Increasing Regional and Local Relevance of Engineering Institutions through Service Learning - A Case Study of the Unnat Bharat Abhiyan Program

Samyuktha Penta [1*], Rohit Kandakatla [2], Srinivas Depally [3], B. Lingam [4], Tuti Sandhya [5], A. Seshappa[6] , Ch. Chandana [7]

KG Reddy College of Engineering and Technology, Moinabad, Hyderabad, Telanagana.

Samyuktha.penta@gmail.com

Abstract— **Engineering education in India is undergoing a significant transformation with the introduction of innovative teaching methodologies such as Project-Based Learning (PBL). This pedagogical approach emphasizes practical, hands-on experiences where students engage with real-world problems, promoting deeper learning and skill development. Service-learning is one form of PBL where the problem in focus is situated within the community. This research paper presents a case study on how the integration of service learning in undergraduate engineering curricula could improve the regional and local significance of engineering institutions. The study focuses on the Unnat Bharat Abhiyan (UBA) initiative, launched by the Government of India, which aims to bridge the gap between higher educational institutions and rural communities by leveraging academic resources to address local challenges. In alignment with UBA's objectives, KG Reddy College of Engineering and Technology (KGRCET) established the Centre for Innovation and Social Transformation (CIST) to foster regional and local relevance in engineering education through community engagement and problem-solving. This study explores integrating service learning in undergraduate engineering, highlighting its challenges and benefits. Effective coordination among faculty, students, and community partners is crucial, emphasizing reciprocal community engagement. It also underscores the increased time commitment for faculty beyond teaching, proposing a model for Indian institutions to align service learning throughout the undergraduate engineering program and empower students in solving real-world village problems.**

Keywords—**Service Learning, Problem-based Learning, Engineering Design, Community Engagement, Sustainable Development Goals, Unnat Bharat Abhiyan.**

I. INTRODUCTION

(ZERO1 CoLabs et al., 2024) Transforming Indian engineering education: Emphasizing project-based and experiential learning. This research had the purpose for demonstrating how problem-based learning, integrated with particular focus on service learning. In recent years, there is a growing interest in using PBL in undergraduate engineering education in India, especially concerned with sustainable development (Kandakatla, R. et al., 2024). Singh, G., & Sharma, S, 2020 observed that Learning by Doing (PBL) strategy encourages students in practice learning and thereby enhance the understanding of real-world issues. Prior research has indicated that PBL can lead to the development of student's problem-solving skills (Asundi et al., 2021)and beliefs about sustainable development (Amashi, R et al., 2021)Students were required to perform community service as part of a sort of project-based learning (PBL) that was designed to reinforce their learning experiences.

This paper examined the possibility of service learning as a supplement to undergraduate engineering curriculum to make educational institutions more relevant to regional and local sustainability. The case study in the paper is based on the UBA program, an initiative by the Government of India that attempted to develop a strong connection between higher education institutes and the rural populations that were located in the surrounding area (Radhakrishnan et al., 2022). This was accomplished by utilizing academic resources to tackle problems that were occurring at the village level. A Center for Innovation and Social Transformation (CIST) was established at KG Reddy College of Engineering and Technology to lead the service-learning initiatives, one of them being the UBA program. Thus, by bringing out innovative ideas and encouraging community interaction, the aim of this center was the intensification of the impact of engineering education both at the regional and at the local level.

This paper sought to present the experiences that KGRCET has undergone in introducing service learning into its undergraduate engineering program. Since it involved effective coordination between teachers, students, and community partners, along with strategic collaborations, implementing the same proved challenging but rewarding (Bandi, S. et al., (2021), It was important to maintain a balanced approach that connected academic learning to community impact since this was the only way to ensure true community involvement. Other

considerations included the heavier time involvement needed of faculty members to teach service-learning courses. In terms of absorbing service learning into a four-year engineering degree, the model developed by this study would have implications for accrediting other similar learning institutions spread all over India. Significantly, it also underlined the need for teaching engineering students to recognize and overcome problems unique to a rural environment.

