

Developing Socially Responsible Students of Engineering at the First-year level through Design Thinking Approach- A New Understanding

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Abstract— Engineers, as problem solvers, need to stay connected with society. Delivering the expected service to the community and making it worth living requires a strong social connectedness because the engineering profession is not only about Technology but, more importantly, about creating social values by providing solutions to societal challenges. This is possible by placing the students in an ecosystem that provides the scope to develop socially responsible students with the designer's mindset, to establish a positive social connection. Such an ecosystem is possible to build using the Design thinking approach. Design thinking, as the name implies, comprises two elements, a designer mindset, and a well-defined process. For engineers, it is mandatory to have a designer mindset to sharpen their problem-solving skills, which is the basic quality expected. The Design Thinking approach helps students in building an empathetic mindset which establishes a strong positive connection with society and makes them socially responsible. The core strength of the design thinking approach is the concept of empathy. The whole approach revolves around empathy and the user for whom the solution is developed. It believes that the people who face problems are the one who holds the key to the solution. At every stage of design thinking, a strong connection with society in the form of the user is experienced. This paper derives a new conceptual understanding of how the design thinking approach will help students to become socially responsible engineers. The study was conducted on a student group of 500 from a first-year engineering Program. Phase-wise presentation made by individual teams of 5-6 students on the societal problems was assessed using rubrics. In conclusion, the design thinking approach has been an effective tool for developing socially responsible students in their first year of engineering.

Keywords—: Design thinking; empathy; mindset; socially responsible.

JEET Category— Practice.

I. INTRODUCTION

Design Thinking, as an iterative process, helps us to understand the user, challenge, assumptions, and redefine problems in an attempt to identify alternative solutions that might not be instantly apparent with our initial level of understanding. More than a process Design thinking

approach provides an effective way to think and experience hands-on methods to help with a new mindset (Min, 2020). Design thinking helps students to be critical and empathic thinkers who seek innovative methods to address the real societal need (Ghanavati et al., 2020). It has been said that engineering programs should graduate engineers who can design effective solutions to meet societal challenges (Razzouk & Shute, 2012) (Hill et al., 2021). Today the whole world is facing many social challenges like sustainable goals, which need to be addressed. Developing socially responsible engineers with positive social connections will help to solve these problems. One of the most used approaches is Design Thinking, which systematically develops the engineering mindset to address societal challenges. Design- Thinking believes that the people who face problems are the one who holds the key to their problem's solution. The key to this process is empathizing with the users to uncover unmet needs by understanding their beliefs, values, motivations, behaviors, pains, gains, and challenges and to provide innovative solutions. The new conceptual understanding, Design Thinking to Societal Connection (DTSC), shows that there are two levels, as part of the Design Thinking approach, in establishing the social connection i-e Level 1: Individual Transformation and Level-2: Process Approach. Level 1 focuses on individual transformation by developing the required mindset, and Level 2 on applying the various stages of design thinking with the Process approach. Here Level 1 drives Level 2. This ensures a strong student bonding with society, establishing a positive social connectedness. This, in turn, helps to develop socially responsible students. This paper demonstrates the new understanding, of Design Thinking to Societal Connection (DTSC), developed from the experiences of first-year engineering students addressing societal challenges using the Design Thinking approach.

II. DESIGN THINKING TO SOCIETAL CONNECTIONS(DTSC)

The core principle on which design thinking revolves around is a user-centric approach. This enables the designer to keep the user at the center through societal connections to arrive at unique solutions. The designer (student) will always keep in touch with the user to

capture the pain points and frustrations. And finally, convert these pains into gains that the user is expecting. This societal connection, with the design thinking approach, will be in two levels, Level 1 and Level 2. The new understanding can be visualized in the following Fig. 1

Level 1 is the individual preparation for solving societal challenges. It mainly involves the development of a mindset toward seeing problems as challenges. It is a systematic transformation of an individual mind to solve problems.

On the other hand, Level 2 is applying well-connected phases starting with capturing user pains through empathy and culminating (close) with the user through solution validation.

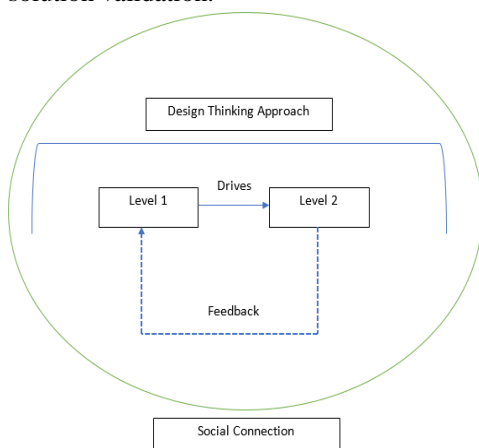


Fig. 1: Design Thinking to Social Connection (DTSC)

III. METHODOLOGY

The experiences of the students of the first year have been captured at two different stages:

- A. *Level 1 is the individual preparation for solving societal challenges.*
- B. *Level 2 is applying well-connected phases in project implementation.*

At both stages, the nature of societal connection has been documented through the rubric-based assessment. The nature of activities in the stages for both levels is tabulated in the following tables.

