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Impact of Service Learning in Engineering Education – A Case Study

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***Abstract*— In the 21st Century, significant number of students have access to the tools for digital learning and spending most of their time on the internet and other social media platforms. Our college core philosophy is "Doing Engineering" rather than just studying engineering. In this context, EPICS (Engineering Projects in Community Service), UBA (Unnat Bharat Abhiyan), EWB (Engineers without Borders), GCSP (Grand Challenges Scholar Program) have been introduced to promote the learning through service. The above service learning which encourages students to work with local communities. and NGOs. real-time problem faced by the communities are identified by following design thinking approach. EPICS originated from Purdue University, USA. HITAM has been sprinting the EPICS program for the past five years. All freshmen engineering students enroll into EPICS Program as a mandatory course. To work on the real-time problems, multidisciplinary teams are formed for doing the community-based projects to enhance communication skills, technical knowledge, teamwork, presenting skills, and other traits along with progress in data analysis which will be unfolded in this paper. Forming the multidisciplinary teams in the beginning of the process has become a hindrance because students are separated discipline wise in the classrooms. To overcome this setback, a google form is created which consists of questions about interesting areas, technical knowledge and circulated among all the students for recording responses and area of interest. Subsequently, a meeting is called for all students and kindled their design thinking activity among the multidisciplinary teams as well. A strict line structure is followed to adapt design thinking methodology for implementing the EPICS course in the curriculum.**

***Keywords*— EPICS; UBA; EWB; GCSP; Interdisciplinary.**

I. INTRODUCTION

Engineering students should know how to solve real time problems. In this context to encourage students in learning rather than only studying engineering, we have introduced EPICS, UBA, EWB, and GCSP in the institution. In two Institution EPICS programs was introduced, and it is observed that in the two institution the students learning was improved through project-based service-learning approaches. Teamwork, critical thinking, solving society-based problems & technical knowledge in the students is increased (Jennifer Benning et.al, 2022). To motivate high school students to study engineering as a course after completion of high school the service-learning activity introduced. In this activity University students are presented their work done on society-based approaches for high school students. (Bele N et.al, 2021) After doing this activity high school students are interconnected with university students, high school students learned the importance of engineering, and most of the students joined the technical course. For assessing the outcome of service learning a rubric should be designed by mapping service objectives with course objectives. It is observed from the assessment that students are more interested in doing real-time service-oriented projects. The author also expressed that by introducing SL in engineering students will be connected with society and humanity for the better future (Marián et.al, 2021). The SL initiative will substantially affect the student's attitude & identity. A list of questions was created to challenge the student's attitudes and identity by asking questions on the reflection of service-learning approaches. Rubrics were designed to assess the attitude and identity of students. This approach was successfully implemented for a set of undergraduate students in the mechanical engineering heat transfer course (N. Dukhan et.al, 2008). The last 40 decades of journal articles survey were completed for identifying the gaps in community engagement and active involvement of students, and faculty. The most common problem faced by the students while doing the community engagement project is specific material procurement, language barriers, communication issues, and project-to-product conversion. To overcome this barrier a multidisciplinary approach should be implemented while doing community projects (Malini et.al, 2021). Introducing multidisciplinary concepts in community engagement improves the students learning of emerging technologies, involvement in academics & leadership qualities. After assessing these approaches most of the course outcomes are mapped with program level objectives PO5 to PO12 (Siti Rawdhoh et.al, 2008). EPICS in IEEE motivates the student teams to work with local communities for solving community problems. It provides funding to the new innovative idea to convert an idea into a product & delivering this solution to the stakeholders. The student teams will get the identity from IEEE, technology enhancement, ethics, and leadership skills. EPICS in IEEE is help the students to enhance their knowledge but also provides technical solution to the NGOs problems (Nicholas J, 2018) Introducing a pilot course service learning for first year engineering students it connects students with our society and motivates the students to do a course project. Students' reflections were collected it shows that students are very interested to learn this type pedagogies in other courses also.