II. LITERATURE SURVEY

The design thinking process provides a structured approach for framing and solving real-life problems, progressing from problem identification to ideation and solution development. ((Dandge, D., & Desai, S., 2019) have highlighted the integration of project-based learning (PBL) across various educational levels in India to provide students with hands-on experience, aligning classroom tasks with practical applications. Prior research states that combining problem-based learning (PBL) with the service-learning empowers students to address real-world challenges using their technical skills (Singh, G., & Sharma, S, 2020) To better prepare students for industry demands, the authors included the Robocon competition, a prestigious event in India that enhances students' innovative abilities. This research provided data on how participating in the competition influenced students' learning outcomes. One study focused on teaching students the practical applications and implementation of AI technology, aiming to increase educational opportunities for female students in higher education. (Srikanth V. et al., 2020). recommend project-based learning (PBL) as a tool to bridge the gap between theoretical knowledge and practical application, particularly in architecture, which integrates both artistic and scientific elements. This study conducted a comprehensive analysis of previous studies on problem-based learning (PBL) and developed its hypothesis for the implementation of PBL.

This comprehensive analysis reviewed prior studies on PBL and hypothesized its effective implementation. According to Chen, meticulous planning and commitment are required at every stage of PBL implementation to achieve successful outcomes (Chen, J. et al., 2019) A study identified numerous challenges faced by educators. The program was designed to present a range of training sessions for engineering staff in order to foster an appreciation for the value of PBL as well as the competencies to apply it. The selected engineering personnel underwent through the following trainings communication skills, and practical training on hands on PBL implementation in their institutions. (Naik, S. et al., 2019) explains that the design thinking process provides a framework for executing project-based learning (PBL) and outlines the different stages and phases of the engineering process to achieve the goal, ultimately leading to the successful implementation of PBL. Following the design thinking process for student real-time projects has the potential to trigger the emotional aspects of empathy spontaneously.

(Singh, G., & Sharma, S, 2020)found that in the PBL approach, students learned the importance of teamwork, decision-making, leadership skills, and time management.

According to Naik, S. M., Bandi, S., & Mahajan, H (2020),. the design of the student's wallet depends on the needs of the target customer, and as such, the students understand how to work with the community partner, create a product, and find solutions. Emphasis of empathy as a multifaceted construct encompassing emotional and behavioral characteristics is credited to ((Batson, C. D. et al, 1997); empathy is central in design thinking as well as community engagement. Some of the experiences are likely to elicit the emotional component of empathy automatically.

(Kandakatla, R. et al., 2022) analysed Engineering students' perception on a UBA program in which they had to make a social visit to some selected villages to assess the unmet needs of the people. Since empathy was pointed out in the findings, the rural immersion assisted the students in appreciating community concerns. As central to the Unnat Bharat Abhiyan strategy, the efficacy of the interventions is maximised, while the social-economic relevance and the wastage of resources minimized. (Dustker, S. et al., 2021) defines service learning is a key component since students engineer with partner communities to co-design services as solutions for the community. Additionally, faculty members must ensure that students actively collaborate with community members and apply their course knowledge to create effective solutions. In service-learning activities, it's crucial to provide students with structured reflections that encourage them to evaluate the solutions they are creating, the process they are using, and the potential impact on the organization.

Reciprocity is the fourth important module of service-learning because it is believed that reciprocal relationships between community and academia should be constructed (Bandi, S. et al., 2023). According to there are three types of reciprocities in service learning: exchange, influential and generative. Each differs in advantages and is thus crucial in the formation of sustainable community partnerships. (Thompson, J. D., & Jesiek, B. K., 2017) categories the types of institution-community relations into transactional, cooperative, and communal; an attempt is made showing how power dynamics influences community engagement outcomes

