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Enhancing Different Skill Sets of Engineering Students through Project based Interdisciplinary Approach - A Case Study of Azadi Ka Amrit Mahotsav Project

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***Abstract*— Technology and the availability of information have shifted the focus of researchers of engineering education towards experiential learning, a three-dimensional learning approach for students' engagement and development. The MIT report on The Global State of the Art in engineering education also shows the importance of experiential learning as a pedagogical tool for engineering education. Many researchers have discussed how this pedagogical tool is used to develop various skills like leadership, decision-making, teamwork etc. However, how experiential learning is mapped with learning outcomes and strategy for their assessment is yet not developed and discussed in depth. This research paper discusses the learning of students while working on the project undertaken under Mission Amrit Sarovar- Jal Dharohar Sanrakshan-2022 as part of the Azadi Ka Amrit Mahotsav initiative by the Government of India to rejuvenate ponds, advocating sustainability, and enhancement of analytical skills. The paper also discusses how effectively various learning aspects and understanding of all participating students would be mapped with required skill sets. The survey instrument has captured the detailed response to do an analysis of learning and later on, that has been mapped with required skill sets. Moreover, activities were designed with a perspective to provide experiential learning for students to engage with relevant officials, enhancing their communication and presentation skills. This also facilitates interdisciplinary collaboration in addressing environmental challenges and conserving valuable natural resources. The findings provide a direction for field-academic scenarios with practical knowledge and foster students' ability to contribute to real-world problems.**

***Keywords*— Rejuvenation, Engineering Education, experiential learning, engineers' skill set, field academic, real-world problem**

I. INTRODUCTION

BACKGROUND information on the shift towards experiential learning in engineering education. Experiential learning is an educational approach that focuses on practical, hands-on experiences to acquire knowledge and skills. In recent years, there has been a noticeable trend in engineering education towards incorporating experiential learning methodologies. This shift is driven by various factors, including advancements in technology, evolving industry needs, and a growing recognition of the limitations of traditional classroom instruction.

One of the main drivers behind the adoption of experiential learning in engineering education is the rapid advancement of technology. The availability of advanced tools and resources has made it easier for students to engage in real-world problem-solving and project-based learning. With the use of cutting-edge software, simulation tools, and prototyping equipment, engineering students can gain practical experience and develop skills that directly apply to their future careers. Another factor contributing to the shift towards experiential learning is the changing nature of the engineering industry. Employers' increasingly seek graduates who not only possess technical knowledge but also have the ability to apply that knowledge in real-world situations. Experiential learning provides students with opportunities to work on authentic engineering projects, collaborate with industry professionals, and navigate real-life challenges. These experiences help develop critical thinking,

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problem-solving, and teamwork skills, which are highly valued in the engineering profession.

Furthermore, Selina Mae Quibrantar, Obidimma Ezezika (2023) has shown that experiential learning enhances student engagement and motivation. By actively participating in hands-on projects and practical activities, students become more invested in their learning process. Experiential learning instills a sense of ownership and responsibility as students take on active roles and witness the impact of their work. This heightened engagement can lead to a deeper understanding of engineering concepts and better retention of knowledge.

Influential reports and studies, such as Graham (2018), in MIT report on the global state of the art in engineering education, have underscored the importance of experiential learning as a pedagogical tool. These reports advocate for a shift from passive, lecture-based instruction towards active learning approaches that promote student engagement and skill development. In summary, the integration of experiential learning in engineering education responds to the need for providing students with practical skills, preparing them for real-world challenges, and increasing their engagement and motivation. By incorporating hands-on experiences, project-based learning, and industry collaborations, educators aim to bridge the gap between theory and practice, ultimately producing competent and well-rounded engineering professionals. Overall, the MIT report on the global state of the art in engineering education underscores the importance of experiential learning in engineering education. it emphasizes the need to prioritize active learning approaches that foster practical experience, critical thinking, and collaboration to produce well-rounded and competent engineering professionals.

There is a knowledge gap identified in the abstract concerning the mapping of experiential learning with learning outcomes and assessment strategies. While the value of experiential learning in engineering education is acknowledged, there is a lack of in-depth exploration and discussion on how to effectively align and assess the learning outcomes associated with experiential learning activities.

