

Effective Approach towards Development of Idea through Foundations to Product Design

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Abstract- Nowadays, uniqueness, innovation, and team workers are expected in every aspect of industries. Every student undergoes a challenging task in the daytoday life to meet their long term and short term goal. Being proactive and exhibiting their skills acquires a job to make their dream come true. To enhance the design attributes, out of box thinking, creativity, teamwork, decision making this novice course named “Foundation to product design” inspires and motivates students to work in teams, to build prototypes, promotes learning and thinking skills, understands the role of the user and also improvises communication skills. These features form the base to build their career of each individual to dwell in their professional life to become a successful or effectual engineer.

Keywords: Design thinking, prototyping, teamwork, Ethnography, Functional Analysis

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1. Introduction

Design thinking and design attributes are becoming the main impact of a society and the nation's development. Keeping these attributes in mind this course “Foundation to product design”, has been introduced in the curriculum to develop the design thoughts and project prototyping interest among the students. This course has grabbed a lot of attention among the students since it allows the students to think out of the box and come up with innovative ideas. Idea generation is one of the core outcomes of this course enhancing the inner ability of the students to develop their design skills, teamwork, communication skills, understanding the role of a user and role of prototyping towards the product.

Every aspect of engineering field emphasizes on the design thinking. The design has made a great impact in every flourishing industry like business corporate fields, textile industry, automation sectors, Aircraft sectors and various small-scale industries. Enhancing the design feature in the young students is a challenging task, however, there seems to be a large response and expectation among the student's communities as they seek for better job opportunities and like to build their designing skills. Design attributes of an individual are clearly distinguished and exploited in this course. Students are exposed to real-time issues end users are facing, where this course helps them find a better solution for the problem faced by the end user. The course mends each and every attribute of the students to work for a better

solution and involves hands-on experience to develop a working model to fix the issues. Students experience real designing atmosphere to show their skills and bring up an excellent project to serve the end user community with ease taking up this course.

2. Literature Review

An emphasis on sustainability in design will catalyse a change in engineering education so that students will approach design with a multidisciplinary, global perspective. This approach will be used to solve problems around the world and further connect students and their University to the world [1]. Social innovation for some designers might manifest itself in abiding by existing professional organizations' codes of conduct on social responsibility while designing for businesses and nonprofits [2]. The research included five key stages. Firstly, an investigative study was conducted into the meaning and capabilities of design, using a literature review and subsequent content analysis method to create a theory-based Design Spectrum, which laid the foundation to demonstrate the wide breath of design parameters [3]. The four images of design thinking (= the combination of the aim of the innovation project, the vision on innovation and the main challenge) together with the developed card deck (48 cards) serve as a common language and tool that supports capturing the value of design thinking in innovation. The second stage was an exploration of the expanding parameters of innovation in the commercial environment [4]. In general education, it is particularly important that teachers have a fundamental understanding of the abilities that they are seeking to develop in their students. In tertiary, professional education, teachers can get by as long as their students are reasonably competent enough to enter their profession at the end of their course. Unprofessional education the distinctions between education and training are perhaps less clear-cut than they are in general education, [5].

3. Broader Context – SR Engineering College Educational Innovations

3.1 Core Values

SREC defined its mission as to create and foster the development of entrepreneurial mindset in students, staff, and faculty by creating a vibrant educational ecosystem. To achieve this mission, the

SREC educational ecosystem was designed to synergistically integrate the experiential engineering curriculum with an array of extra-curricular learning opportunities focused on forming the next generation engineering thought leaders. SREC developed a new curriculum based on extensive input from industry thought leaders, academic experts, and student focus groups. The curriculum was designed to address the need to make the graduates employable, globally competitive for pursuing higher education and to face engineering grand challenges. The new curriculum is being implemented from Fall'2015.

Innovation, Creativity and Entrepreneurial-mindset – We value innovation, creativity and entrepreneurial-mindset as the fundamental building blocks of our next generation engineers. Our institutional culture fosters the development of this mindset through multiple design courses and projects in individual courses that are tightly integrated into the curriculum as well as student competitions that are open to all students. In this ecosystem, students become thought leaders who have the ability to conceive creative ideas, realize the innovative solutions, and create marketable products.

