

Effectiveness of Alternative Assessment Tools used in EiS-SULAM Projects for Sustainable Communities in Engineering Programme

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Abstract

Service-Learning Malaysia-University for Society (SULAM) approach integrates theory and practice to expose students to real-world community problems and develop their higher-order thinking skills (HOTS). However, there is a lack of research on alternative assessment tools used to evaluate SULAM projects in engineering programs. This study focuses on the assessment tools used for the Engineers in Society (EIS) course integrated with SULAM (EiS-SULAM) and their effectiveness. A questionnaire survey was administered to 462 civil engineering students who took the EiS-SULAM course during the October 2020, March 2021, and October 2021 semesters. Of the 462 students, 165 responded to the questionnaire, resulting in a response rate of 36%. The students' perspectives were triangulated with the direct attainment of the program outcomes for the course based on the assessments used. The results showed that all students met the 50% cut-off mark for the EiS-SULAM course, satisfying the EAC Standard 2020 criterion. The study highlights that the four assessment tools used in the EIS course are effective, but there is a room for improvement. The students suggested the need for financial support from the university, improvements to the assessment tools, facilities such as internet, conducive environment to enhance their learning experience, and additional support from lecturers/advisors highlighting the importance of quality guidance and mentorship for student success. The study's findings could help improve engineering assessment instruments to enhance the students' skill sets related to sustainable community. However, the use of purposive sampling may limit the generalizability of the results to other engineering programmes or institutions. The results suggest that the EIS-SULAM course is effective in developing students' HOTS and achieving essential skill sets for societal well-being. In conclusion, this study provides valuable insights into the effectiveness of assessment tools in SULAM projects for engineering programmes and its potential to develop the essential skill sets required for community and societal well-being. Future research could explore the effectiveness of SULAM in different engineering programmes and institutions using different sampling methods. In addition, promising avenue for future research is the integration of Artificial Intelligence (AI), such as ChatGPT, in the development of assessment prompts for engineering courses. This research could focus on creating AI-powered prompts aligned with course and program outcomes to enhance the efficiency and effectiveness of student evaluation.

Keywords: Assessment tools, community, Engineers in Society, SULAM

1. Introduction

The Ministry of Higher Education in Malaysia introduced Service-Learning Malaysia-University for Society or known as SULAM, emphasizing the importance of community engagement and learning experiences for university students (MoHE, 2019). These initiatives reflect the recognition that service-learning should foster sustainable collaboration between institutions and communities, as suggested by a study conducted by Mackenzie et al. (2019). SULAM offer views on how students respond to community's needs by applying their knowledge and skills learned in the classroom environment (Yusof et. al., 2020). SULAM projects in engineering courses encourage students to be creative in engineering profession to resolve societal, ethical, and cultural issues encountered. Moreover, some universities have developed their own set of service-learning criteria that they believe are more appropriate for their specific context. Assessment-led reform is now one of the most widely favoured strategies to promote higher standards of teaching, more powerful learning and more credible forms of public accountability. Within this context of change, higher education in many countries is increasingly subjected to demands to implement alternative assessment strategies that provide outcome measures of both student and program effectiveness (Libman, 2010). The implementation of service learning is an important aspect of Malaysia's current learning strategy, as it is seen to achieve the national educational goal of producing graduates with employable skills (Musa et al., 2017). While traditional examination methods have long been the norm for assessing student performance, the evolving landscape of education recognizes the need for more diverse and comprehensive assessment approaches. SULAM projects, which emphasize community engagement and the practical application of classroom knowledge and skills, provide a unique opportunity to explore alternative assessment tools tailored to the engineering discipline.

In Malaysian engineering education, assessment tools are vital for evaluating student outcomes and identifying areas for improvement, as mandated by the Engineering Accreditation Council, Board of Engineers Malaysia, ensuring the effectiveness of the educational process (Engineering Accreditation Council, 2020). In addition to traditional exams, alternative assessment tools include a variety of methods such as grading rubrics, assignments, portfolios, and self and peer evaluations (Muhammad et al., 2018). These tools, such as grading rubrics, assignments, portfolios, and self and peer evaluations, offer a multifaceted view of student learning and potentially enhance the educational experience. In addition, these tools also help educators tailor their teaching strategies to meet group and individual student needs. They may also provide a framework for measuring student performance, progress, and achievement in different areas of studies based on criteria to achieve the learning outcomes. Mohd-yusof et al. (2015) explored challenges in global engineering practice in the 21st century, before laying down the status quo in engineering education. Thus, the 21st century learning has led to the development of new alternative assessment tools, such as digital portfolios, online quizzes, and simulations, that offer more interactive and engaging learning experiences for students. These assessment tools not only provide more accurate and timely feedback on student progress but also help educators identify gaps in learning and adjust their teaching strategies accordingly.