María Teresa Del Val Núñez, Fernando Javier Crecente Romero, Rafael Castaño Sánchez and Alba Yela Aránega (2018) have discussed the development of skills like leadership, decision-making, and teamwork through experiential learning, there is a need for further examination and understanding of how experiential learning can be mapped to specific learning outcomes and how to assess those outcomes appropriately. To analyze the learning outcomes and their alignment with course outcomes, the researchers employed a survey instrument to collect detailed responses for subsequent analysis. This methodology provides a framework for assessing the effectiveness of experiential learning activities and their alignment with the intended learning outcomes. By addressing this knowledge gap, the research paper contributes to the development of strategies for effectively mapping experiential learning with learning outcomes and assessment methods in engineering education. This will offer educators valuable insights to design and implement experiential learning activities that align with desired learning outcomes and foster students' development in various areas.

II. Literature Review

I. O. Pappas, S. Mora, L. Jaccheri and P. Mikalef (2018)have discussed on experiential learning fosters active engagement and participation, leading to enhanced student motivation, interest, and retention of knowledge. SlaŁana ŽivkoviŁ (2016) promotes the development of critical thinking, problem-solving, and decision-making skills, which are essential for engineering professionals. Marshall, M. M., Carrano, A. L., & Dannels, W. A. (2016) carried out experimental work to provide opportunities for the students to bridge the gap between theory and practice by applying concepts in real-world scenarios. It encourages teamwork, communication, and collaboration skills, which are vital for successful engineering projects.

Experiential learning has gained considerable attention in the field of engineering education, and numerous studies have explored its effectiveness in developing skills such as leadership, decision-making, and teamwork

Leadership Development: Research by Moraes, T. M., Guedes, L. G. D. R., & Root, S. (2019) demonstrated that experiential learning activities, such as team-based projects and simulations, effectively enhance leadership skills among engineering students. These activities promote self-reflection, encourage students to take initiative, and provide opportunities for practicing leadership behaviors. The study emphasized the importance of debriefing and reflection sessions in facilitating the transfer of leadership skills from experiential activities to real-world contexts.

Teamwork and Collaboration: Numerous studies have emphasized the role of experiential learning in fostering teamwork and collaboration skills. For instance, Kruse et al. (2020) conducted a study exploring the impact of project-based learning on engineering students' teamwork skills. The findings revealed that experiential learning activities, coupled with structured reflection and feedback, significantly improved students' ability to collaborate effectively, communicate, and solve problems in a team setting.

Overall, the existing literature supports the notion that experiential learning in engineering education is instrumental in developing skills such as leadership, decision-making, and teamwork. Kong, Yangtao. (2021) had discussed the experiential learning can motivate students more as compared to classroom studies. Through hands-on experiences, students have the opportunity to engage in real-world problem-solving, collaborative projects, and simulations, which foster the acquisition and application of these skills. Additionally, reflective practices and debriefing sessions play a vital role in connecting experiential learning to the development of these skills, enabling students to transfer their learning to practical engineering contexts.

It is important to note that while the existing literature provides valuable insights, there is still room for further research to explore the specific mechanisms and optimal approaches for developing leadership, decision-making, and

teamwork skills through experiential learning in engineering education. Future studies can focus on the long-term impact of experiential learning activities on skill development, the influence of contextual factors, and the most effective instructional strategies for maximizing skill acquisition in engineering students.

III. Research Objectives

The research objectives of this study are as follows:

- To evaluate the effectiveness of experiential learning activities in developing leadership, decision-making, and teamwork skills in engineering education.
- to understand the perceptions and experiences of students regarding the impact of experiential learning on skill development.
- to analyze the alignment between the collected data from experiential learning activities and desired skill sets.

IV. Methodology

The research employs a survey instrument with structured and open-ended questions to gather detailed responses from students. Data collected, including survey responses, undergoes analysis using techniques such as qualitative coding, quantitative analysis, and thematic analysis. The study also involves mapping the acquired understanding and skills from the project to the intended course outcomes, and assessing the alignment and effectiveness of experiential learning in achieving educational goals. The findings will contribute insights for refining future experiential learning initiatives in engineering education.