The individual transformation begins with the following elements:

- Empathy
- Collaboration &
- Experimentation

The following Tables, provide the details of the activities which help the transformation changes and develop the required mindset against each element. These activities are captured by observing the activities of First-year students working on societal challenges.

The involvement of the students clearly showed the activities performed.

TABLE I
DESCRIPTION OF ACTIVITIES- LEVEL 1

Elements of Design Thinking: Mindset	Description of Activities
Empathy	<ul style="list-style-type: none"> Visualize the situation based on the curiosity developed. Draw analogous inspiration from similar situations.
Collaboration	<ul style="list-style-type: none"> View the problem and solution from different perspectives of the stakeholders and challenge the problem definition and the suitability of the solution.
Experimentation	<ul style="list-style-type: none"> Constantly seek evidence right from Initial observation to the final test.

On the other hand, the following table provides the details of the activities performed in implementing the various Processes of design thinking.

Design Thinking: Process	Description of Activities
Empathy: Learn about your user	<ul style="list-style-type: none"> Community Study through observation. Expanding the curiosity developed through observation by interacting with the community and identifying the user. Empathetically capture the pain points and frustration of the user. Immerse into the pain points and identify the core challenge to be addressed.
Define: Construct a point of view based on user needs	<ul style="list-style-type: none"> Interact with the stakeholders & translate the voice of the user into a design challenge definition. Set boundaries and redefine the problem as a design Challenge in a human-centered way.
Ideate: Brainstorm & come up with creative solutions.	<ul style="list-style-type: none"> Generate multiple ideas to address the design challenge. Evaluate the ideas and zero down on doable solutions.
Prototype: Build Representation of your ideas	<ul style="list-style-type: none"> Bring life to the best-selected idea with which the design challenge shall be addressed.
Test: Test your ideas	<ul style="list-style-type: none"> Conduct usability tests with users to see whether the prototype is solving the design challenge.

TABLE II
DESCRIPTION OF ACTIVITIES- LEVEL

The extent of achievement has been further realized by mapping the activities with the extent of the societal connection. The study exhibits a strong societal relationship from moderate to very high. A focus group study was carried out on 500 students from a first-year engineering Programme. Phase-wise presentation made by individual teams of 5-6 students on the societal problems was assessed using rubrics this rubrics-based assessment of the student's work facilitates the development of mapping between activities to the extent of the societal connection. The following table exhibits the Extent of Societal Connection against the activities of the design thinking mindset.

TABLE III
EXTENT OF SOCIETAL CONNECTION – LEVEL 1

Mindset: Empathy					
Description of activity	The extent of Societal Connection				
	No	Low	Moderate	High	Very High
Visualize the situation based on the curiosity developed.			•		
Draw analogous inspiration from similar situations.			•		
Mindset: Collaboration					
Description of activity	The extent of Societal Connection				
	No	Low	Moderate	High	Very High
View the problem and solution from different perspectives of the stakeholders and challenge the problem definition and the suitability of the solution				•	
Mindset: Experimentation					
Description of activity	The extent of Societal Connection				
	No	Low	Moderate	High	Very High
Constantly seek evidence right from Initial observation to the final test				•	

The following table exhibits the Extent of Societal Connection against the activities of the design thinking process.

TABLE- IV
EXTENT OF SOCIETAL CONNECTION -LEVEL 2

Empathy Phase: Learn about your user					
Description of activity	The extent of Societal Connection				
	No	Low	Moderate	High	Very High
Community Study through observation			•		
Expanding the curiosity developed through observation & interaction with the community & identifying the user				•	
Empathetically capture the pain points & frustration of the user					•
Immerse into the pain points and identify the core challenge to be addressed.					•
Define: Construct a point of view based on user needs					
Description of activity	The extent of Societal Connection				
	No	Low	Moderate	High	Very High
Interact with the stakeholders & translate the voice of the user into a design challenge definition.					•
Set boundaries and define the problem as a problem statement in a human-centered way			•		
Ideate: Brainstorm & Come up with Creative Solutions					
Description of activity	The extent of Societal Connection				
	No	Low	Moderate	High	Very High
Generate multiple ideas to address the design challenge.				•	
Evaluate the ideas and zero down on doable solutions.			•		
Prototype: Build a Representation of your ideas					
Description of activity	The extent of Societal Connection				
	No	Low	Moderate	High	Very High
Bring life to the best-selected idea with which the design challenge shall be addressed.			•		
Test: Test your Ideas					
Description of activity	The extent of Societal Connection				
	No	Low	Moderate	High	Very High
Conduct usability tests with a user to see whether the prototype is solving the design challenge.					•

IV. CONCLUSIONS

The design thinking approach has been an effective tool to develop socially responsible students in their first year of Engineering. The design thinking approach has in built elements to develop the required empathetic mindset to observe society from a different angle. The extent of societal connection the students have exhibited through the activities by engaging themselves, in teams, on societal problems forms a strong foundation to make them socially responsible. The flavor of this may be further seen in their participation in problem-solving at higher semesters. The study has revealed that societal connection ranges from moderate to very high in all the activities performed.

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