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(Froyd, J. E., Wankat, P. C., & Smith, K. A, 2012) It is indeed true that during the last few decades, engineering education worldwide has experienced some great changes, and involvement in engineering design has largely outdone the technical knowledge originally emphasized in STEM subjects particularly in the field of engineering.(Felder, R. M., & Brent, R, 2023) observes that engineering students increasingly view the acquisition of problem-solving and design abilities as a vital objective. These skills allow them to use scientific knowledge to address real-world problems via a repetitive design approach. (Zhao, L., & Vernaza, K, 2023) acknowledges that service learning and community involvement are effective approaches for enhancing students' comprehension and application of design abilities. Consequently, we have established four principles that link to the pillar of designing learning outcomes. (Duckenfield, M., & Swanson, L, 1992) defines service-

learning as "an educational approach that can enhance academic and civic learning outcomes with the practice of service as a direct and active model of service within community based activities". The process offers exposure to the practical skills within the setting while delivering answers to the community's needs coupled with individual, cognitive as well as social growth. (Bixler, G., & Caldwell, J, 2014) assert that the Quality Assurance Standard demands integration soft skills into the curriculum "for engineering" (Anderson, J. B., & Hill, D., 2001) note that community service-learning initiatives aim to The community service-learning programs aimed to help students acquire variety of skills, knowledge and attitudes while meeting the requirements needed for academic evaluation. Service-learning pedagogy has cognitive effects.. (Bielefeldt et al., 2016) resolved that it achieves greater results in academic performance.

III. METHODOLOGY

The strategy of the KGRCET to implement the Project Based Learning (PBL) in Unnat Bharat Abhiyan (UBA) is to establish a structure of integrating the theoretical knowledge with the practical experience. This methodology emphasises student participation by giving challenges that can only be handled in their own contexts. The concept intends to build technical abilities as well as important soft skills such as critical thinking, team spirit, and empathy for women and children through direct work in rural regions. By integrating the course structure with experiential learning methods, KGRCET guarantees that students receive hands-on experience, preparing them for the multifarious difficulties in their professional engineering careers. This methodology promotes academic advancement and strengthens students' ability to make meaningful contributions to societal development and sustainability.

A. Implementation of UBA in Association with CIST at KGRCET

At KG Reddy College of Engineering and Technology (KGRCET), a Centre for Innovation and Social Transformation (CIST) was established to build a community of practice among faculty members interested in service-learning initiatives (Kandakatla, R., & Palla, A (2020), n.d.). CIST had actually initiated a major effort toward networking the Unnat Bharat Abhiyan (UBA) program into our academic system. This project is focused on the implementation of sustainable development solutions in cooperation with the community, with students participating in practice-based projects for solving the problems of communities. When the goals of UBA are incorporated with those of Problem-Based Learning (PBL), it is beneficial to improve the learning experience for students by providing them relevant situations which address real life situations in the community. It helps in closing the gap between knowledge and experience, faculties are able to help students understand their subject better while students get an opportunity to apply their education and make a difference in society (Kandakatla, R. et al., 2023). Our approach incorporates both structured and unstructured education procedures where the community is engaged, and such experiences are integrated into the curriculum to foster positive learning experiences.

B. Community Engagement and Collaboration

At KGRCET, community engagement is a crucial component of the implementation strategy. Through CIST, meaningful collaboration is fostered between students and local communities across various initiatives. One key initiative is village partnering, where KGRCET partners with nearby villages to serve as main centers for student projects. This includes a series of surveys to study socioeconomic profile and needs, as well as staying present in the villages with regular visits and interactions — building trust and rapport among community members who will eventually play an important role during project implementation.

However, implementing the program through CIST has not been without challenges. Initially, gaining the trust of the villagers was difficult, as skepticism existed about the program's benefits. Additionally, maintaining effective communication with the communities. Students also faced difficulties transitioning from classroom-based learning to solving real-world problems, often requiring them to adapt to new cultural contexts and environments. Despite these challenges, persistent engagement allowed for a deeper understanding of the communities' culture, traditions, food habits, and livelihood. This also helps us to identify the most pressing problems of the community and these problem statements will be given to the students for the innovative and unique solutions as their Problem Based Learning (PBL).

C. Strategic Planning and Goal Setting

The first action that was taken during the first stage by KGRCET when undertaking the process of designing UBA for PBL was the formulation of a workable plan together with the set objectives. To align the goals of Unnat Bharat Abhiyan program formulated for the institution, objectives need to be set out for the institutional goals formulated herein, with both output and outcome indicators that would highlight the positive impact on the communities as well as the specific gains for the students. CIST described below are the main goals of placing UBA in the curriculum:

• Foster a sense of social responsibility among students.
• Bridge the gap between theoretical knowledge and practical application.
• Address local community needs through sustainable solutions.
• Enhance student learning experiences through hands- on projects.

