2025, vol. 12, issue 1, 187 - 192

RESEARCH ARTICLE

https://doi.org/10.5281/zenodo.15804538

EVALUATING THE IMPACT OF ACTIVE LEARNING ON ENGINEERING FACULTY DEVELOPMENT AT KOTELAWALA DEFENCE UNIVERSITY, SRI LANKA

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Abstract

The Certificate in Teaching in Higher Education (CTHE) is a mandatory program for aspiring permanent academic staff in Sri Lankan Higher Education Institutions. General Sir John Kotelawala University (KDU) plays a crucial role in training young academics for this program. Active learning strategies have been increasingly adopted in engineering education to enhance student engagement and learning outcomes. This study investigates the impact of active learning techniques on the performance of engineering students at General Sir John Kotelawala University (KDU). A cohort of 60 were evaluated engineering teaching performance based on feedback from engineering students. The evaluation focused on three key areas: lecture delivery, content quality, and overall session effectiveness. Active learning strategies can significantly enhance teaching quality by engaging students in the learning process, fostering critical thinking, and improving retention of knowledge. KDU aims to further enhance the quality of its engineering programs and produce highly skilled graduates.

Keywords: Active Learning, Engineering Education, Faculty Development, Teaching Effectiveness, Higher Education

1. INTRODUCTION

The Certificate in Teaching in Higher Education (CTHE) is a ten-year-old annual program offered by the Staff Development Centre (SDC). This accredited course runs from February to November each year and aligns with global best practices in teaching and learning. Primarily designed for newly recruited permanent academic staff at Sri Lankan universities, it is recognized by the University Grants Commission (UGC) as a mandatory induction program for probationary academics (Arruda and Silva, 2021; Marikar and Zayan, 2024). Senior academics have also benefited from the course due to its personal and systemic advantages. The course has consistently received positive feedback from both participants and international resource persons.

The CTHE involves fifteen weekday workshops, conducted either in-person at the General Sir John Kotelawala Defence University or online, depending on circumstances (Shanmugalingam, 2023). Participants must be able to attend both in-person and online sessions and actively engage in various activities, including designing and implementing new teaching and learning strategies, reflective self-development, and extensive reading. Assessment is based on workshop participation, a seminar presentation, and a portfolio documenting the

implementation of improved teaching practices (Guimarães and Silva Lima, 2023; Pushpakumara and Marikar, 2021). Proficiency in English is essential for the portfolio and the overall CTHE.

The CTHE's tenth batch (2022-2023) highlighted the importance of delivering the message by effective method. To recognize teaching excellence among delivering message by lecturers, a framework was developed focusing on three key areas: lecture delivery, content quality, and overall session effectiveness. This paper delves into identifying the best resource pool for CTHE programs and analyzes feedback to determine the top-performing group based on the established criteria (Vodovozov et al., 2021; Xu et al., 2023).

Active learning strategies have the potential to revolutionize engineering education. By shifting the focus from passive listening to active engagement, students become the architects of their own learning journey (Børte et al., 2023; Neves et al., 2021). This transformative approach fosters critical thinking, problem-solving skills, and a deeper understanding of complex engineering concepts. Through interactive activities like group discussions, case studies, and hands-on projects, students are encouraged to apply theoretical knowledge to real-world scenarios (DeCaro et al., 2023; Qureshi et al., 2023). This not only enhances their technical abilities but also equips them with essential communication and teamwork skills.

Implementing active learning in engineering classrooms requires a paradigm shift in teaching methodologies. Faculty members must embrace a student-centered approach, moving away from traditional lectures and towards interactive discussions and collaborative problem-solving (Cho et al., 2021; Lima et al., 2024). This necessitates a careful redesign of curricula to incorporate active learning strategies seamlessly. Additionally, faculty development programs can empower educators with the necessary tools and techniques to facilitate effective active learning experiences.

The benefits of active learning extend beyond improved student engagement and learning outcomes. By fostering a collaborative and supportive learning environment, active learning can enhance student satisfaction and motivation (Ghai et al., 2021; Lombardi et al., 2021). Furthermore, it can bridge the gap between theoretical knowledge and practical application, preparing students for successful careers in engineering (Dominquez et al., 2025; Theobald et al., 2020). As engineering education continues to evolve, active learning emerges as a powerful tool to shape the future generation of engineers, equipping them with the skills and mindset to address the complex challenges of the 21st century.

The CTHE course was delivered through a combination of in-person and online workshops, conducted at the General Sir John Kotelawala Defence University or via an online platform. Participants were required to attend both physical and virtual sessions and ensure reliable internet access. The course curriculum involved designing and implementing new teaching and learning activities, engaging in self-reflection, and completing required readings. Active participation was crucial, including creating activities and critically reflecting on personal growth. This active approach enhanced participant learning and success.