V. Data Analysis and Mapping:

The collected data was analyzed using a mixed-methods approach. Quantitative data from the closed-ended questions were analyzed using statistical techniques such as descriptive statistics and inferential analysis. Descriptive statistics provided a summary of participants' responses, while inferential analysis allowed for the examination of relationships between variables. The qualitative data from the open-ended questions were analyzed through thematic analysis. This involved identifying recurring themes and patterns in participants' responses. The qualitative analysis aimed to provide a deeper understanding of participants' experiences and perceptions related to the development of leadership, decision-making, and teamwork skills.

To analyze the collected data, a systematic process was followed. The project was categorized based on the relevant skill areas, such as leadership, decision-making, and teamwork.

VI. Project Description:

The Prime Minister launched a new Mission Amrit -Sarovar on 24th April 2022. The objective of the mission is to conserve water for the future. The Mission is aimed at developing and rejuvenating various water bodies of the country as a part of the celebration of Azadi ka Amrit Mahotsav. As a part of the internship project, B.H.Gardi College of Engineering and Technology which is situated in Rajkot, Gujarat has been allotted Veri Lake lies at Gondal in Rajkot District of Gujarat. The lake is home to flamingoes and other migratory birds such as cranes, pelicans, spoonbills, black, white, and glossy ibises. It is an ideal place for the bird watchers. Bhuvaneswari Temple and Shri Swaminarayan Mandir are the nearby attractions.

TABLE I
Testing Results of Veri Pond Water Sample

Test parameter	Units	Result
PH	--------	7.66
Turbidity	NTU	37.9
Total Suspended Solids	Mg/L	145
Total Hardness	Mg/L	125
Alkalinity	Mg/L	116.67
Acidity	Mg/L	30
Total Dissolved Solids	Mg/L	179.67
Conductivity	M/S	0.406
Residual Chlorine	Mg/L	Nill
Acidity	--------	7.66

The project aims to beautify ponds and promote sustainability by undertaking various initiatives. It involves rejuvenating and developing ponds in different locations, focusing on enhancing their aesthetic appeal and ecological value. The project also emphasizes raising awareness about the importance of ponds in maintaining a healthy environment and conserving water resources.

A. Fostering Analytical Skills and Learning Aspects:

The project provides an opportunity for participating students to develop their analytical skills by understanding the ecological significance of ponds and identifying ways to improve their condition. They learned about the impact of human activities on water bodies and explore solutions for sustainable management. Analyzing data related to water quality, biodiversity, and environmental challenges will enhance their critical thinking abilities.

Based on observations of students and faculty team, Various Proposals and suggestions have been made in order to achieve The Amrit Sarovar Mission’s goal that is to revitalize ponds, make them more appealing to tourists, beautify them, give lighting around the pond, plant trees around the pond, maintain cleanliness, and raise public awareness about the importance of ponds.

B. Design of Activities for Experiential Learning:

The project incorporates activities that offer experiential learning opportunities. Participants may engage in activities such as water testing (Table-I), biodiversity surveys, and cleaning drives to gain hands-on experience. These activities

Fig. 1. Proposed Masterplan for VERI pond,Gondal, Gujarat

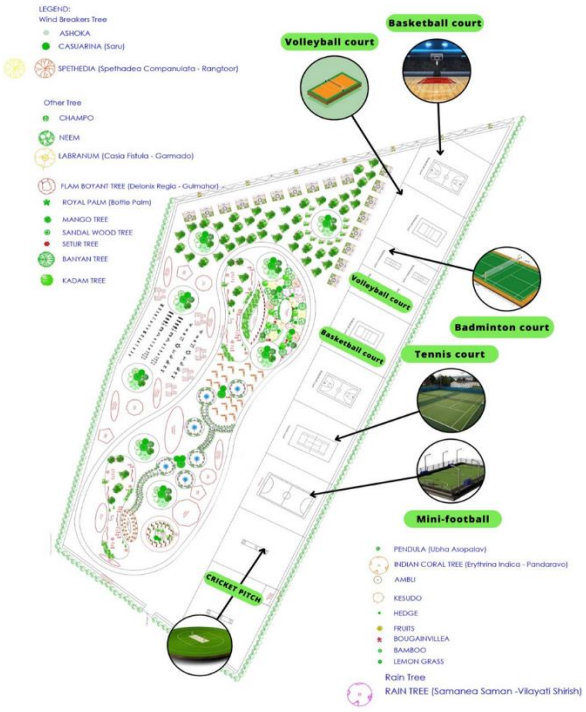


Fig. 2. Design for Masterplan

allow them to connect with the environment, understand the practical aspects of conservation, and foster a sense of responsibility towards natural resources.