CIST had adopted a detailed plan including new courses introduction, community engagement activities, and continuous assessment and feedback mechanisms with the desire of reaching these goals.

D. Development of Curriculum and Courses

To align with the objectives of UBA through PBL, CIST introduced three courses Design Thinking and Sustainable Development, Social Innovation, and Engineering for Sustainable Development specifically designed to integrate community service and sustainable development into the

engineering curriculum:

"Design Thinking and Sustainable Development" course introduced to freshmen students in this course students will learn about the United Nations Sustainable Development Goals (SDGs) and strategies for reducing carbon footprints. This course focuses on the concept and steps of Design Thinking, with an emphasis on the importance of learning people's needs in society. The students are given semi-skeletal problem scenarios that enable them to approach the design thinking methodology in all developmental stages and learn through practice. As the course culminates, every student must design and implement 3D models or conceptual presentations of their solutions as we assess how they are able to translate the theories into reality in solving societal problems. This process followed by second course

The Social Innovation course in the second semester focuses the students on solving real-time problem based on the 'Gyanshodh' initiative and partner village identified from the problem statements. Some students use these villages to spend a lot of time conducting needs assessment within the communities thereby enhancing the empathy and practical nuances. Based on these ideas, they set up requirements and limitations; gather information; talk over creative ideas. Students then model and develop 3D models and or prototypes as Proof of Concept to affirm their creations. The last lecture is a presentation by each student, with their developed solutions and their relevance to the community presented

These two courses offered as compulsory and credit courses offered for first year engineering students.

Engineering for Sustainable Development guides students through the final stages of product development and implementation. Which is offered as open elective for all the engineering programs. It includes advanced prototyping, where students refine their prototypes based on feedback from the community where the product is to be deployed. The product will be developed and tested in a real-time environment ensuring sustainability. Last, but not the least, students perform an impact assessment by checking how their projects have affected community and get it documented (so that its success measure is recorded) to make more changes in future continuous improvement process towards Sustainable Development. The market-viable product can be patented and suitable for student entrepreneurship startups. As of this writing, 5 entrepreneurships were already registered and two projects deployed.

E. Monitoring, Evaluation, and Feedback

Though CIST at KGRCET there are strategies in place to monitor evaluate and a feedback mechanism by the introduction of specialized courses. These courses are designed with specific rubrics to assess student progress, ensuring a comprehensive evaluation of both technical and soft skills. CIST also adjusts from time to time the assessment evaluation criteria derived from the information obtained from communities about their needs. The refinements of the rubrics help in students' learning and creating community impact. Project based learning

integration into curriculum helps in effective achievement of curriculum objectives as well as meeting social needs.

F. Sustainability and Long-term Vision

CIST is working on various fronts to ensure the sustainability and long-term impact of the UBA Program through PBL. To sustain the solutions, training for capacity within the context of community member is required first. This was done in the form of outlining an approach to ensuring technical support for projects' maintenance and a set of community based mechanisms for checking on the sustainability of the projects. In addition, the reinforcement of the program development is expressed through the feedback and evaluation process that occurs on an ongoing basis.. To remain up-to-date the course should be regularly improved based on feedback and updated with new technology or approaches. After all, broadening reach is critical for the program's long-term success. Furthermore, engagement with supplementary firms, as well as additional financing and resources, was required to enrol even more villages/communities in the initiative.

UBA programme for PBL through CIST at KGRCET is a wholesome mode to add the social justice and sustainable development into engineering curriculum. CIST accomplishes this by strategic planning, curriculum development, community outreach and involvement of students followed by regular assessment that helps ensure valuable hands-on learning experiences occur for our students while benefitting local communities. This twofold focus on education and community development not only enriches the student's learning, but also allows society to be sustainable in a long term vision of PBL compliance with UBA objectives.