Participant assessment was based on active workshop participation, a seminar presentation, and a portfolio showcasing the impact of the course on their teaching practices. This paper explores how the Engineering Faculty benefited from the CTHE program.

- Delivery Of the Lecture (Adequacy of Content, Clarity in content, Relevance, Conducting Sessions in an organized and well-planned manner, Maintain participants interest and motivation)
- Content of learn (Clarity, Relevance, Coverage, Provides Guidance about the Subject and Shares Additional knowledge)
- Session Overall (Clarity in Presentation, Time Management of Lecturer, Knowledge added, Quality of presentation, and Overall learning environment)

Through a real-world example, this paper identifies a model way for Professional Development Specialists to educate Engineers. It provides examples of efficient techniques that encourage a cooperative interaction between Engineering educators and student, thereby increasing the teaching young budding engineers.

2. METHODOLOGY

A. Research Design

This study aimed to investigate the impact of effective teaching methods on young engineering students at the General Sir John Kotelawala Defence University (KDU). Specifically, we examined how active learning influenced the development of concepts, knowledge, skills, attitudes, and mindset. This research was crucial to understand whether the selected resource persons effectively contributed to the learning curve of young budding engineering students in a state defense university. A standardized feedback form, recommended by the University Grants Commission, was used to collect data. Participants completed the form after each session. A total of 60 students feedback was analyzed. The testing group generally agreed with the feedback format.

B. Data Collection

Data collection encompassed printed forms for physical lectures and online feedback for professional development specialists, underscoring their commitment to tailored learning. Data followed a structured format and underwent comprehensive evaluation, utilizing both traditional and online teaching approaches to obtain a holistic perspective. This multifaceted feedback strategy enables the identification of individual learning requirements for each student. In response to this data, professional development experts can adapt their methods to ensure effective instruction for young engineers.

C. Data analysis

The data was processed and analyzed by inputting the results into the computer, and a basic descriptive analysis was conducted using Microsoft Excel.

3. RESULT AND DISCUSSION

The study's findings serve as a blueprint for enhancing the Engineering Training program's success in effectively educating academics and engineers. To achieve this, professional development experts employ interactive teaching methods, tailor the learning journey, and nurture a supportive atmosphere. Implementing these results can significantly enhance the efficiency of your Engineering Training program (Jesionkowska et al., 2020). Use interactive teaching techniques to involve engineers. Personalize learning experiences and foster a positive environment. Adopting these tactics will improve your program's performance and guarantee effective teaching results. They support academics and engineers' ongoing skill development and learning through their expertise, which ultimately improves engineering practices (Ren et al., 2021). In collecting data on teaching effectiveness from students, we supplement traditional course evaluations with additional feedback processes. It served as a valuable decision-making indicator. We prioritize feedback from young academics, consistently inviting external experts. If negative feedback persists for two consecutive instances, we introduce a new lecturer, fostering a dynamic and effective program that nurtures young engineers.

As an instructor, the white board and the relevant apparatus were used for teaching and demonstration purposes. Other than that, no chance of preparing or using any other sort of material was gotten until becoming a lecturer. As a lecturer, the main source of knowledge sharing used would be the lecture notes prepared using Microsoft PowerPoint. In addition to this, different Manuals and Codes required for design modules taught, related to Highway and Transportation Engineering, were also used. The typical mode of delivery of lectures before CTHE was explaining students using the handouts. If calculations were involved, one sample calculation on the white board was done on each topic.

With the requirement of completing the lectures in the given duration, it was felt that some chapters were rushed, resulting in negative feedback from students. Comments from the feedback analysis for Highway Engineering included complaints about the fast pace of the lectures, difficulty in understanding the content, unclear slides, and a lack of examples. Students also expressed concern that the lecturer did not adequately address the needs of weaker students.

Accordingly, it was identified that considerable changes were required in teaching methods to retain students' attention and ensure understanding. It was noticed that lectures should be designed to be slower-paced for better comprehension. Regarding lecture note design, the use of excessive text led to smaller font sizes. Figure 1 illustrates a slide from a Highway Engineering lecture note prepared before CTHE. Peer reviews by senior lecturers highlighted the congested nature of the notes, hindering student concentration. It was concluded that these issues needed to be addressed for effective student learning.