Alternative assessments, such as problem-based and project-based assessments, can be used in conjunction with performance exams or authentic assessments to assess a student's ability to apply their knowledge and solve specific tasks. Unlike traditional assessments that focus on knowledge acquisition, alternative assessments prioritize applied proficiency in a subject. In higher education, alternative assessments can play a critical role in evaluating students' performance and promoting reflective thinking, which facilitates deep learning (Kiew et al., 2020). However, there were various challenges in assessing community service-based experiential learning, thus there is a need to develop assessments tools having clear assessment criteria, ensuring fairness and consistency in grading, and assessing the learning outcomes beyond technical skills. Thus, it is important to ensure that assessment tools are valid, reliable, and aligned with learning objectives. Educators need to use a variety of assessment methods to ensure that students are demonstrating a wide range of skills and knowledge. They also need to be aware of the potential biases and limitations of different assessment tools and ensure that they are using them appropriately. The study by Chan (2012) investigated the assessment methods used in community service-based experiential learning within the field of engineering. The study revealed a wide range of assessment methods employed in community service-based experiential learning, including written reports,

presentations, portfolios, self-assessment, and group evaluation. The different evaluation criteria were used to assess students' performance, such as project management skills, technical competence, problem-solving abilities, teamwork, and communication skills.

Kiew et al. (2020) investigated the effectiveness and acceptance of alternative assessments by focusing on authentic and flipped assessment methods by conducting a qualitative analysis on 208 engineering students that revealed positive experience towards the implementation of alternative assessments. The students acknowledged that these assessment approaches promote cooperative learning and reinforce their understanding of the course materials in an active manner. Earlier, a study by Gadusova et al. (2017) focused on the evaluation of instructors from the aspect of the impact of their activities on students by adding new content to existing assessment tools and design a set of assessment tools, along with the criteria for the evaluation of the obtained data, while, Chan (2020) obtained feedback from students and teachers gauge their preferences towards these assessments, as well as their opinions on assigning academic credits to experiential learning projects in Hong Kong's Sichuan Reconstruction Community Service Project. Shortly after, researchers delved into the impacts of alternative assessment in the context of a Civil Engineering Materials course, both before and during the Covid-19 pandemic. This investigation involved comparing various factors, including the content of assessments, grades achieved, and student perceptions, as demonstrated in the study conducted by Mustafa et al. (2020). In contrast, a more recent study aimed not only to enhance traditional assessment methods but also to innovate by developing an authentic alternative assessment instrument tailored for the Engineers in Society (EIS) course. This novel assessment tool was seamlessly integrated with the Service-Learning Malaysia (SULAM) approach (Mat Isa et al., 2022). The research focused on analysing the anticipated outcomes and assessing the instrument's success, particularly in the challenging context of the Covid-19 pandemic thus, addresses a critical gap in the existing research by examining the effectiveness of the tools employed.

Mohamad Uri and Abd Aziz (2017) explored the effectiveness of self-assessment practice among engineering students based on the form of written assignments were collected throughout the study and analysed via students' own analyses and lecturers' evaluation. Despite some studies exploring the effectiveness of alternative assessments in various educational settings, there exists a critical research gap pertaining specifically to the evaluation of these tools within the context of SULAM community projects in engineering programs in Malaysia. This gap is significant, given the increasing emphasis on community-based learning and the need to ensure that assessment methods align with the desired program outcomes and promote a deeper understanding of course materials. In the context of Malaysian engineering education and the implementation of Service-Learning Malaysia (SULAM) community projects, there is a significant gap in the evaluation and understanding of the effectiveness of alternative assessment tools. Thus, the objective of this study is to investigate and evaluate the effectiveness of alternative assessment tools in the context of SULAM community projects within Malaysian engineering education. As the initiative, this study aims to determine the effectiveness of alternative assessment tools used in the EIS-SULAM by advocating interim report, presentation, final report, and video montage as the assessment tools to identify the learning experiences gained by the students through sustainable community projects.