IV. APPROACH

KGRCET's adoption of Project-Based Learning (PBL) within the Unnat Bharat Abhiyan (UBA) initiative merges community-oriented experiential learning with engineering education, aiming to create a positive impact on local and regional communities by working directly with rural populations. However, during the initial phases of execution using the CIST method, various challenges arose due to the intricacies of active community participation. Students found that theoretical knowledge alone wasn't enough, as they faced difficulties adjusting to village life and grappling with real-world issues without hands-on experience. Additionally, discrepancies between academic timetables and village schedules further complicated sustained involvement, making it challenging to build trust and maintain projects. At first, community members were reluctant, needing more time to gain confidence in the students' dedication before engaging cooperatively. These challenges highlighted the need for a refined approach to ensure meaningful, long-term community benefit and successful PBL integration.

A. Building Trust: Establishing Trust and Credibility with Village Communities

In the very beginning when CIST-based project building was initiated, gaining trust and credibility with the community was

a challenge. Villagers, who had become suspicious of 'outsiders' because of past experiences of promises and short- term interventions, were skeptical about the intent of these students and what tangible differences they could make. Earning trust is a process that hinges on reliable engagement. These efforts required a delicate balance of humility, patience, and perseverance. Customary practices, language difficulties, and a variety of cultural subtleties have sometimes been misunderstood and have strengthened doubts among the villagers. The barrier was overcome by collaboration between students and CIST instructors, who established a team with a common desire to learn and incorporate into community activities. In most instances, Team had to venture way out of their comfort zones by involvement in the activities like Gramasabhas, Harithaharam, Gyanshod, Swatch Bharath Programs and some used their influence to advocate for the student's goals, which helped build trust.

Gradually, through actions such as participation in community gatherings, respect for traditions, and attendance to meaningful responsibilities, the perception of the people began to change. Slowly but surely, the locals began to realize that these students would not give up, and the achievements, though incremental, served to transform their initial doubt into cautious hope and, lastly, an alliance of cooperation. This meant that gaining their trust was not only about convincing these villagers of the good intentions of the students, but also of laying the ground for a relationship of mutual respect and reciprocity central to the collaborative efforts that would ensure the success of one of the CIST Project.

B. Student Engagement: Ensuring All Teams Are Equally Motivated

At KGRCET, approximately one-third of students showcased a strong empathy for the community and participated actively in the community's problem-solving which leads to increased commitment levels. However, depending on each student's commitment and mindset, monitoring students and productivity was the biggest challenge in solving pressing community issues. The students should have a deep connection with the community's well-being along with academics in order to fully engage in community-driven projects. Initially, students seem interested in the course- but slowly lose interest as the experience students face during the community engagement is completely stranger than reality of personal life.

KGRCET has introduced several effective strategies to sustain students' motivation and commitment. Many reflection activities have been incorporated in the project design where the students could reflect on their learning process and recognize how their efforts affect the community towards sustainable development which improves their commitment towards community engagement and better understanding of community needs. The creation of a supportive and unified team atmosphere helps the students to discuss or share any kind of experiences and difficulties within the team of classmates. The faculty and professional mentors are also involved in teaching and guiding them to overcome the challenges being faced in community engagement.

KGRCET also conducts competitions like hackathons and innovation fund pitches where they can present their concepts and gain the support from institute to make their sustainable products for community deployment. These are also helpful in sustaining their motivation toward community engagement. Celebrating milestones and accomplishments ensures students stay committed and motivated to their projects throughout the process of converting their ideas into real solutions. The competitions are crucial and act as the venue for sustaining student   motivation and commitment   towards   community engagement.

C. Interaction Barriers: Facilitating Effective Communication and Understanding Cultural Nuances

It was tricky but vital to facilitate easy communication and being mindful of the cultural nuance between the students and the villagers, which is difficult compared to the identification of the problem and building of empathy in the CIST approach. While starting the project, we could note many obstacles in communication and understanding between the team members. Challenges occurred mainly because of the language factor; most students did not know the local dialects, and it was hard to have the first conversations in some cases, which many times set up misconceptions. Students—being often not familiar with the rural lifestyle and the myths that go with it—operated from an altogether cultural context different from the one in which the villagers operated, and cultural difference didn't stop at the linguistic level. The challenge was catered to by cultural and meant-to-be preparatory training that was done for the students and faculty before going to the village. It is a curriculum that involves language and culture and role-playing by use of life scenarios. Therefore, this meant that in addition to knowing what differences exist between cultures, an analysis of each other's cultures had to be translated by the community liaison who was chosen from the student's area of residence because these people helped translate culture. Also conveyed were points of view held within a community on specific issues; suggestions on how such matters should be brought up and handled with care, respect, and empathy were included in order not only to close the gap but also to ensure effective communication. Another tip was about active listening during which students were encouraged not just to pay attention but also to show genuine interest as well as value villagers' stories and experiences: appreciating them for sharing.