Students' attendance percentage also increased compared to other traditional engineering courses (Laura, 2015).
This paper presents the importance of service learning in engineering education, implementation, outcome, assessment and leadership skills.

II. METHODOLOGY

A. EPICS (Engineering Project in Community Service)

EPICS was introduced the institution in the year of 2016. This initiative we adopted from Purdue University, USA. At first, it is introduced to only interested students who can take this course and work on community related projects. Initial stage a small group 20 students joined for this program. For the deeper understanding of this program, we have followed design thinking process shown in figure.1. For problem identification, student teams visit NGOs, schools, and villages. After identifying the problem, the faculty in charge conducts the brainstorming activity for the students (Naik etl.al, 2020).

Students discuss the problem in groups and select the problem depending on the societal need and impact of the problem. Next step teams will conduct the product survey to know the market study, is the same problem solution existed in the market or not, and to identify the gap in the problem. After the product survey teams will work on the decision matrix to get a feasible solution for the problem and develop the working prototype. This working prototype team will show it to the community partner and takes the feedback. Depending on feedback students will develop the final working model and carry out the testing step. If testing is successfully completed the final product will deliver to the community partner. The product working will be checked twice a year, if the product fails in between again it will be transferred to the redesign stage the new product will be developed and delivered to a community partner, this process continues (Naik et.al, 2019).

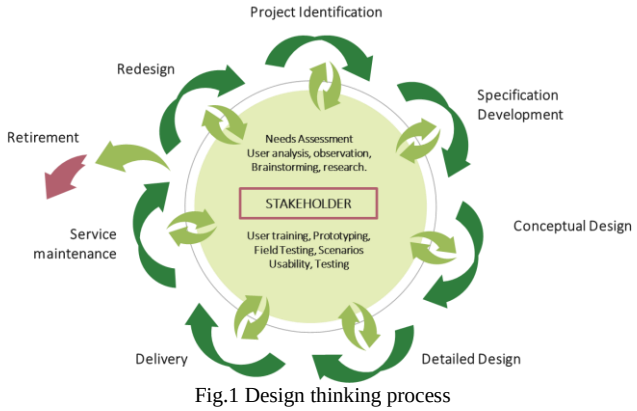

Fig.1 Design thinking process

After collecting reflection from the students, all students suggested that course should be introduced to first year engineering students because students can learn from the basic steps. In the first-year important subjects which are mechanics, applied physics, mathematics etc students are unable to understand due to traditional way of teaching. To solve these issues, we can provide the service-learning concept in first year to incorporate real time learning in courses (Hema et.al, 2021). So, we have introduced Engineering Project in Community Services course as mandatory subject for first year engineering students, the timetable shown in Table.1.

Table.1 Timetable

Period/Day	10:30 (AM) -12:15 (PM)	2.15 (PM)-4.00 (PM)
MON	EPICS – ECE	EPICS - EEE
TUE	EPICS - Data Science	EPICS - IOT
WED	EPICS - AI&ML	EPICS - CSE
SAT	EPICS -MECH	EPICS - Cyber Security

B. UBA (Unnat Bharat Abhiyan)

The Ministry of Education, India introduced the UBA initiative to promote grassroots innovation in the villages and in institutions to connect students with villages. In this context we have adopted five villages and we have conducted household survey and village survey to identify the problem in the village. (Anjali et.al, 2021) In the village Participatory Rural Appraisal (PRA)conducted shown in figure.2. In this activity 80 students and 10 faculty, and gram panchayat members participated. This activity was conducted to know village resources, interact with communities (Surendra & Naik, 2021).

Fig.2 PRA Activity

UBA will give the fund for technological development and technological intervention in the adopted villages.

