Workshop-Driven Internship: A New Paradigm in Engineering Education

[1]Makarand G. Kulkarni, [2]Madhura A. Pednekar, [3]Jagannath H. Nirmal,
[1,2,3]Faculty, Dept. of Electronics Engineering, K J Somaiya School of Engineering,
Somaiya Vidyavihar University, Mumbai, Maharashtra, India
[1]makarandkulkarni@somaiya.edu, [2]madhura.pednekar@somaiya.edu, [3]jhnirmal@somaiya.edu

***Abstract*—This paper explores a new educational paradigm that integrates workshop-driven internships into innovative engineering education. Using the cutting-edge technology of the Internet of Things (IoT) as a core topic, the approach is implemented in two phases. The first phase provides hands-on training through workshops, while the second phase includes an internship focused on project design and development, complemented by industrial visit and alumni interaction. By combining practical experience with theoretical knowledge, this model bridges the gap between classroom learning and real- world applications. It enhances students' technical skills, problem-solving abilities, teamwork ethics, and professional readiness. Key benefits include increased student engagement, improved workforce preparedness, and the development of innovative thinking. This approach aligns academic learning with industry needs, creating a transformative educational experience.**

***Keywords*—Hands-on Education, Internships, Industry Integration, Project-Based Learning, Workshop-Driven Internship.**

ICTIEE* Track*: Pedagogy of Teaching and Learning
ICTIEE Sub-Track: Enhancing Pedagogy for e-Learning

I. INTRODUCTION

In today's rapidly evolving technological landscape, engineering education must continually adapt to ensure that students are equipped with both theoretical knowledge and practical skills. Traditional educational models often fall short in bridging the gap between classroom learning and real-world application, leaving students underprepared for the complexities of modern engineering challenges. To address this gap, innovative educational paradigms are needed.

Significant reforms in engineering education are needed to prepare engineers as societal change agents (Wakhlu, 1992). It critiques the current curriculum's heavy focus on technical skills, arguing for the integration of communication, management, and social awareness courses. The work emphasizes the importance of leadership and teamwork in engineering.

The Department of Electronics and Telecommunication Engineering at Fr. C. Rodrigues Institute of Tech. (FCRIT) adopted the Outcome-Based Education (OBE) model to enhance the quality of their Bachelor of Engineering program. This approach ensures that the curriculum is aligned with specific learning outcomes, preparing students more effectively for their careers (Shah & Kolhekar 2021). The implementation led to significant improvements in student outcomes, demonstrating the effectiveness of the OBE model.

The Project-Based Learning (PBL) in engineering education is effective in enhancing students' problem-solving and employability skills (Upadhye, Madhe & Joshi, 2022). By engaging students with real-world problem statements, the study reports improvements in both technical skills, such as system design, and non-technical skills, including teamwork.

A strategic approach was implemented by forming student teams with diverse learning styles and assessed using the Felder-Soloman Index of Learning Styles (Kittur & Salunke, 2020). The results indicated that teams formed with mixed learning styles showed improved conceptual understanding, suggesting that strategic team formation enhances student learning outcomes in collaborative educational settings.

Crespo et al (2022) propose the implementation of Radio Frequency Identification (RFID) Pocket Labs and an Internet of Things (IoT) platform as innovative teaching tools is discussed, aiming to enhance student-centered learning in engineering education. The paper outlines a structured approach where students engage in hands-on experiments involving RFID technology and IoT project development.

K. F. Ystgaard (2022) explores how intelligent networks can prioritize human well-being, ethics, and control by aligning technical designs with human-centric principles. It aims to bridge the gap between theory and practice, creating IoT systems that enhance inclusivity, empowerment, and meaningful human involvement.

A. Mahmood et al. (2022) presented future of Industrial IoT (IIoT) by ensuring robust, efficient, and secure wireless connectivity. This article highlights technological challenges to enable large-scale IIoT deployments.

This paper introduces a novel approach that integrates workshop-driven internships into engineering education, using the IoT as a core topic. The IoT represents a frontier in technology, offering a rich context for applying both theoretical concepts and practical skills.