V. RESULTS AND DISCUSSION

Students and faculty have worked with partner villages to identify critical issues and, through the framework of design thinking, developed innovative solutions proposed to funding agencies and secured approximately ₹2 crores in funding. Prototypes have been designed and tested in real-world contexts where two projects are successfully deployed in communities. Five community projects started as a mere idea and have turned into successful enterprises founded by students and faculty. This, therefore, is an initiative where design thinking and collaboration through this model for PBL really works out in

bringing about meaningful change and entrepreneurship. After several struggles and difficulties upon the establishment of the center, that trust has been nurtured by multiple visits to the community such that the community started supporting it. Gradual increase in the number of students attending although not up to expectations. However, the experience has proven that if carried out repeatedly to the interaction barrier and made familiar about the culture of the community, trust can be built. With time and continued efforts, this center will be able to see even more growth as the community becomes more engaged.

TABLE I
FUNDED PROJECTS

Funded Project	FUNDED BY	Amount Funded
Low cost, high speed solar based automated incense stick-making machine	TSIC	1,00,000
IoT-Based Cooling Chamber	TSIC	1,00,000
Grim Reaper Binder	TSIC	1,00,000
Hand lever-based tapioca plant uprooter	NIF	58,000
Multi-Tool Agricultural Implement	NIF	75,000
Empowering ST women by upgrading traditional Banjara's Embroidery skills and improving the livelihood of the rural ST Community of Kamareddy District by standardizing Mobile Milk storage facility	DST-SEED/TITE	1,47,69,881
Enhancing the Livelihood of ST Farmer Community in Bheelyanaik Thanda by Development of Post-harvest Preservation Ecosystem for horticultural crops and flowers.	DST-SEED/TITE	39,70,107
Design of Automated Incense Stick Making Machine Low-cost Solution to Uplift Farmers Cultivating Rose Flowers in Sriram Nagar Village	MSME	4,00,000
Development of Menstrual Disposal Machine	Nidhi Prayas	4,00,000
Integrated Smart Solar Fencing with Blue lights and Sound Repellent to Protect the Crop from Wild Boars, Monkeys, Peacocks and Parrots	UBA	1,00,000
Novel approach for detecting dangerous species (Snakes and other harmful insects) and prevent Human-species collision to improve agricultural productivity	UBA	1,00,000

TABLE II
COMPLETED PROJECTS

S. No	Project	Beneficiary Village
1	Low cost, high speed solar based automated incense stick-making machine	Sriram Nagar
2	IoT-Based Cooling Chamber	Surangal
3	Grim Reaper Binder	Surangal
4	Hand lever-based tapioca plant uprooter	Shadhnagar
5	Multi-Tool Agricultural Implement	Kammadanam

TABLE III
ONGOING PROJECTS

Project	Beneficiary Village	Status of Project
Paddy Grain Drier	Appareddy Guda	Prototyping
Protection of Crops from Wild Boars	Tholkatta	Prototyping
Weed plucker	Bakaram	Prototyping
Farmicon (App): F2C to remove middlemen	Nakkalapally	Prototyping
Mobile Milk storage vehicle	Yethbarpally	Prototyping
Child tracking and tracing system from bore well	BVIC	Prototyping
Smart Sweeping Tool	KGRCET	Prototyping
Tongue-Controlled Wheel Chair	NPDO	Prototyping
Smart Dustbin	Chilkur	Prototyping
ST Women Empowerment by making Traditional Banjara clothes and accessories	Banjepally village, Kamareddy District	Prototyping

The implementation of Project-Based Learning (PBL) within the Unnat Bharat Abhiyan (UBA) framework at KGRCET has demonstrated significant and measurable outcomes, showcasing the effectiveness of integrating engineering education with community-oriented projects. One prominent example of this approach is the development and deployment of the Automatic Incense Stick Making Machine. This initiative not only strengthened local women but also supported the establishment of a circular economy, showcasing the practical and transformative effects of project-based learning.

