PERCEPTIONS OF INTEGRATING PRACTICAL-BASED WORKSHOP ON ELECTROMAGNETISM FOR THE FIRST-YEAR ENGINEERING UNDERGRADUATES OF THE OPEN UNIVERSITY OF SRI LANKA

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This study presents the outcomes of a specialized workshop conducted at the Open University of Sri Lanka (OUSL) aimed to enhance the understanding of electromagnetism among first-year engineering undergraduates. The workshop, specifically designed for the students enrolled in EEX3410 - Introduction to Electrical Engineering, which is a compulsory course in the Bachelor of Science Honours in Engineering programme. 70 Participants out of 310 registered students of the course, engaged in hands-on activities and practical demonstrations covering key concepts in electromagnetism, including electromagnetic field, electromagnetic induction, and electromagnetic force. At the end of the workshop students' perceptions were gathered through a questionnaire having close ended and open ended questions. Results indicated notable positive feedback on the relevance and the method of conducting the workshop. It is evident from the survey that more than 95% of participants rated "good" and "excellent" as their learning experience and 83% recommend the workshop to other students. No one has opted for "probably not" or "definitely not" indicating that all in agreement in recommending the workshop. Students appreciated the opportunity given to them to bridge theoretical knowledge with real-world applications, through an interactive learning environment with practical engagement. In the 21 responses made in the open-ended questions of the questionnaire, it is evident that students find this workshop helpful for their learning. All the 21 responses include positive phrases such as "it is very helpful" and "it is a useful workshop". The findings indicated the importance of incorporating practical oriented workshops into engineering courses. Recommendations include integrating similar workshops into engineering courses and exploring the possibility of delivering them prior to course material reading, especially in distance learning context because of the teacher assistance. Future research avenues may investigate the impact of such workshops on long-term retention of knowledge. Overall, this study highlights the value of experiential learning in enhancing students' understanding of complex scientific concepts and underscores the need for a more balanced approach to engineering education.

Keywords: Workshop, Engineering education, Hands-on learning, Practical demonstrations

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INTRODUCTION

Electromagnetism is a fundamental area in the field of physics and engineering, providing crucial insights into practical applications. However, first-year engineering undergraduates often face challenges in understanding its concepts through traditional lecture-based teaching methods and written course materials alone especially without laboratory based hands-on practical studies. This is reflected by less attempts made at assessments based on the said topic. Recognizing these difficulties, the students themselves requested a tailor-made workshop to facilitate their understanding of electromagnetism. In response, the Department of Electrical and Computer Engineering of The Open University of Sri Lanka (OUSL) conducted a workshop focusing on practical demonstrations in electromagnetism.

The recent study (Behera et al., 2023) states that the laboratories were the most preferred for face-to-face delivery of engineering courses especially in distance mode learning. Although the students requested knowledge gaining support which is in cognitive domain learning, it was decided to integrate laboratory demonstrations since researches such as Nikolic et al., 2024 rank the laboratory learning objectives across the cognitive, psychomotor and affective domains. The research (Willmot & Perkin, 2011) shows the impact of integrating workshops in a first year engineering module designed to improve student engagement and for collaborative learning especially in learning real-world scenarios (Kolfschoten et al., 2008).

METHODOLOGY

Considering previous work done (Willmot & Perkin, 2011), related to first year engineering education the research team decided to conduct the workshop in the laboratory premises instead of lecture halls to keep an active student engagement.

The workshop was conducted at Colombo Regional Centre of the Open University of Sri Lanka as a pilot study, for the students registered for EEX3410 - Introduction to Electrical Engineering. This is a compulsory course in the Bachelor of Science Honours in Engineering program offered by the OUSL. It was conducted during the academic year 2022/2023 where the registered student count was 310. Out of this, 70 students enrolled in the workshop and participated. The objectives of this workshop were:

- To enhance students' understanding of electromagnetism through practical-oriented workshops.
- To foster active learning among first year undergraduates through workshops.

The workshop was repeated for four sessions where the students were given a choice to select a session which the size is limited to 25. The duration of a session was 4 hours. The workshop began with an introductory presentation to all participants briefing the theoretical aspects of electromagnetism, supplemented by an educational video to visually demonstrate the key concepts. Following the presentation, students were assigned to lab workstations not exceeding 8 students per workstation. Each workstation was assisted by a Demonstrator to engage students in hands-on experiments listed below:

1. Electromagnetic Field: Finding the field strength of a coil against the earth’s magnetic

field, illustrating Faraday's Law and Lenz's Law.