Makarand G. Kulkarni,
K J Somaiya School of Engineering, Somaiya Vidyavihar University, Vidyavihar East, Mumbai 400077
surenpatwardhan@isomaiya.edu

The flow of the proposed 'Workshop cum Internship' is presented in Section III. The actual implementation of the two distinct phases such as the first phase provides hands-on training through targeted workshops, while the second phase includes an immersive internship focused on project design and development as described in the Section IV. This phase also incorporates industrial visits and interactions with alumni to enhance real-world learning. The overall impact of the proposed model is explained in Section V along with the mapping of each activity carried out with the six levels of Bloom's Taxonomy (BT). In this section the feedback of the participants and benefits of the proposed model with the 'Traditional Internship' are discussed followed by the conclusion in Section VI.

II. MOTIVATION

Conventional Engineering Education typically emphasizes theoretical knowledge in the classroom. Students frequently enter the workforce without adequate practical experience. This discrepancy leads to several issues like:

1) Employability: The lack of hands-on practice, students may struggle to apply theory to real-world circumstances, making them less attractive to potential employers.

2) Student Engagement: The lack of practical application of classroom teachings can reduce student engagement, leading to decreased interest and motivation.

3) Lack of Innovation: Students without hands-on project opportunities may struggle to think creatively. This makes it difficult for them to come up with new solutions to problems.

4) Industry Readiness: The gap between what students learn in the classroom and what industries need. Graduates often need a lot of training to be fully productive. This increases costs for employers and hence students need to compromise with lower starting salaries.

To address these issues, engineering education could benefit from a more balanced approach that integrates practical experiences with theoretical learning.

Here, as discussed in the earlier section, 'IoT' which is cutting edge technology is selected as a core topic for this 'Workshop-cum-Internship' program titled as "Empowering IoT Tech: Workshop, Internship and Project Development". The importance of IoT in engineering hands-on projects lies in its ability to enhance practical learning. It allows students to apply theoretical knowledge to real-world scenarios, to develop valuable technical skills, and to innovate solutions. IoT projects help students to work together, think critically, and understand how modern technology is used in engineering applications.

III. METHODOLOGY

The proposed 'Workshop cum Internship' model is shown in Fig. 1. A four week 'Workshop cum Internship' program was organized during 15th December 2023 to 16th January 2024 titled "Empowering IoT Tech: Workshop, Internship and Project Development" for SY B. Tech. and TY B. Tech. students of all engineering branches. Total 30 students were participated in this program. As shown in the Fig. 2, this program was executed in two phases. Phase 1 - Workshop on IoT technology and Phase 2 - Internship on Project Design and Development.

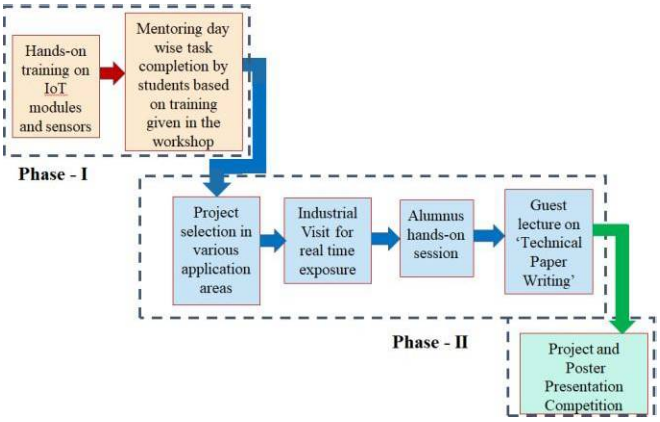

Fig. 1. Framework of the proposed 'Workshop cum Internship'

IV. IMPLEMENTAION

As discussed in the previous section, this program was executed in two phases. These two phases are described here.

A. Phase 1 - Workshop on IoT Technology:

1. Hands-on training sessions were conducted along with theoretical concepts on various IoT modules like Arduino, NodeMCU (ESP8266), ESP32, ESP32cam, Raspberry Pi, cloud platforms (Blynk Cloud, Thingspeak Cloud). and various sensors like temperature sensor , humidity sensor, gas sensor (LM 35, DHT 11, MQ135,) and actuators (stepper Motor, Servomotor, DC Motor, OLED) etc. The workshop covered data acquisition, wireless communication protocols, real-time data monitoring. It provided practical experience in design and programming IoT devices using integrated development environment (IDE) tool like Arduino IDE and New Out of Box Software (NOOBS) which is a software designed to install an operating system on Raspberry Pi.
2. Mentoring was provided in the training phase for day-to-day hands-on task give to participants.
3. Introduction to IoT and its applications were also discussed in this phase of the program.