Industry Relevant Curriculum – We place great emphasis in developing industry-ready engineers. To this end, our curriculum is designed with the input from industry experts, our design projects guided and assessed by industry mentors and evaluators, and our students exposed to the current industry trends through constant interaction with the local industry. Through constant exposure to the industry, our students have the business acumen to work and make a difference in their chosen industry.

Interdisciplinary Learning - We believe in interdisciplinary learning where students see connections between different disciplines as well as courses and also, learn to work with people from other disciplines. Our academic ecosystem is designed to promote these constant collisions between ideas, thoughts, disciplines, and people by creating a large common core curriculum as well as extra-curricular opportunities that lead to rich learning experience.

Information Technology – We recognize the key role of information technology in revolutionizing our way of life. Our students are trained to leverage the ever-changing computer tools to create new products and services in their own areas of specialization. Our

students are computer savvy trained through a set of rigorous computer competency courses. They learn to apply the computational tools in their discipline-specific projects and courses.

3.2 Foundations to Product Design – Connectivity to Related Courses

Foundations to Product Design is one of the courses introduced to all engineering students. The course improves their abilities to understand the needs of the users, think creatively, communicate effectively through verbal as well visual tools, and build working prototypes. Students take the following courses before or after taking this course –

- Introduction to Engineering is a freshmen-engineering course that introduces design thinking in terms of pain storming, brainstorming, SCAMPER technique, Concept Mapping, exploration and refinement, and sketching.
- Product Design Studio provides a studio experience where students learn to use hand-tools, build electronic circuits, create three-dimensional computer models and print using rapid prototyping machines, and cut two-dimensional shapes using Laser Cutter.
- Foundation to Product Design builds on the previous two courses providing a depth to students' design thinking abilities. The course introduces ethnographic methods, functional analysis, six-hats method, and Kano model.
- Engineering Pathways Into Community Service is an elective course that takes students into the community. In this course, students visit users along with community partners (NGOs), identify problems and collaborative develop and deploy solutions.
- Mechatronics is a required course for all engineering students. In this course, students learn using Arduino microcontrollers and interface different sensors and actuators. They build working systems to solve real problems.
- Media Project is another course designed to promote self-expression, communication, creativity skills, and curiosity about community problems in all engineering students. They work with professional moviemakers to create short-films (3-5 minutes in length).

4. Course Overview

4.1 Basic Information

Foundations to product design is an impelling course which infuses cognitive and methodical approach to solve problems. It is an requisite assortment of creative and practical thinking leading towards green innovation. This course enables students to generate ideas, explore possibilities by lateral thinking, challenging complexities and hyper turbulence in synthesizing an idea into an efficacious product for commercialization.

Branch	All Branches
Class	II Years
Pre – requisite	Introduction to Engineering, Product Design Studio
Credits	3
No. of Lectures per Week	3
No. of Weeks	14
No. of Instructors	2 for 30 Students
Continuous Internal Evaluation	Assignment – I (15)
	Assignment – II (15)
	Assignment – III (15)
	Attendance (5)
	Total - 50 Marks
Semester End Examination	Modelling (30)
	Presentation (20)
	Total - 50 Marks

4.2 Course Objectives and Outcomes

Course Objectives:

Students will learn:

1. The overall design process and the various stages in the process
2. Methods to identify and frame the needs from ethnography to functional decomposition
3. Elements of value proposition from the point of view of different stakeholders.
4. Idea generation techniques, concept development methods based on appropriate experimentation, and concept selection method.
5. Project planning, cost estimation, managing intellectual property Rights, and report writing skills

Course Outcomes:

At the end of the course, the students will develop an ability to:

1. Describe and discriminate the design process and its stages.
2. Conduct an ethnographic study and frame a design need
3. Decompose the need in terms of independent functions
4. Formulate value proposition from the point of view of different stakeholders
5. Conceive ideas, develop them into viable concepts through appropriate investigation, and select viable concept.
6. Plan a project and work towards implementation
7. Develop a working prototype and create a design report
8. Demonstrate the project/product and prepare cost estimates