2. Electromagnetic Induction (Generation): Moving a bar magnet inside a coil of wire connected to a center-zero galvanometer, illustrating Fleming's Right-Hand Rule.

3. Electromagnetic Force (Motoring): Movable conductor connected to a DC source and a fixed magnetic field, illustrating Fleming's Left-Hand Rule.

During these sessions, students were given the opportunity to execute experiments on their own, under the guidance of the Demonstrators. Each session was followed by a guided discussion, encouraging students to ask questions and discuss their observations.

At the end of the workshop, student feedback was collected via a questionnaire with closed ended and open ended questions, from all 70 students who participated, under the following areas:

- Content relevance and alignment with student expectations.
- Quality of delivery, including support and handout materials.
- Students' insight on the selected topics in Electromagnetism from their perspective.

RESULTS AND DISCUSSION

All the 70 participants responded to the questionnaire which marks a 100% response rate. Results indicated notable positive feedback on the relevance and the method of conducting the workshop. All students reported that the hands-on practical made abstract concepts more tangible and easier to grasp. The interactive nature of the workshop also fostered a collaborative learning environment, which was positively received by the participants. The feedback is shown under the main aspects of the workshop as follows.

Content Relevance and Student Expectations: Students felt that the workshop content was highly relevant and met their expectations, bridging the gap between theoretical knowledge and practical applications. Figure 1 shows that more than 91% of the participants agree with the contents and the handouts provided are very much related to their expectations. Also, the instructiveness of the activities was also accepted by the majority of the participants.

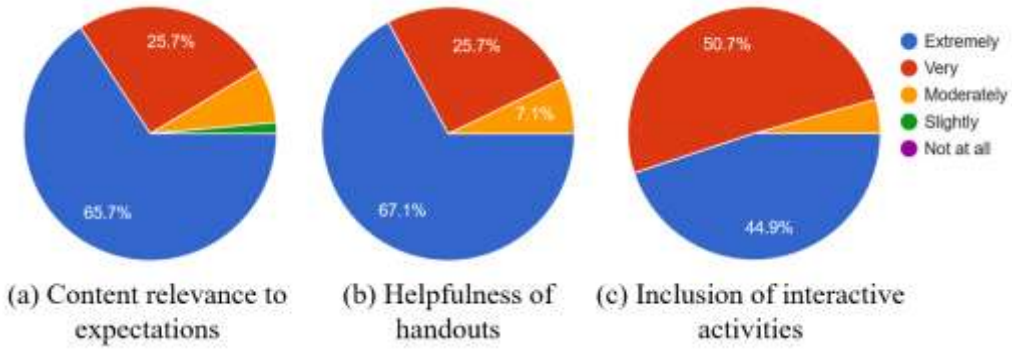

Figure 1: Feedback on Content relevance and student expectations

Quality of Delivery: The quality of delivery, including the support from demonstrators and the time duration, was rated highly. However, as shown in figure 2, 25.8 % of the participants say that the time duration of too much for this workshop.

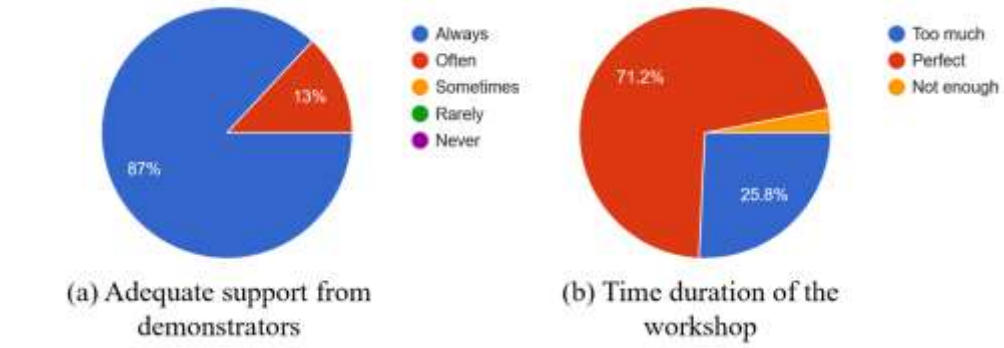

Figure 2: Feedback on quality of delivery

Figure 3 shows the participants' rating of their experience and how likely they recommend the workshop to others. It is evident that more than 95% of participants rated it as good and excellent as their experience and 82.9% recommend the workshop to other students. No one has opted for "probably not" or "definitely not" indicating that all in agreement in recommending the workshop.