A. Linking Results to Educational Objectives

The incense stick-making venture's success provides an insight into how Project-Based Learning fits into the larger educational goals of KGRCET. Students were actively engaged with the community, learning the practical aspects of the product's design and production. Further, they acquired soft skills in collaboration, analytical reasoning and cultural empathy. Through cooperation and interaction with community members, students developed empathy and practical skills, which are beneficial factors for their career and growth as individuals.

B. Deeper Analysis and Challenges Overcome

In the initial stages of the project, several challenges were encountered. The major problems originated from the following areas: One of them was that it was a continuous process and the commitment of the faculty to solve the problem within the community. This shows that there is a lot of capacity building activities that are needed to prepare faculty for service-learning programmes, since their participation is not only limited to academia, but extending to the community projects as well As such, it becomes imperative for institutions to identify and come up with ways of maintaining Faculty engagement in service-learning programmes (Kandakatla, R. et al., 2024). The other challenge was to locate prospective female candidates in the community who would not only be motivated to learn and

manage the newly introduced incense stick-making machine for them to have sustainable source of income but equally committed to do so. Also, identification of a favorable placement for the machine meant having to look for an area that was safe and easily accessible. The means by ascertaining flowers and developing a drying structure were complex, but gaining the consumer trust was a challenge since the villagers did not believe in the products they were selling. Marketing was also challenging because the women had no sale experience. To overcome these challenges, a training program which included all facets of product usage, cultural awareness, and working standard methods were imparted by KGRCET. Because the program covered the practical group workshops and role-playing sessions, the women were in a better position to effectively coordinate the production and sales aspects and thereby create a viable business model.

C. Project Impact and Community Engagement

Project-Based Learning initiative, as part of the UBA framework was very positively welcomed in the local community. Through the establishment of a self-help group (SHG), four women made incense sticks from flower powder available in their surroundings. The initiative not only created economic opportunities for these women, but also benefited nearby farmers who now had a way to sell their flowers in the village. The collaboration invigorated the village economy, setting up a manufacturing system in line with neoliberal ideals as exemplified by PBL and working towards sustainable development where agriculture connects back to production for local livelihoods.

D. Broadening Impact through Hackathons and Competitions

To further enhance student motivation and expand the impact of such initiatives, KGRCET organized hackathons and innovation fund pitch competitions. These events provided students with a platform to present their ideas, receive mentorship, and access college support for product development. This structured support encouraged creativity, translating ideas into practical solutions, and further reinforcing student commitment and enthusiasm. Celebrating small milestones and achievements also proved effective in maintaining motivation, fostering a sense of community, and ensuring sustained engagement throughout the program.

VI. CONCLUSION

Centre for Innovation and Social Transformation, KG Reddy College of Engineering and Technology PBL was effectively implemented in two curriculum courses, and in multiple ways, benefited the staff, students and partners from the community. Efforts were largely rewarded by a corpus of almost ₹2 crores, and funding comes in from different agencies. Five of the community projects developed as part of this initiative have matured into successful enterprises. Students have been provided with Project-Based Learning and resulted in some notables increments in student engagement, practical experience, and more in-depth problem-solving. More importantly, they have honed their ability towards greater empathy, listened better, and reached a deeper understanding of social issues. Thus, it has emphasized the ability of PBL to support sustainable development and contribute to improved livelihoods among rural communities. The success of the Automatic Incense Stick Making Machine project highlights the transformative potential of PBL at KGRCET. By overcoming cultural and logistical challenges and aligning educational practices with community needs, KGRCET has created a model that not only benefits students by developing critical skills but also positively impacts rural communities through sustainable development.

REFERENCES

Amashi, R., Joshi, G., & Kandakatla, R. (2021). Influence of Sustainable Development Module on the Values and Beliefs of First-Year Students in Undergraduate Engineering Education. Journal of Engineering Education Transformations.