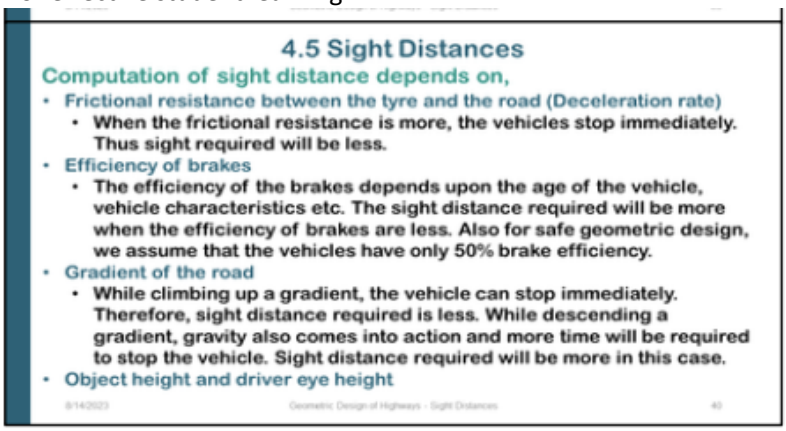

Figure 1 - Slides from lecture note before the CTHE Program

Additionally, Figure 2 presents the results of the analysis of student feedback on their learning experience in the Highway Engineering module conducted in 2022. This analysis was based on six indicators: enthusiasm, organization, lecturer-student interaction, task organization, clarity, and overall learning experience.

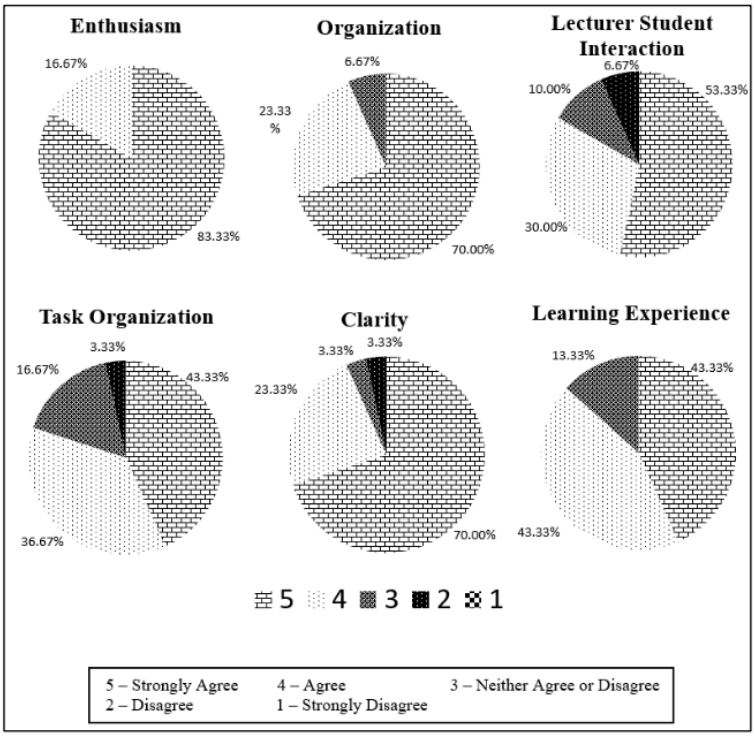

Figure 2: Student feedback summary for a lecture conducted pre-CTHE (2022)

According to Figure 2, it is visible that while enthusiasm in delivering the lectures was at a commendable level, deficiencies were observed in task organization, clarity, and lecturer-student interaction. Accordingly, the requirement for adopting new teaching approaches to enhance the lecture delivery experience was understood.