C. Engineers Without Borders

EWB student chapter started in the year 2019 by the students. It started with a vision to motivate students to take real time sustainable social problems as a project and to become global leaders. This chapter contains the student's body were president, VP, Treasures, Secretary etc shown in table.2 now currently we are having from 1st, 2nd & 3rd year total 50 students in the chapter (Syed et.al, 2021).

Table.2 Executive Committee 2021-2022

Sl. No	Name	Branch	Year	Role
1	Sheeba Shaista	CSE	3	President
2	M Sohel	ECE	3	VP
3	G Ramya	ECE	3	Secretary
4	Tushar Shah	ECE	3	Treasurer
5	Preetham	EEE	3	Member
6	Pavan Kumar	MECH	3	Member

Our Chapter Working Principle is well designed, and it consists of 8 phases starting from Survey, picking up Idea,

Brainstorming Session, Developing Prototype, Showcasing Product to Stakeholder, Review & Suggestions, Real-time Product and at last to Stakeholder shown in figure.3.

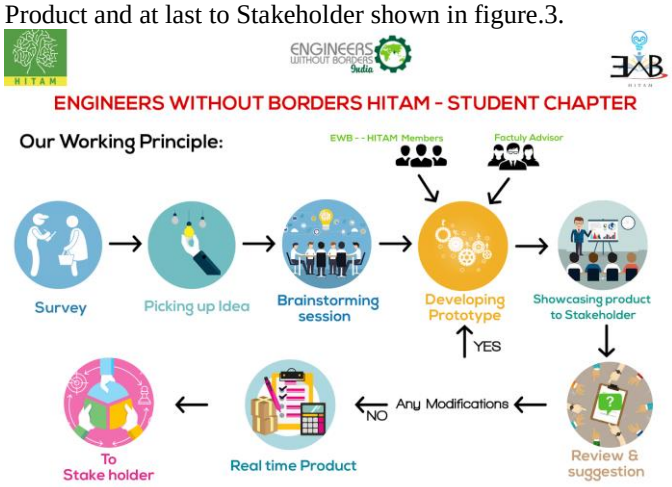

Fig.3 Working Principle

D.GCSP (Grand Challenges Scholar Program)

This program we have taken from the NAE (National Academy of Engineering), this initiative promotes entrepreneurship, multidisciplinary, and service learning in the institution. For students joining this program, we have prepared a policy that students should be from interdisciplinary branches with a team size of 05 members only from first and second-year engineering students. This program is designed in such a way that students in four years of study, will get a deep knowledge of emerging technology which helps to pursue startup, higher education, jobs, etc. Teams should select a theme from 14 grand challenges, after selecting the theme students will identify the problem related to the selected theme, next teams should submit the proposal containing problem definition, theme, and brief solution for the problem (Hema et.al, 2020). The instructor will assign the mentor for the teams, the mentor will guide the students and design a 4-year curriculum for the assigned team theme problem shown in table.3.

Table.3 GCSP Theme Vs Component Vs Subject Mapping

GCSP Theme	**Sustainability**	
GCSP Learning Component	Make solar energy economical	Provide access to clean water
Research	Solar Photovoltaic Systems	Engg Chemistry& Biosensors
Inter-disciplinary component	Solar Radiation &Energy	Water Supply
Entrepreneurship	Design of Solar EnergySystems	Wastewater Treatment
Multi-cultural/	Professional Ethics	Professional Ethics
Service Learning	Entrepreneurship Development	Entrepreneurship Development

III. RESULTS

In this study, it was found that the service learning with the design thinking process students learned how to work in a team, taking challenging roles, participate in the national level competition, identity, etc. Currently, in EPICS we are having (N=255 Students, N= 4 Faculty) only from the first year, EWB (N=50 Students) UBA (N=80 Students) from the first, second, and third year, GCSP (N=60 Students) shown in figure 4. All this initiative comes under the umbrella of service learning, so we combined all these programs into one center is XPLORE (Experiential Platform for Learning and Outreach in Realtime Engineering). The students graduated from the college and spent their time in this program we have collected feedback from graduated students shown in table.4 and prepared data of students after graduating from XPLORE how this initiative helped them to get a job or to pursue higher studies shown in figure.5.