Anderson, J. B., & Hill, D. (2001). Principles of good practice for service-learning in preservice teacher education.

Asundi, M., Kandakatla, R., & Joshi, G. (2021). Impact of Modelling and Simulation in Solving Complex Problems in First Year Engineering Course.

Bandi, S., Dustker, S. M., Kandakatla, R., Oakes, W., & Kotabagi, S. (2021). (n.d.). Enablers and Barriers to Implementing Service-Learning in India – A Case-Study of Two Service-learning Models Integrated into Undergraduate Engineering Curriculum. 2021 World Engineering Education Forum/Global Engineering Deans Council.

Bandi, S. et al. (2023). A Systematic Literature Review on Faculty Learning in Service-Learning. 2023 IEEE Global Engineering Education Conference (EDUCON).

Batson, C. D. et al. (1997). Perspective taking: Imagining how another feels versus imagining how you would feel. Personality and Social Psychology Bulletin.

Bielefeldt et al. (2016). Contributions of learning through service to the ethics education of engineering students.

Bixler, G., & Caldwell, J. (2014). Humanitarian engineering at The Ohio State University: Lessons learned in enriching education while helping people.

Chen, J. et al. (2019). Aalborg UNESCO Certificate: Staff development and challenges in PBL training programme. Journal of Engineering Education Transformations.

Dandge, D., & Desai, S. (2019). Adding elements of competition to multi-disciplinary PBL: Case study of Robocon competition.

Duckenfield, M., & Swanson, L. (1992). Service Learning: Meeting the Needs of Youth at Risk. A Dropout Prevention Research Report.

Dustker, S. et al. (2021). Role of reflection in service learning-based engineering programs: A cross-cultural exploratory and comparative case study in India and the USA.

Felder, R. M., & Brent, R. (2023). Designing and teaching courses to satisfy the ABET engineering criteria.

Froyd, J. E., Wankat, P. C., & Smith, K. A. (2012). Five major shifts in 100 years of engineering education. Proceedings of the IEEE.

Kandakatla, R., & Palla, A (2020). (n.d.). Role of Community of Practice (CoP) to Facilitate Change in STEM Instructional Practices through Faculty Development Programs. 2020 IFEES World Engineering Education Forum—Global Engineering Deans Council (WEEF-GEDC).

Kandakatla, R. et al. (2022). Role of empathy to identify unmet needs in indian villages through service learning program-a case of the unnat bharat abhiyan program.

Kandakatla, R. et al. (2023). Achieving Indian National Board of Accreditation Engineering Graduate Attributes through Project-Based Service-Learning: Conceptual Analysis. International Journal for Service Learning in Engineering, Humanitarian Engineering and Social Entrepreneurship.

Kandakatla, R. et al. (2024). Exploring Motivational Factors for Faculty Engagement in Service-Learning Courses: Perspectives from Indian Undergraduate Engineering. Research in Engineering Education Symposium.

Kandakatla, R. et al. (2024). Post-Colonial Agenda for Engineering Education Research in India.

Naik, S. et al. (2019). Implementing PBL to enhance technical knowledge through design thinking process. Journal of Engineering Education Transformations.

Naik, S. M., Bandi, S., & Mahajan, H. (2020). Introducing service learning to undergraduate engineering students through EPICS. Procedia Computer Science.

Radhakrishnan. (2022). Participatory Approach to Engineering Service Learning Programs—Quality Framework for the Implementation of Unnat Bharat Abhiyan Program in Indian Engineering Institution.

Singh, G., & Sharma, S. (2020). Service learning in engineering education: Integrating PBL for sustainable development in India. International Journal of Engineering Pedagogy.

Srikanth V. et al. (2020). A comparative pedagogical approach in vernacular architecture: Theoretical method vs. PBL method.

Thompson, J. D., & Jesiek, B. K. (2017). Transactional, cooperative, and communal: Relating the structure of engineering engagement programs with the nature of partnerships. Michigan Journal of Community Service Learning.

ZERO1 CoLabs et al. (2024). Transforming Indian engineering education: Emphasizing project-based and experiential learning.

Zhao, L., & Vernaza, K. (2023). Teaching first-year engineering students engineering design process and problem-solving through service learning projects.