B. Phase 2 – Internship on Project Design and Development:

1. Industrial Visit: In this phase 2, participants initiated the thought process and discussed their bare proposals on IoT projects with faculty mentors. To explore current IoT applications and projects, an industrial visit was conducted to SMARTi Systems Pvt. Ltd. Photograph of the visit is shown in Fig 2. Students observed how various industrial products integrated IoT technology to enhance both operational efficiency and system safety. They saw how the implementation of IoT significantly improves system productivity, reduces downtime, and ensures better resource management.
2. Alumnus Session: A full day practical session was conducted by our alumnus who is working as Senior Engineer in IoT domain. In his session he covered

topics on 'Client to Server Communication using Node MCU' and 'Machine to Machine Communication'. He shared his experiences of implementations of IoT in industrial products. He discussed challenges, innovative solutions, and the impact of IoT on cutting-edge technology, providing valuable insights to participants.

Fig. 2: Industrial Visit

3. Project Design and Development: Based on the ideas from Industrial Visit and interaction with alumnus, students groups finally formulated their internship projects in consultation with faculty mentors. IoT projects involve both software and hardware concepts, which students found challenging when grouped within the same stream. Therefore, groups were formed to include at least one student from Computer Engineering and one from Electronics Engineering. Total seven student groups were formed in this internship phase. Students were consistently engaged with their project task, demonstrating their understanding and application of the material learned. This regular practice not only reinforced their knowledge but also allowed them to actively apply theoretical concepts in practical scenarios. They received regular guidance during the design, simulation, analysis, testing, and final prototyping stages. Few snapshots of those projects are shown in Fig. 3-5.
4. Project and Poster Presentation Competition: Participants demonstrated their projects and competed in a 'Project Competition'. They explained their project work during a 'Poster Presentation'. Our Principal, Head of the Department and many students, faculty, staff members visited this 'Project and Poster Presentations' and given their valuable inputs to participants as shown in photograph given in Fig. 6. This event not only enhanced their presentation skills but also broadened their knowledge through exposure to diverse projects and interdisciplinary learning. Two judges (experts in the area of IoT) evaluated all the projects. Following evaluation parameters were set for evaluation of projects developed by each group: Selection of topic (10 Marks), Product design (10 Marks), Simulation of prototype (15 Marks), Hardware interfacing (15 Marks), Testing and measurements (15 Marks), Development of project (15 Marks), Demonstration of project (15 Marks), Commercialization strategy for the project prototype (10 Marks).The top three projects won awards and Internship Certificate was given to all the participants.
5. Guest Lecture on 'How to write an Effective Technical Paper': After successfully completing their projects, students are encouraged to publish their work at the conference.

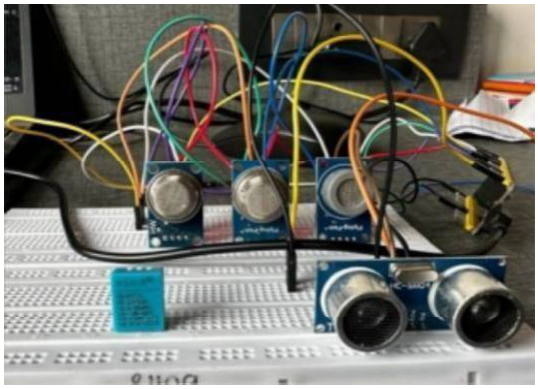

Fig 3. Project on 'Smart Environmental Monitoring System for Mines'

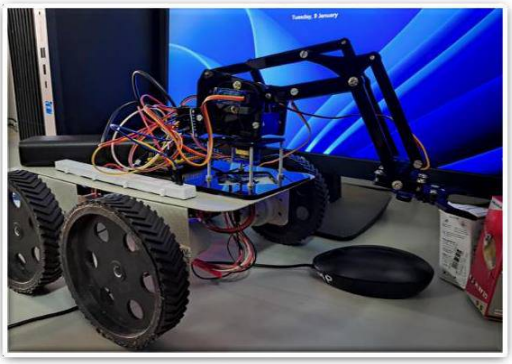

Fig. 4 Project on 'IoT Based Robotic Arm Rover'

Fig. 5 Project on 'IoT Based Door Lock System'

To support this, a guest lecture session on 'How to Write an Effective Technical Paper' was arranged. This session was conducted by our senior faculty member of our college. She explained the importance of writing a research paper and presented the essential elements of a technical paper, including how to organize findings logically.