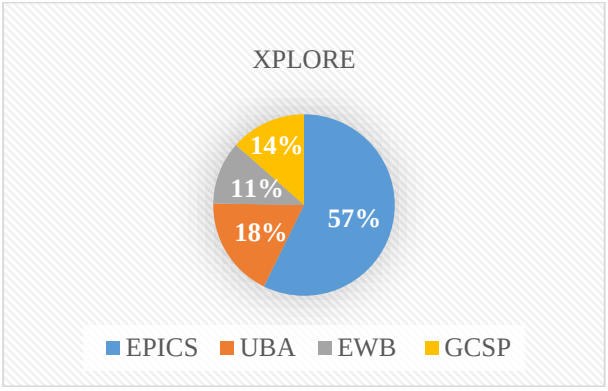

Fig. 4. Students' enrollment

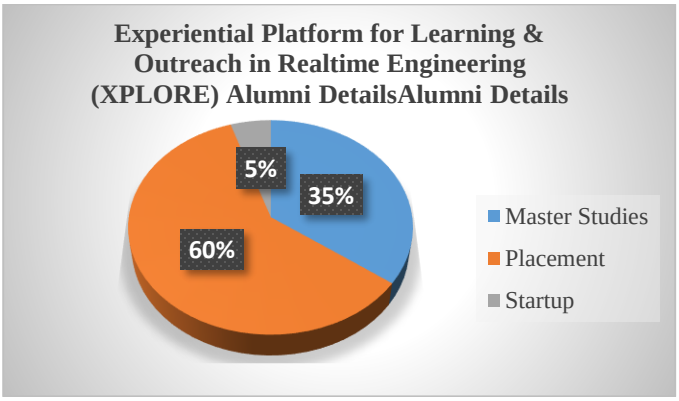

Fig.5. Alumni Details

Table.4 Feedback from the Alumni

Sl. No	**How XPLORE helped in pursuing MS/JOB/Startup/Business**
1	It helped me with communication skills, taking initiative to do projects, able to build new ideas, interact with different people, gain knowledge and many more.
2	EPICS gave the real time cases for working on projects that mattered. It also enables you to develop multidisciplinary skills that you would never do/learn otherwise. EWB help me improve on my interpersonal skills. One might not realize but it come handy when you are working in teams or under a timeline, in a professional work environment.
3	The community approach/problem statement step from epics process cycle helped me to get the job in manufacturing company as a BDA role

4	Developing my interpersonal skills, presentation strategies and leadership skills
5	It helped me improving my interpersonal skills and advancing my technical skills.
6	It helped me improving my interpersonal skills and advancing my technical skills
7	In such a short place I can't fit all my learning, but if I summarize my learnings, it could be- "Let the size of a problem be that of an ant or an elephant, a designed systematic approach can solve the problem effectively"
8	Every project I have contributed time in EPICS helped me in developing interest towards community
9	The design process is the most important aspect of EPICS that I've encountered, and it aided me in building the product.
10	Self-learning, doing projects based on community need solving complex problems, utilization of resources
11	In EPICS, we got a chance to do the real time projects which gave us in-sites of the real-world scenarios. We also got chance to learn new and trending technologies.

IV. CONCLUSION

The objective of our college is rather than studying engineering students should apply engineering to real time problems. From this service learning, students are more interested to work on projects by maintaining both academic learning goals and as well as contributing to society. Alumni feedback shows that service learning plays an important role in engineering to get a job or pursue higher education. While doing curriculum design by incorporating the design thinking process in service learning attains the maximum program outcome attributes which is not possible in traditional course design.

The future work is by introducing EPICS as a credit-based course for second- and third-year engineering students. Also incorporating project-based learning in all engineering courses (Aashish et.al, 2020).

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