4.3 Course structure

Unit	Topic	Content
I	The Engineering Design Process	Overview of the engineering design process, Stages of design, Identification – conceptualization – Exploration and refinement – Modeling – Commercialization
II	Identification and Analysis of Need	Ethnography, Framing the Need, Functional Analysis - Functions, Constraints, Functional Decomposition and Development of Requirements, Kano Model, Value Proposition from the Point of View of Different Stakeholders.
III	Conceptualization	Concept Generation – Six Hats method, Concept Development , Concept Selection
IV	Skill Development	Project Planning, Cost Estimation, Intellectual Property Rights, Effective Report Writing
V	Project work	An open ended design project executed from opportunity to a working prototype culminating with an investor pitch, customer product unveiling, and report

4.4 In-Class Activity and Assessment

Foundations to Product Design is a Course which Incorporates Active Learning wherein Interaction and Collaborative Learning have been the Focal Point to Conceive Ideas through various activities. The following Provides the glimpse of Activities generally conducted during the Course.

4.4.1 Ethnography

This activity is done to Identify and Frame the Needs for Development of Products. Finding a Need or a pain is a very easy today since we are in the world where you see plenty of complications around. But a Need or a Pain for which a prudent step can be taken to terminate such Problem is very difficult.

In this case the,

Need emphasizes “the dire necessity to reduce or eliminate the problem”

Pain “Pain which is treated as utmost important for its culmination”.

The question is what is the purpose of identifying these needs?

And there lies the answer: “NO PAIN NO GAIN”

Mostly there cannot be a new existence of product without any Pain.

So, to identify a Need a study named Ethnography is used which makes it very easy, effective and Clear to Identify the Needs.

During this exercise, the Instructors shall request the students to enlist one by one, what they have observed during the whole day in a particular circumstance.

For example:

It is instructed to list the Observations made during Travelling from Home to College. The Observations Made has to be very simple and need not be judged.

After an ample time is given (20 - 30 Mins) to the students to list out their observations, randomly the students are asked to put their Observations upfront in order to identify any Needs. After listing out the observations, the Students are asked to evaluate

whether it's a Positive Observation or a Negative Observation. Mostly all the Negative Observations either directly or indirectly contemplates to the Need or Pain.

After the observations are listed out, it is very important to judge or evaluate on which needs or pains one can focus. It becomes very important to constantly monitor them and make the students aware regarding the viability of the Desired Product. An approach is to be given to the students to construe an Idea. The Activity is followed by an Assignment.

Assignment : Identification and analysis of customer needs.

The students are requested to do perform the same activity for a week, thereby coming up with the defined problem and an abstract solution.

4.4.2 Functional Analysis

Once the desired product is selected and approved to head forward, it is essential to list out all the functions of the product and they are synchronized in a proper chronology to effectively bring out the requirements of a physical product.

It is immensely important to make a note that,

“Functions follows Product”

Once the Product outline is Done Constraints are further put forward for enhancement of the Product. Product Decomposition usually construes to parts.

1. Functional Decomposition

2. Physical Decomposition

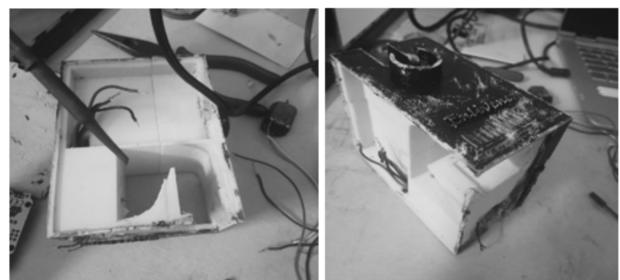
Students are given an ample time (about 90 Mins) to perform Functional Analysis on their respective Ideas for forming their Ideas into A Form and Develop it Further. The several Advantages of this activity is to trim the parts which stand as just a mere redundant agent in the product. Only Functional parts remain in the product, which thereby increases the effectiveness and efficiency of the product and also makes it Cheaper than before.

Assignment: Students are assigned to form their functional requirements of their Ideas and bring them into a Physical Form.