The Phase 2 of the program was successfully implemented, receiving an overwhelmingly positive response from all the

participants.

Fig. 6 Students presenting their Project and Poster

V. RESULTS AND DISCUSSIONS

After successful completion of the 'Workshop cum Internship' program, students are encouraged to showcase their work by participating in the International Conference and Hackathon by eYantra IITB.

A. Paper Presentation in the International Conference: Motivated by the guest lecture on technical paper writing, three project groups successfully submitted papers that were accepted at the International Conference on Technologies for Energy, Agriculture, and Healthcare (ICTEAH 2024). The photo of this event is shown in Fig. 7. This opportunity allowed the participants to present their innovative project work on an international platform, showcasing their technical skills and gaining valuable exposure. Participation in this prestigious event not only validated their hard work taken during entire internship but also provided a unique chance to network with experts, receive constructive feedback. It marked a significant milestone in their academic journey, underscoring the real-world impact of their research, the importance of team work and effective technical communication.

B. Participation in 'Hackathon by eYantra , IIT Bombay': Two project groups participated in the eYantra Hackathon organized by IIT Bombay, an international competition where student teams showcased their project demonstrations. The eYantra is a robotics program held at IIT Bombay funded by the Ministry of Education. Our college secured in a top-five ranking in this Hackathon. The group photo of this occasion is shown in Fig. 8.

Fig 7. Paper presentation by student group in the International Conference- ICTEAH-2024

Fig 8. Students participated in 'Hackathon by eYantra , IIT Bombay'

As stated earlier, activities carried out during two different phases of this 'Workshop cum Internship' program are mapped with levels of BT as given in Table I. As shown in the Table I, it can be observed that all the six levels of BT were mapped through various activities executed in the program. The percentage of achievements is shown in Fig. 9. It shows that the program effectively addresses a comprehensive range of cognitive skills. It ensures that learners gained basic knowledge and developed higher-order thinking skills like analysis, evaluation, and creation. This thorough approach helps to create well-rounded individuals who can think critically and solve problems in different situations.

TABLE I
ACTIVITIES MAPPING WITH BLOOM'S TAXONOMY (BT)

Activities carried out in the 'Workshop cum Internship' program	Mapping with Bloom's Taxonomy (BT)
Hands-on training on IoT modules and sensors	Understanding, Remembering
Monitoring day wise task completion by students Project selection in various application areas Industrial Visit	Understanding, Applying
Alumni hands-on session Guest Lecture on 'Technical Paper Writing'	Understanding
Project Implementation, Demonstration and Poster Presentation	Applying, Analyzing, Evaluating, Creating

At the end of the program a feedback questionnaire was circulated in the form of Google form. The students' viewpoints on the program were collected through their responses and summarized in Fig. 10.

The questions included w.r.t following points:

- Usefulness of this workshop cum internship program for hands-on learning'
- Becoming familiar with various modern hardware and software tools and techniques.
- Experience of working in team
- Development of overall project management skill

The chart shown in Fig. 10 illustrates the students' opinions on the above aspects. It clearly shows that approximately 85% of students gained overall project management skills through this program. This indicates the program's effectiveness in

enhancing essential project management competencies among students.

