural transportation vehicle, a solar powered electric trike, an aeroboat were designed and fabricated after prototyping. The worth of these outcome are more than Rs. 10 million in quantified value for man days engaged.
Few snap shots of products developed under this programme is given in Figure 1-3

Figure 1 A Trike and a Tricycle Rickshaw and its derivative designed and prototyped

Figure 2 Aeroboat designed and prototyped & Clay model from Transdesign workshop

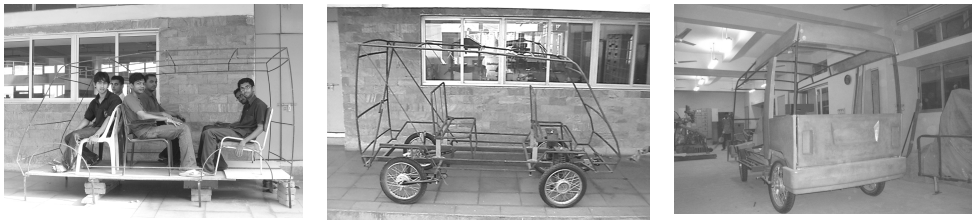

Figure 3 Stages of RuBus designed and prototyped

Based on the success of the programme, it can be recommended for institutes of similar nature not only in India, but in other parts of the globe.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the participation of all the students from various engineering institutions in India and sponsoring and participating agencies and SMEs in this research.

REFERENCES

[1] Das A. K. The Philosophies of design education in context of a developing nation. In Rodgers, P., Brodhurst, L. and Hepburn D., eds. *Crossing Design Boundaries*, pp. 139-144 (Taylor & Francis., Napier University, 2005).

[2] Asimow, M. *Fundamentals of Engineering Design*. (Prentice-Hall, Eaglewood Cliffs, New Jersey, 1962)

Prof. Amarendra Kumar DAS
Department of Design
Indian Institute of Technology Guwahati
Guwahati – 781 039
Assam
India
dasak@iitg.ernet.in, http://www.iitg.ernet.in
+91-361-2582454, +91-99540-27062