2. Methodology

2.1 Research Approach

This study adopted a quantitative approach using a survey questionnaire to collect data from targeted respondents who had taken the Engineers in Society course. In addition, document analysis was also conducted on the outcomes attained by the students based on the direct assessment using the developed alternative assessment tools for the course.

2.2 Design of Survey Questionnaires

The survey questionnaire was developed based on a review of relevant literature and pilot tested to ensure its

validity and reliability. The survey questionnaire consisted of five sections: Section A (Demographic), Section B (Perception and Understanding on Design Thinking approach), Section C (Assessment Tools), Section D (Challenges), and Section E (Recommendations and Improvements). Only Section A, Section C, and Section E are presented in this paper.

2.2 Target Respondents

The target population consisted of 462 students who were in their final year and semester 8, selected using a purposive sampling method based on a sampling frame obtained from the Academic Affairs Office of the School of Civil Engineering Universiti Teknologi MARA, Shah Alam for Semester October 2020 (240), March 2021 (102), and October 2021 (120). Informed consent was obtained from all participants, and confidentiality was ensured. The questionnaire was administered online, and reminders were sent to encourage participation. Of the 462 students, 165 responded to the questionnaire, resulting in a response rate of 36%. While the response rate is lower than ideal, the results provide some insight into the experiences of a subset of the target population.

2.3 Data Collection and Analysis

The main data collection techniques were questionnaires supplemented by documentary review. Data collected from the survey questionnaire were analysed using descriptive statistics, including frequencies and percentages. This study adhered to ethical principles and guidelines for research involving human participants, including obtaining informed consent, ensuring confidentiality, and protecting the rights and welfare of participants. The performance of the students in this course is also presented based on the programme outcome attainment, which are Engineers in Society (PO6) and Ethics and Professional Behaviour (PO8) extracted from the assessment system namely, myCOPO as shown in Figure 1.



Figure 1. A sample of PO6 and PO9 Direct Attainment from myCOPO System

2.4 Validity and Reliability

The items, constructs and variables of interests are selected and design through a thorough review of the literature and expert opinions (lecturers, course coordinator and resource person assigned to the course) to validate that the tools used are appropriate for assessing the intended outcomes. A pilot study was also conducted where a small sample of participants was involved to improve the tools accordingly based on feedback. In addition, the direct attainment of both programme outcomes was obtained from the Office of Academic Affairs of the School of Civil Engineering, using an assessment platform known as myCOPO (see Figure 1).

3. Results and Discussion

Results analysis from the administered survey is discussed in the following sub-sections.

3.1 Respondents' Profiles and Background Information

Section A includes demographic questions to collect background information about the respondents. The questions cover four areas, including the gender of the students, their age, CGPA, and whether they have taken the EIS-SULAM course. According to the survey data, the respondents were almost evenly split between male and female, with 49% identifying as male and 51% as female. Most respondents (95%) were between the ages of 24 and 26. All but a few of the respondents (98%) reported taking the Engineers in Society course. In terms of academic performance, almost half of the respondents (49%) attained a CGPA of 3.0 or higher. It is worth noting that the distribution of CGPAs was skewed slightly toward higher grades, with the median CGPA falling above 3.0. Overall, these results suggest that the surveyed population is diverse in terms of gender, age and performance with a majority having taken the Engineers in Society course and a significant proportion achieving high academic performance.

3.2 Respondents' Awareness on SULAM Initiatives

Section B of the questionnaire assesses the respondents' awareness of SULAM initiatives, which are inspired by the Ministry of Education in Malaysia. Figure 2 displays the percentage distribution of respondents based on their level of awareness of SULAM's purpose as an effective initiative to achieve the Ministry's aspirations.