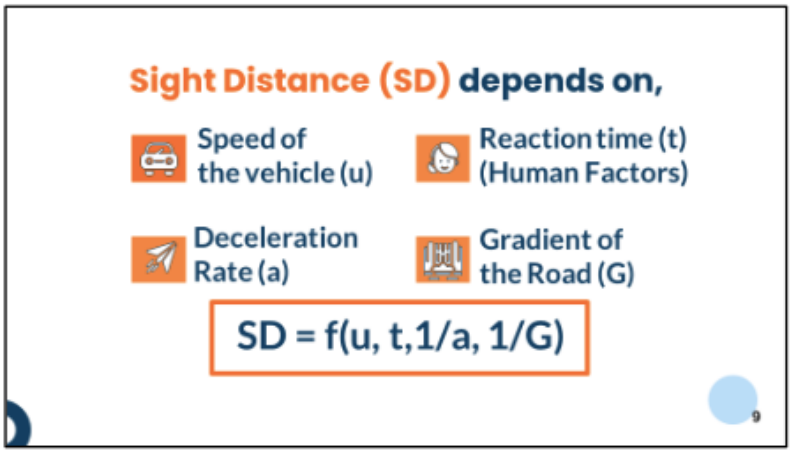

Figure 3 -Revised slide using in Highway Engineering module after CTHE

Furthermore, improvements were needed in presentation design. After learning about color harmony and concerns regarding color blindness, the font colors of presentations were changed to complementary colors (colors on opposing sides of the color wheel). Complementary colors, split complementary colors, and tetradic colors are known to be the best color combinations for better visual effects for human eyes (Ferreira and Canedo, 2020; Nguyen et al., 2021). Accordingly, the color scheme of presentations was changed to blue and orange with a white background. Another improvement considered was reducing text content and adding more images to support white balance. The rule of thirds was followed in most instances, dividing the image into sections using a 3x3 grid. Figure 3 illustrates a revised slide incorporating these changes.

Accordingly, it is with delight that the following comments from students, taken from the student feedback analysis for the Fundamentals of Transportation Engineering module conducted in 2023, are mentioned. These comments resulted from the changes made to the teaching and learning experience.

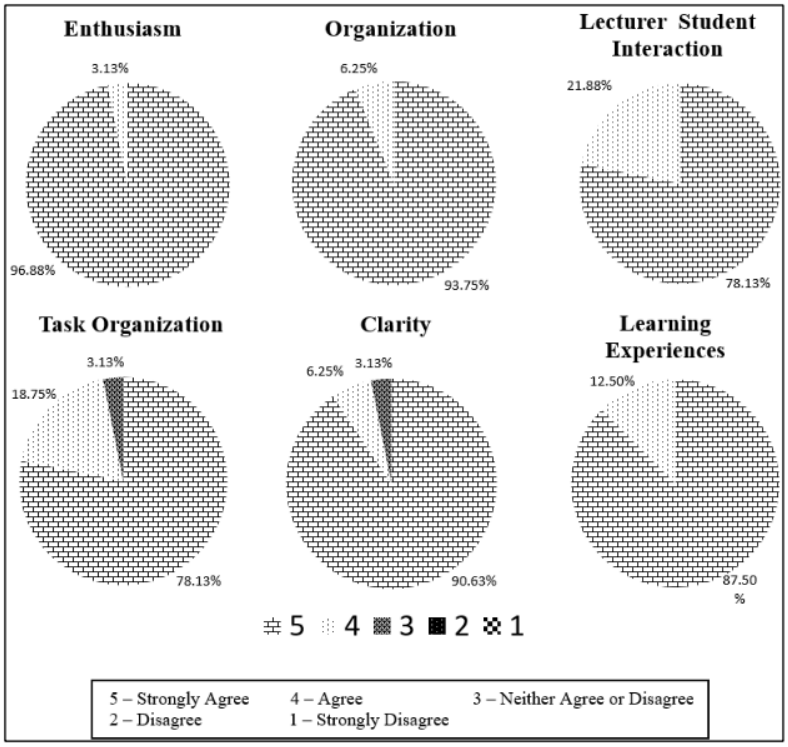

Figure 4: Student feedback summary for a lecturer conducted during CTHE (2023)

By the end of this activity, students were able to gain hands-on experience in calculating the peak hour factor based on data collection, which significantly improved their understanding of the topic. Furthermore, another significant change made to the lectures was the use of images and videos to explain content in 20–30-minute segments, rather than relying solely on text-based presentations. This helped to maintain student attention throughout the lecture, as the delivery style varied every 20-30 minutes. This change is believed to have contributed to the improved feedback for the 'Fundamentals of Transportation Engineering' module conducted in 2023 while participating in the CTHE Programme, as shown in Figure 4.

4. CONCLUSION

Active learning is a powerful approach to enhance student engagement and learning outcomes in engineering education. By shifting the focus from passive listening to active participation, students become active learners, constructing knowledge through hands-on activities, group discussions, and problem-solving exercises. This approach fosters critical thinking, problem-solving, and teamwork skills, essential for success in the engineering field. To effectively implement active learning, educators must adopt a student-centered approach. This involves designing engaging activities, providing timely feedback, and creating a supportive learning environment. By incorporating a variety of active learning techniques, such as case studies, simulations, and peer instruction, educators can cater to diverse learning styles and maximize student learning. To ensure the effectiveness of active learning, ongoing evaluation and improvement are crucial. By collecting feedback from students and faculty, educators can identify areas for improvement and refine their teaching practices. Additionally, professional development opportunities can help educators stay updated on the latest research and best practices in active learning. By embracing active learning, engineering educators can empower students to become innovative problem-solvers, critical thinkers, and lifelong learners.

5. ACKNOWLEDGMENTS

We appreciate the time and insights of our respondents and the other young academics who contributed to early phases of the study

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