5. Sample Student Works

5.1 Automatic Enlivener

Automatic Enlivener is an automated freshener which was built for Gym where in it becomes stinky because of all sweating and CO₂. Thus upon observing the peak hours and understanding the air circulation an automated freshener using certain sensors and Timer were built so that the air remains fresh and fragrant.



5.2 Multi Utility Umbrella

A multi utility Umbrella was made in order to make it function in various ways. During Monsoon it became difficult to walk on streets only with umbrella since the power was not supplied during rains. Hence an LED torch was inbuilt with Ball and socket Joint to give it a thorough degree of Freedom and enable to be used as a Torch along with an Umbrella. Even The casing of the umbrella was tend to make it strong as if it could be used as a walking stick.

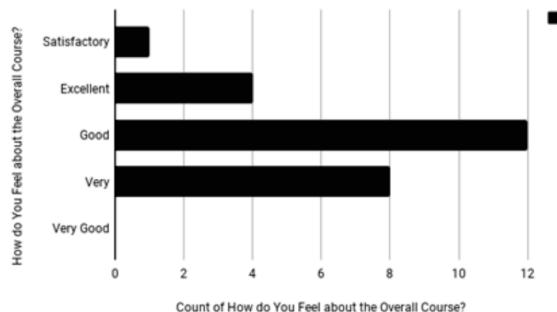


6. Impact of Course

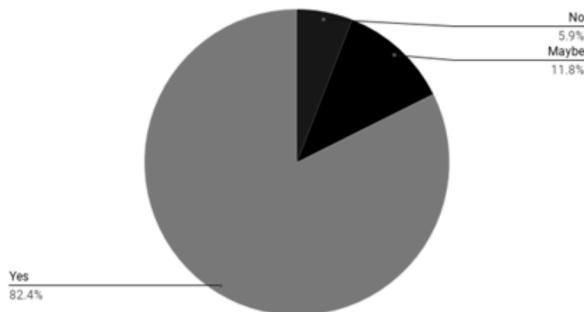
As Collaborative Learning Techniques have been adopted, a batch of 4 – 5 students were made In order to address the Problems Identified. Every Batch has

successfully come up with solutions to solve the problems either temporarily or permanently. A feedback after the course also stated optimistic impact as shown in the figures.

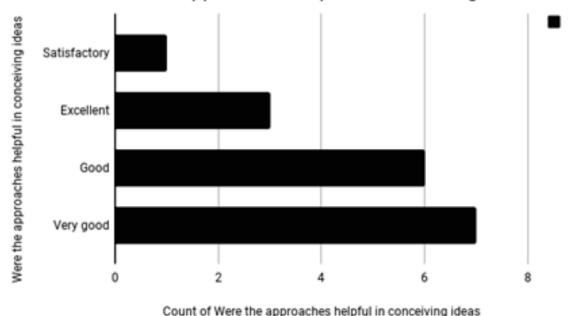
Count of How do You Feel about the Overall Course?



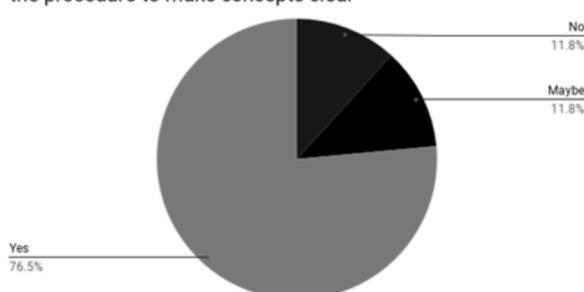
Count of Were the Primary objectives of the Course Fulfilled.



Count of Were the approaches helpful in conceiving ideas



Count of Did you feel that the supervisor appropriately follow the procedure to make concepts clear



7. Conclusions

This paper impresses the importance and widens the scope of design thinking in the field of Education. However, indeed more research is necessary to promote and facilitate an effective and efficient approach in bringing out Innovations. We feel we have just started and yet there is a thrilling ride ahead. This paper mainly concentrated on the basic aspects of identifying and implying the constraints of the design. There shall be Explicit Models, and studies involved at the later stage which shall further boast the viability of the product in the user's perspective.

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