C. Enhancing Communication and Presentation Skills:

The project also focuses on developing effective communication and presentation skills (Fig-1). Participants were encouraged to communicate their findings, project progress, and recommendations through presentations (fig.2), reports, or public outreach initiatives by interviewing the village peoples surrounding the area. This enables them to articulate their ideas, share knowledge, and create awareness among different stakeholders.

D. Interdisciplinary Collaboration for Environmental Challenges:

The project highlights the importance of interdisciplinary collaboration in addressing environmental challenges. Participants from various fields such as Civil, Mechanical and Computer engineering students have worked together to develop comprehensive solutions. This collaborative approach encourages the exchange of diverse perspectives, fostering creativity and innovation in tackling complex environmental issues.

E. Conserving Natural Resources:

The core objective of the project is to conserve natural resources, specifically water. By rejuvenating ponds, implementing sustainable practices, and promoting water conservation measures, the project aims to create a positive impact on the local ecosystem. Participants will gain a deeper understanding of the interconnections between water resources, biodiversity, and human well-being. Local around the pond can earn money by making it a tourist attraction.

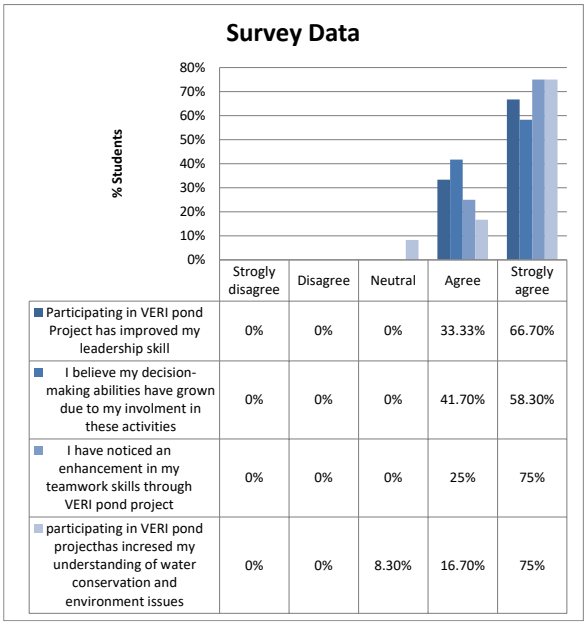
Overall, the project combines elements of environmental education, experiential learning, interdisciplinary collaboration, and sustainability to beautify ponds and advocate for the conservation of natural resources. It empowers participants with analytical, communication, and problem-solving skills while nurturing a sense of environmental responsibility.

VII. Findings and Analysis

The collected data from the survey instrument provides valuable insights into the project's outcomes and its alignment with the desired skill sets. The following findings and analysis shed light on the project's effectiveness and implications:

A. Learning Outcomes and Mapping:

The collected data clearly indicates that the students enjoyed working with one another which implies their positive engagement to the project. Students were assigned to different teams to complete certain tasks in stipulated time with the leader of the group. As per the survey, 66.7% students strongly agreed on the skill development and 33.3% were agreed on skill development, (fig-3) which indicates the development of leadership skills in the students. Apart from this they have shown improvement in decision making abilities, enhancement in team work, and clearly understood the core learning that is water conservation.



	Strogly disagree	Disagree	Neutral	Agree	Strogly agree
Participating in VERI pond Project has improved my leadership skill	0%	0%	0%	33.33%	66.70%
I believe my decision-making abilities have grown due to my involment in these activities	0%	0%	0%	41.70%	58.30%
I have noticed an enhancement in my teamwork skills through VERI pond project	0%	0%	0%	25%	75%
participating in VERI pond projecthas incresed my understanding of water conservation and environment issues	0%	0%	8.30%	16.70%	75%

Fig. 3. Chart of Survey data

B. Effectiveness of Experiential Learning:

The analysis of collected data has assessed the effectiveness of experiential learning activities implemented in the project. From the open-ended question we got feedback from the students suggesting that real world problem solving and data collection on field trips with different people gathering with students from other branches leads them to get a very engaging atmosphere for learning something new. It has provided evidence of how hands-on experiences, such as water testing or biodiversity surveys, have enhanced students' understanding and application of concepts. The findings also reveal the impact of experiential learning on communication and presentation skills, as well as the development of analytical thinking abilities. Because as a part of the project students have to prepare posters and present the poster to the local people for educating them about the water body and water conservation.