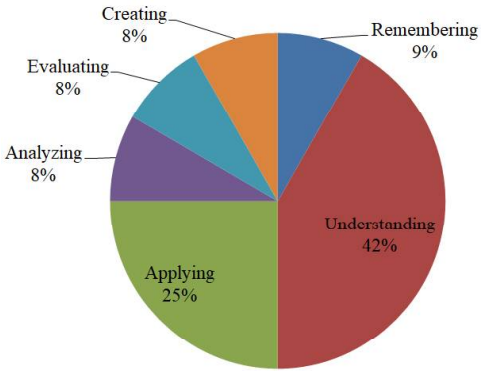

Fig 9. Mapping various activities of the program with Bloom's Taxonomy

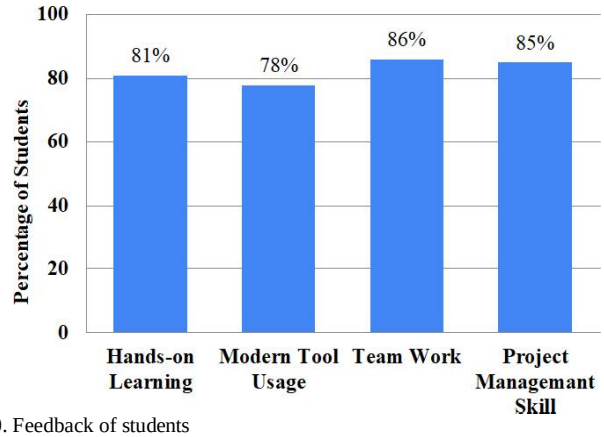

Fig 10. Feedback of students

The comparison between the 'Traditional Internship' and the 'Workshop cum Internship' is shown in Table II. This table clearly shows the advantages of the proposed framework on 'Workshop cum Internship' over the traditional one.

TABLE II
COMPARISON BETWEEN 'TRADITIONAL INTERNSHIP' AND THE 'WORKSHOP CUM INTERNSHIP'

Traditional Internship	Workshop cum Internship (the proposed model)
Hands-on working on ready industry problem.	Balances theoretical learning and hands-on training.
Direct interaction with professionals in the field.	Mentoring day to day task completion and progress.
Significant practical experience in a professional environment.	Practical experience through real projects, combined with theoretical knowledge from workshops.
Direct exposure to company's operations and culture.	Balanced exposure to theoretical and practical aspects.
Structure will be dependent on company's program.	Structured learning followed by project development.

Sample expressions by the students about the course are as follows:

- Overall very good practical experience in this internship.
- The faculty was so kind, it's because of them the program went so smooth.
- The duration of the program can be extended.
- It was useful and interesting.
- Nice workshop. Hope to see more like such.
- Additional workshops of this nature would be greatly appreciated.
- Excellent workshop, proper guidance and training. Wishing for more such in the upcoming future.

CONCLUSION

This paper explains how integrating workshop-driven internship with project learning experiences in innovative engineering education bridges the gap between classroom teaching and hands-on learning. Example from field like the IoT technology is used to illustrate this approach. It creates a transformative educational model. This approach effectively connects theoretical knowledge with practical application, greatly enhancing students' technical expertise, problem-solving aptitudes, teamwork ethics, and professional readiness. Working with modern tools and engaging in real-world projects, students develop critical thinking and innovative skills essential for today's dynamic engineering field. Inclusion of industrial visit and interactions with alumni further enriches the practical learning experience, keeping the curriculum relevant and impactful. This 'Workshop cum Internship' model promotes continuous learning and adaptability, resulting in graduates who are not only well-prepared for the workforce but also confident in driving societal progress as innovative engineers. This approach of 'Workshop cum Internship' aligns academic goals with industry needs.

REFERENCES

Wakhlu, O. (1992). Curriculum for Society-Engineer Interaction Studies. *The Journal of Engineering Education, 5(3),* 1-5.

Shah, M.,Kolhekar, M. (2021). A Case-Study on Leveraging the Policies on Outcome-Based Education. *Journal of Engineering Education Transformations, 35 (2),* 126-139.

Upadhye, V.,Madhe, S., Joshi, A., (2022). Project Based Learning as an Active Learning Strategy in Engineering Education. *Journal of Engineering Education Transformations, 36,* 18-24.

Kittur, J., Salunke, M. (2020). Mixed Learning Styles: A Strategy for Team Formation. *Journal of Engineering Education Transformations, 33,* 434-441.

Crespo, R., Lopez-Caudana, E., Romo, K., & Mantilla, A. (2022). Scenarios for student-centered learning: RFiD Pocket Lab and IoT Platform as teaching tools. *2022 IEEE Global Engineering Education Conference (EDUCON),* 108-116.

K. F. Ystgaard, (2022). Future Sustainable and Humanity-centred Intelligent Networks - Translating Theory into Practise. *2022 IEEE 8th World Forum on Internet of Things (WF-IoT),* 1-2.

A. Mahmood et al. (2022). Industrial IoT in 5G-and-Beyond Networks: Vision, Architecture, and Design Trends. *IEEE Transactions on Industrial Informatics, 18,* 4122-41