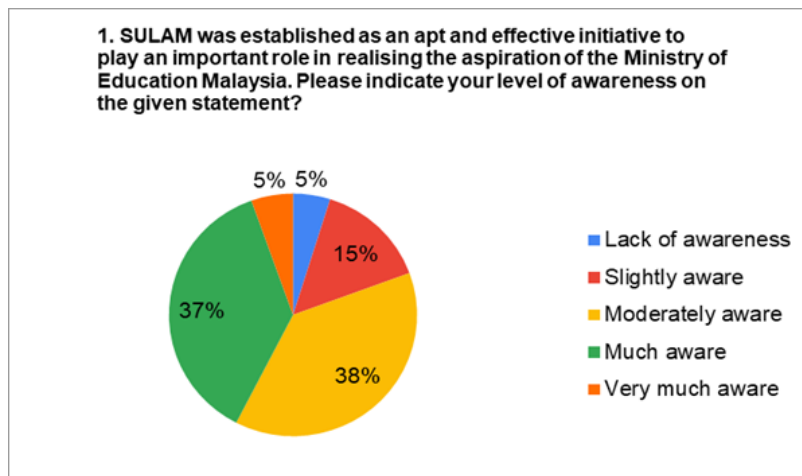


Figure 2. level of awareness of SULAM's initiatives

The survey results indicate that 80% of students are aware of the establishment of SULAM and consider it an effective initiative for realizing the aspirations of the Ministry of Education Malaysia. These findings highlight the crucial role of SULAM in achieving the educational goals set by the government.

According to Figure 3, a staggering 97% of the surveyed students demonstrate a clear understanding of the purpose of SULAM. This indicates that a vast majority of students are cognizant of the role of universities in society and the importance of preparing students to become responsible public intellectuals capable of addressing society's challenges. This is aligned with the study by Mamat et. al. (2019) where through SULAM, students can better understand the content of a course, apply the theories learned in fieldwork with the community and increase their soft skills.

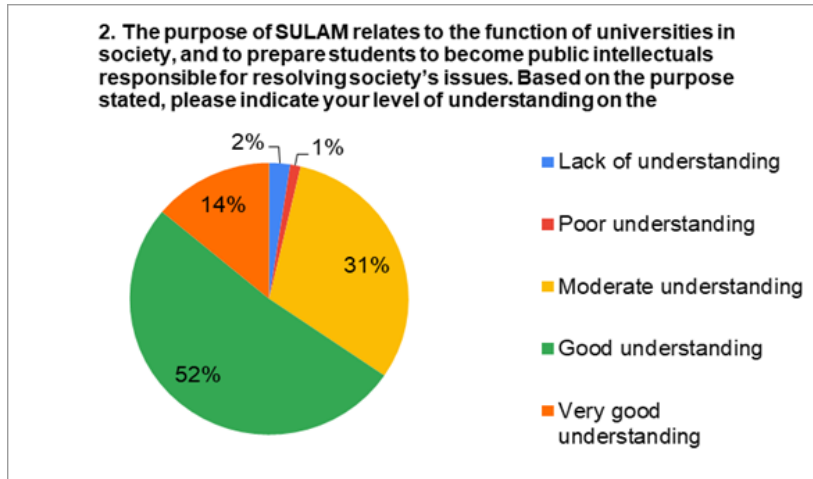


Figure 3. Level of Understanding on the Purpose of SULAM

Based on Figure 4, it can be inferred that 97% of the surveyed students were aware of the EIS SULAM project which aims to bridge the gap between theory and practice by addressing real-world issues in the community and integrating learning objectives with community service. This high percentage suggests that the students have a good level of awareness of EIS-SULAM and its objectives.