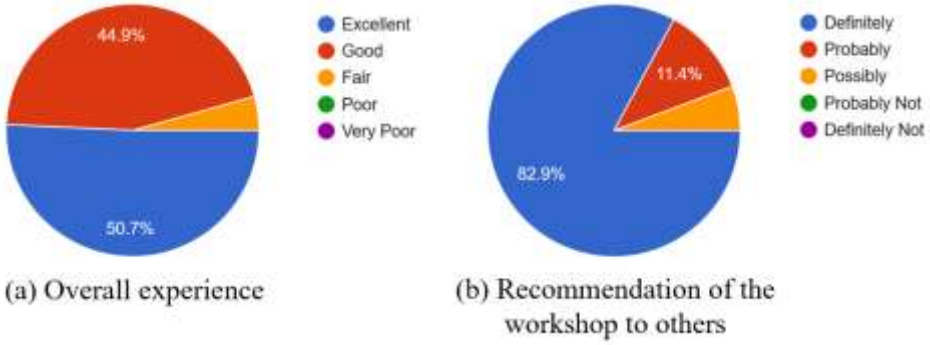

Figure 3: Feedback on overall experience (a) and recommendation to other students (b)

Self-evaluation of students: Figure 4 shows the before and after proficiency levels from the students' perspective. As evident from the results explaining the physical meaning of electromagnetic concepts and relating theories to generators and motors show a boost in student skills. Also, from the students' point of view, the ability to explain the theories increased. However, the ability to perform calculations does not show a significant improvement. This is very common among students because with a certain amount of practice and some help from model answers, calculations can be performed even without a sound knowledge on subject matter.

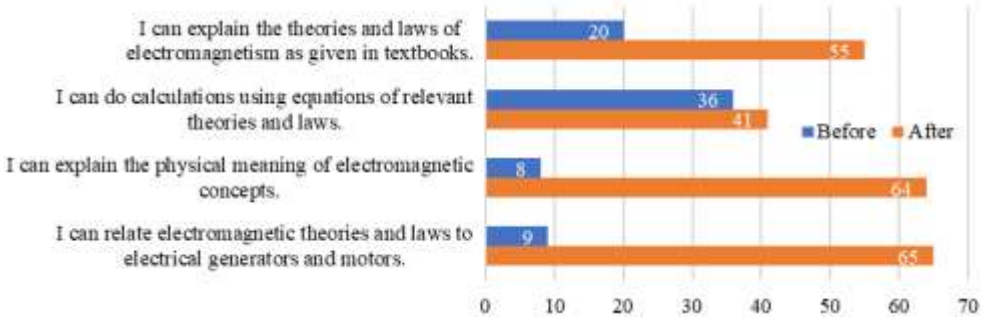

Figure 4: Comparison of level of proficiency before and after the workshop

Twenty-one students responded to the open-ended questions of the questionnaire and included: "Continue these programs", "Keep these programmes going", "There should be more workshop for other areas", "Better if can arrange many workshops for other topics as well" and more appreciations like, "Big thanks for everyone". Therefore, it can be concluded that the workshop was able to fulfil the student-expectations. Interestingly, two students suggested extending the demonstrations to include more advanced activities like "Suggest to make a simple meter at the end", "I suggest to rotate a motor and a generator".

From the 21 responses to open-ended questions, it is evident that students find this workshop helpful for their learning. All of them include positive phrases "it is very helpful" and "it is a useful workshop". Furthermore, the statements such as "...a great help to remind me of many things that I had forgotten", "...a great help for our knowledge", "…If you can do it for every lesson, it is worth it" underscores the need for a more balanced approach to teaching, combining traditional lectures or written material with practical session. This hybrid approach not only enhances understanding but also retains student interest and motivation.

CONCLUSIONS/RECOMMENDATIONS

The workshop presented the efficacy of practical demonstrations in improving the understanding of complex scientific concepts among first-year engineering undergraduates. The positive student feedback suggests that such workshops should be an integral part of the engineering education curriculum. The research team thereby recommends integrating demonstration workshops for engineering courses to explain fundamental concepts, especially in the first year of undergraduate programmes. Also, to explore the possibility of delivering such workshops at the start of a course or before answering assignments, especially in distance learning settings. Future workshops could expand to cover more advanced topics and involve interdisciplinary applications, further enriching the learning experience for engineering students.

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