C. Alignment with Sustainability Goal:

The findings can be evaluated in the context of sustainability goals and environmental conservation. By analyzing the data, it becomes possible to understand the project's contributions towards achieving sustainable outcomes, such as improvements in water quality, conservation of biodiversity, or reduction in water usage. These findings can provide valuable insights for future projects and initiatives aimed at addressing environmental challenges

D. Suggestions were offered by the students for improving VERI pond:

- Safety point of view, railing with narrow space is needed
- Information about the lake needs to be displayed on the site as the site has authentic historical value
- Water conservation can be possible with some help from organizations like SADBHAVNA mission for tree plantation surrounding the lake.
- We can reduce the evaporation and generate electricity with the help of a solar panel roof system.
- This place can be developed as recreational activity zone for the people of Gondal, master plan is provided in this report
- from the results obtained from the water test, the water is not ideally suitable for drinking purposes. Water treatment units can be design on downstream side
- for emergency inspection of the structure during the flood, one road needs to be constructed on the downstream side.
- Earthen dam can be improved structurally by providing geocell reinforcement to the soil.
- as per the discussion with in charge engineer Er. Jaydeep kosiya, assistant engineer, irrigation department, the old gates of the dam is semi-automatic, which need to be improved the design consideration
- This Lake needs to be developed as tourist place with some basic amenities, such design is provided in this project

VII. CONCLUSION

The research findings highlight the positive outcomes and implications of incorporating experiential learning activities in engineering education. The study revealed that these activities fostered student engagement, critical thinking skills, and a deeper understanding of sustainable development principles. Participants benefited from hands-on experiences, such as water testing and biodiversity surveys, which enhanced their knowledge acquisition and practical application of concepts.

The research underscores the significance of experiential learning in engineering education. It promotes active learning, bridges the gap between theory and practice, and cultivates essential skills for future engineers, such as problem-solving, communication, and interdisciplinary collaboration. The findings emphasize that experiential learning provides a holistic educational experience that goes beyond classroom-based instruction

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REFERENCES

Selina Mae Quibrantar, Obidimma Ezezika (2023).Evaluating student engagement and experiential learning in global classrooms: A qualitative case study. Studies in Educational Evaluation, Volume 78.

Graham, R. (2018). The global state of the art in engineering education. Massachusetts Institute of Technology (MIT) Report, Massachusetts, USA.

Núñez, M. T. D. V., Romero, F. J. C., Sánchez, R. C., & Aránega, A. Y. (2018). Developing management skills through experiential learning: the effectiveness of outdoor training and mindfulness. European Journal of International Management, 12(5-6), 676-694.

I. O. Pappas, S. Mora, L. Jaccheri and P. Mikalef, (2018) "Empowering social innovators through collaborative and experiential learning," IEEE Global Engineering Education Conference (EDUCON), Santa Cruz de Tenerife, Spain, 2018, pp. 1080-1088.

SlaŁana ŽivkoviŁ,(2016) "A Model of Critical Thinking as an Important Attribute for Success in the 21st Century" Procedia - Social and Behavioral Sciences, Volume 232, 14 October, Pages 102-108.

Marshall, M. M., Carrano, A. L., & Dannels, W. A. (2016). Adapting experiential learning to develop problem-solving skills in deaf and hard-of-hearing engineering students. Journal of deaf studies and deaf education, 21(4), 403-415.

Moraes, T. M., Guedes, L. G. D. R., & Root, S. (2019). Leadership development of technology students through experiential learning. International Journal on Alive Engineering Education, 6, 63-76.

Bahnson, A., Wilcox, J., Kruse, J., & Schou, T. (2020). From surviving to thriving. The Science Teacher, 87(7), 28-34.

Kong, Yangtao. (2021). the Role of Experiential Learning on Students' Motivation and Classroom Engagement. Frontiers in Psychology. 12. 771272. 10.3389/fpsyg.2021.771272.

Beuro of Indian Standards for Drinking water 2012 (BIS 2012)