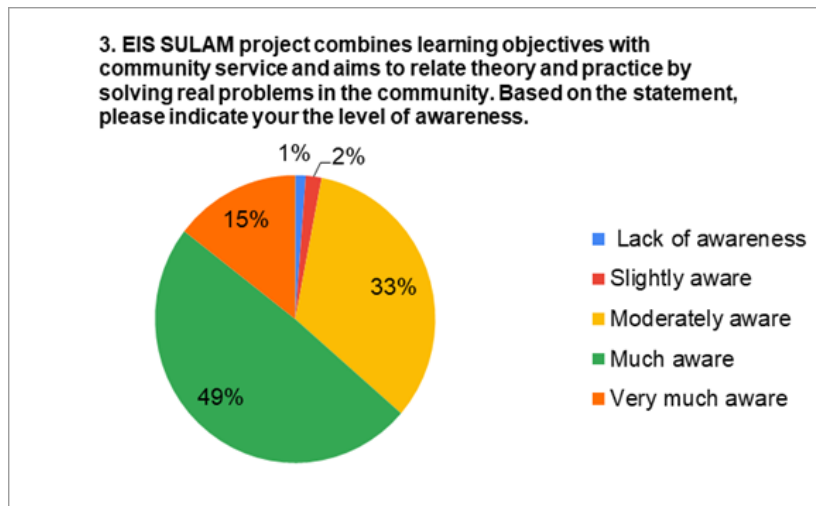


Figure 4. Level of Awareness on the Aims of SULAM

3.3 Effectiveness on Teaching and Delivery Methods

Figure 5 indicates that 95% of students agreed that the teaching and delivery methods were effective in providing them with the necessary and relevant information. These methods also helped students gain a better understanding of the role of engineering in society and identify faults in the engineering practice.

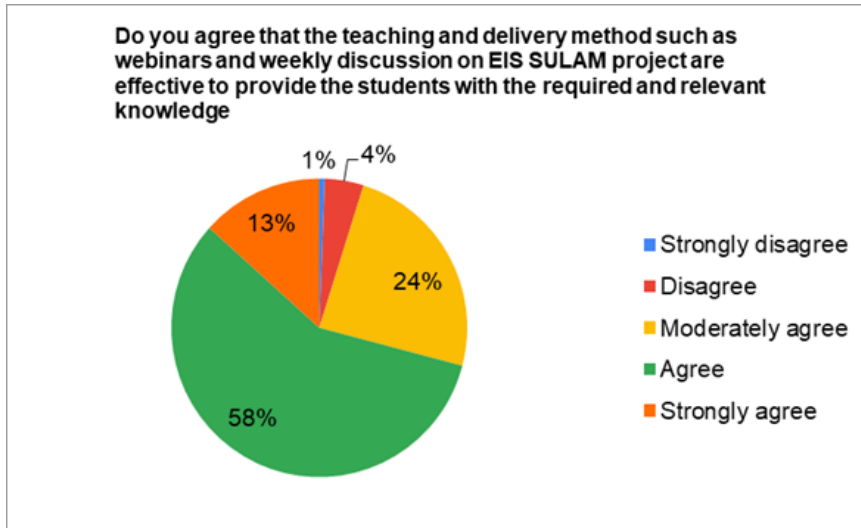


Figure 5. Level of Agreement on the Effectiveness of Teaching and Learning Delivery Methods

Some examples of the sustainable EIS-SULAM community projects carried out by the students in the course include Mangrove Trees Planting as Natural Fortress in Hutan Simpan Banjar Utara for Conservation of Swamp Forest in Kuala Selangor, Safer Mobility for Community at Sekolah Kebangsaan Sungai Binjai Botanical Park, Rescue Mission “Save Our Nature, Heal the Environment”, Botanical Park Clean & Care Program at Taman Botani Negara Shah Alam, Selangor as illustrated in Figure 6 (a, b & c).



Figure 6a. Mangrove Planting in Kuala Selangor



Figure 6b. Innovation Activities with Primary School Students



Figure 6c. Botanical Park Clean & Care Program

3.4 Recommendations for Improvement on SULAM implementation

Figure 7 shows the highest percentage of students (23%) expressing the need for financial support from the university suggests a significant impact of the Covid-19 outbreak on their financial situations. Financial aspects may be discerned by students as an influential factor in assessing their experiences of the educational programme (Boon et al., 2022). This underscores the importance of institutions being sensitive to students' financial challenges and considering measures to alleviate their burdens. Even though the students perceived that the assessments tools used in the course are effective as discussed earlier, the second highest recommendation (18%) for improvements in assessment tools implies that students may believe that the current methods could be enhanced for greater effectiveness and fairness. This highlights the importance of ongoing evaluation and adaptation of assessment strategies to align with students' needs and expectations (Teacher Development and Certification, 2006). The substantial percentage (16%) of students recommending

enhancements to facilities like internet access and conducive learning environments indicates that these factors play a crucial role in their learning experience. Addressing these aspects can contribute significantly to students' overall satisfaction and academic success. The call for improved support from lecturers/advisors (15%) underscores the vital role of quality guidance and mentorship in fostering student success. It emphasizes the need for strong teacher-student relationships and academic support systems within the educational institution. Lastly, the relatively lower percentage (14%) of recommendations regarding the content of the syllabus and teaching delivery method suggests that most students are content with the current course material and teaching approach. This indicates a level of satisfaction in these areas but also highlights the importance of regularly assessing and adapting instructional content to meet evolving student needs. In conclusion, these recommendations offer valuable guidance for institutions aiming to enhance the student experience. They underscore the significance of financial support, assessment tool improvements, facilities, academic support, and effective teaching in ensuring a positive and successful educational journey for students.

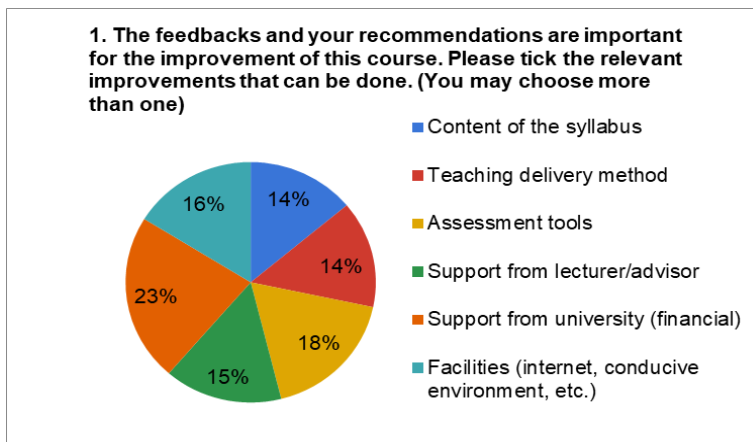


Figure 7. Feedback on Recommendations to Improve the EIS-SULAM Course

3.5 Challenges Faced by Students in Implementing EiS-SULAM Projects during ODL

Figure 3.7 displays the challenges that students faced during the implementation of their SULAM projects through ODL.

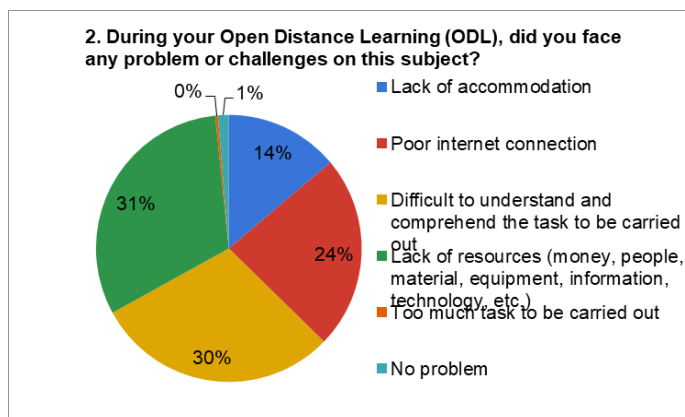


Figure 8. Challenges Faced During ODL

The findings from the current study indicate that students perceive a lack of resources, including financial resources, personnel, materials, equipment, and information technology, as the most significant challenge. This suggests that students may have faced difficulties in accessing the necessary resources to effectively complete their service-learning projects. On the other hand, the study by Yusof et al. (2020) highlights that lecturer identified the lack of structural support as a key challenge in implementing service learning. Even before pandemic, a study by Mamat et al. (2019) emphasized the importance of institutional support, including the provision of resources and training, in facilitating the effective implementation of service-learning programs. This encompasses issues such as institutional policies, availability of resources, and administrative support.

The next most common challenge was understanding and comprehending the task at hand, with 30% of respondents indicating difficulty in this area. This may have been due to the virtual nature of the ODL setting, making it harder to receive clarifications or feedback. On the other hand, Yusof et al. (2020) found that the main challenge identified from the students' experiences is the lack of any close association between what has been learnt in the classroom, and what needs to be implemented in a practical situation. Both findings indicate challenges related to the alignment between theoretical knowledge and practical application. The current study highlights difficulties in understanding and comprehending tasks in a virtual setting, which may hinder students' ability to bridge the gap between theory and practice. Similarly, the previous study identifies a lack of association between classroom learning and practical situations as a challenge. These findings suggest a common issue of disconnect or mismatch between what students learn in the classroom and what they need to apply in real-world scenarios.

The third challenge reported in the current study was the workload, with 24% of respondents feeling overwhelmed by the number of tasks assigned to them. This finding aligns with previous research by Yusop and Correia (2013) that highlighted the mental stress experienced by students during service-learning projects. The intense cognitive and physical labour required in such projects sometimes led to emotional outbursts. The fourth and final challenge was a lack of accommodation during the ODL, which accounted for 14% of responses. Only 1% of respondents did not encounter any problems during their ODL. These findings suggest that students faced significant challenges during the implementation of their SULAM projects through ODL, particularly with regards to resources, understanding of tasks, workload, and accommodation. The findings suggest that there is a need for better institutional support and infrastructure to facilitate the successful implementation of service-learning initiatives (Mamat et al., 2019).

Prior to the pandemic some the challenges during ODL were lack of sufficient time for study, difficulties in access and use of ICT, ineffective feedback and lack of study materials (Zebron, 2015). However, the findings from the current study and the recent studies on ODL during post pandemic highlight several common challenges in service-learning implementation. These include a lack of resources, such as financial, personnel, and technology, which hinders students' ability to complete projects effectively. There is also a disconnect between theoretical learning and practical application, as students struggle to understand and apply knowledge in real-world situations. The workload and associated stress are additional challenges faced by students, leading to emotional strain. Furthermore, the virtual nature of online distance learning poses difficulties in terms of task comprehension and accommodation. These findings emphasize the importance of institutional support, resources, and infrastructure to address these challenges and enhance the successful implementation of service-learning programs. Thus, addressing these challenges could improve the effectiveness of ODL and help students complete their projects more efficiently.

3.6 Effectiveness of Assessment Tools Used in the EiS-SULAM Projects

Figure 9 provides insights into the effectiveness of the assessment tools used in the Engineers in Society course, as perceived by the students.

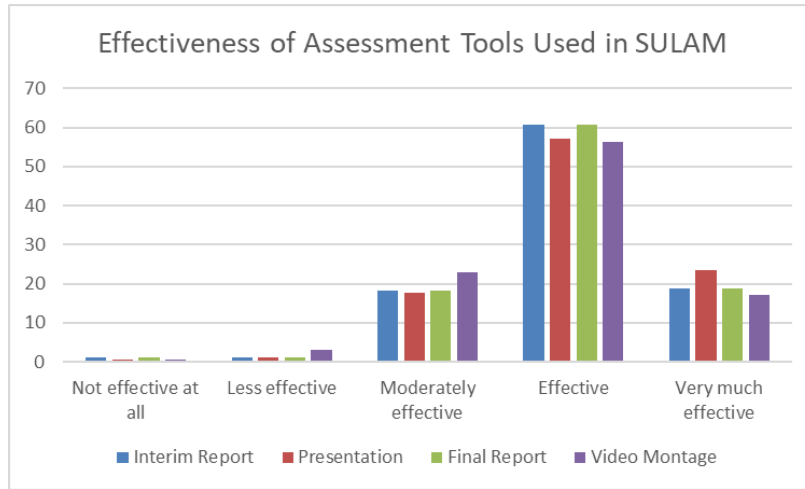


Figure 9. Effectiveness of Assessment Tools used in EIS-SULAM

The data indicates that almost all students (98%) found the presentation to be an effective assessment tool, highlighting its usefulness in evaluating their learning outcomes. Similarly, a high percentage of students (97.6%) agreed that both interim and final reports were effective assessment tools. This finding suggests that these reports could be reliable indicators of students' progress throughout the course. Additionally, around 96.4% of the students indicated that video montage is an effective assessment tool, indicating that it could be an innovative and effective way to assess students' learning outcomes. Overall, the results suggest that the four assessment tools used in the EIS course are effective. As highlighted by Chan (2012), effective assessment methods were found to enhance students' learning experience, promote reflective thinking, and develop their professional and social responsibility.

3.7 Analysis on the Direct Attainment of Programme Outcomes for Engineers in Society Course using the Alternative Assessment Tools

Figure 10 shows the programme outcome attainment for EIS-SULAM course for 3 semesters which are October 2020, March 2021, and October 2021.

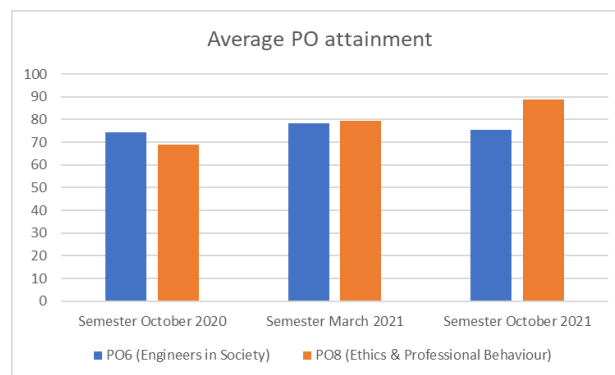


Figure 10. Average PO Attainment based on Direct Assessment through the Four Assessment Tools used in EIS-SULAM Course

The data indicates a positive trend in both PO6 and PO8 attainment across the three semesters. In Semester October 2020, the PO6 and PO8 attainment were 74.4% and 69%, respectively. However, in Semester March 2021, there was a significant improvement with PO6 attainment increasing to 78.2% and PO8 attainment increasing to 79.3%. The improvement could be attributed to the implementation of an improved assessment tools. In Semester October 2021, the PO6 attainment remained consistent at 75.4%, while there was a significant increase in PO8 attainment to 88.8%. This indicates that the assessment tool and teaching methods used in the course are effective in helping students achieve PO8, which focuses on the ability to communicate effectively. Overall, the data shows a positive trend in both PO6 and PO8 attainment, with PO8 showing a significant improvement in Semester October 2021. This indicates that the course is effective in helping students develop the necessary skills and knowledge in these areas.

Based on the findings from the perceptions on the effectiveness of assessment tools and direct attainment of the programme outcomes, the relationship between these findings is evident. The positive trend in PO6 and PO8 attainment suggests that the assessment tools and teaching methods are effective in achieving these outcomes. The second finding, which highlights students' perceptions of the assessment tools' effectiveness, supports the idea that these tools indeed contribute to the positive trend in outcome attainment. Effective assessment methods, not only improve students' learning experiences but also foster reflective thinking and the development of professional and social responsibility. Therefore, these findings collectively indicate that the assessment tools used in the EIS course are not only effective in the eyes of students but also instrumental in achieving the desired program outcomes, particularly in enhancing their ethical and professional behaviour. However, it is important to continue monitoring and improving the assessment tools and teaching methods to ensure that students are meeting the expected learning outcomes (Teacher Development and Certification, 2006). The most recent study, highlighted the how the artificial intelligence namely, the ChatGPT may affect assessment in engineering education by exploring ChatGPT responses to existing assessment prompts from various engineering courses (Nikolic et al., 2023).

4. Conclusion and Recommendations

This paper highlights the significance of assessment tools in evaluating student learning outcomes and improving teaching strategies, specifically in the context of the engineering course known as EIS-SULAM. Educators are advised to use a variety of valid and reliable assessment tools that align with course and programme outcomes, while also being aware of potential biases and limitations of different tools. Student feedback indicated overall satisfaction with the course, but identified the need for improvement in assessment tools, facilities, and support from the university and lecturers/advisors. The analysis of challenges faced by students during ODL identified resource and task comprehension issues, which could be addressed through improved guidance and support. The effectiveness of assessment tools used in the EIS-SULAM course was evaluated, with presentation, interim and final reports, and video montage being perceived as effective by many students. The study highlights the importance of continuous assessment and improvement in teaching and learning processes for successful attainment of programme outcomes PO6 (Engineers in Society) and PO8 (Ethics and Behaviour). Several important implications of this study on engineering education are towards the enhancement in teaching, learning and diversity in assessment tools, improvement in student services. Limitations include the small sample size and the limited scope of the study, and future research could explore the impact of different assessment tools and strategies on student learning outcomes in a larger sample. Additionally, the integration of Artificial Intelligence (AI) in assessment prompts, as suggested, presents an exciting avenue for future investigation. In addition, future research may explore the integration of Artificial Intelligence (AI), such as ChatGPT, in the assessment prompts for engineering courses, particularly those with a service-learning component like EIS-SULAM. This exploration can focus on creating AI-powered assessment prompts that align with course and program outcomes, thus facilitating more efficient and effective evaluation of student learning.

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Declaration of Conflicting Interests

All authors declare that they have no conflicts of interest.

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