Automating Peer Evaluation and Attendance in Chemical Engineering Education: A Google-Based Approach

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Abstract
Teaching and learning processes not only involve activities, but class preparation management and pedagogies also play an important role in ensuring quality education is delivered properly. With high-performance indicators to be achieved by academicians, teaching and learning management must be automated to reduce the time spent on these processes. Thus, the one-stop center on content management, automated peer evaluation form (APEF), and attendance management system (AMS) were developed to assist educators in managing academic duties. To date, three chemical engineering courses have been fully developed under the one-stop center which consists of lecture notes, videos, tutorials, past year questions, and any scaffolding activities. APEF and AMS were developed in a Google environment combining Google Site, Sheet, Form, Docs, and Scripts. The APEF was designed to reduce errors in data management and data population of the peer evaluation marks. Meanwhile, the motivation for AMS is to ensure paperless and seamless attendance monitoring can be conducted on real time basis. The output is a fully automated peer evaluation form and attendance monitoring system that can monitor student peer evaluation submission in real-time, providing automated data population and calculation, tracking student attendance, and serving as an evidence collection tool. These tools have had a great impact on the instructors as well as the students in managing their classroom as shown in the 100% agreement in the user satisfaction survey. Although the implementation of these tools as a department practice is not yet in place, the potential of mass adoption is profound due to its simplicity, applicability, and scalability.

Keywords: Teaching and learning tools, one stop center, peer evaluation, attendance monitoring, quality education.

Introduction

Quality education is the bedrock of any nation that strives to be a developed country. It is even highlighted in The Global Goals by the United Nations (UN) focusing on Quality Education as explained in theme 4. It ensures inclusive and equitable quality education. Furthermore, the initiative promotes lifelong learning opportunities for all. Under target 4.4, it is expected that by 2030 the initiative will be able to increase the number of people with relevant skills to increase their earnings and obtain financial success (Nations & Affairs, 2021).

However, there are still challenges in providing quality education by knowledge providers. With the abundance of information and unchecked quality from unqualified subject matter experts. Furthermore, higher non-teaching deliverables expected to be delivered by the university lecturer hinder a higher quality of teaching and learning (T&L) activities. The repetitive process of managing T&L activities should be reduced to provide space and time for lecturers to focus on developing impactful learning experiences for the students as well as other non-teaching deliverables.

Aligning with the SDG initiatives, the main stakeholders of quality education are the students. Quality information, delivery, and experience need to be provided to ensure full engagement can be made with the students. Staying with a teacher-centric approach has proved to be ineffective in providing a holistic experience. Utilizing any student-centric approach on the other hand has shown a significant improvement in student cognitive, psychomotor, and affective development (Howell, 2021; Ruslan et al., 2021; Wu, 2016). However, developing an impactful T&L experience for the student requires the time and creativity of the instructor. To assist this, the repetitive T&L management needs to be automated.

The current learning management system (LMS) focuses more on content management, group management, and assessment management, providing a platform for online discussions and meetings. To the best of our knowledge, other LMSs only allow for the current students who are enrolled in the course to access the learning materials. Thus, the development of

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a one-stop center allows for a better reach and accessibility to those who wish to use it be it as a learner or as an instructor. Moreover, other features such as peer evaluation that was heavily used in team projects are not available in any LMS that the author has encountered. Even though peer evaluation has been around for years, an effective tool that is incorporated into a learning management system or tools has yet to be developed

Thus, this innovation, aids both main stakeholders, instructors, and learners, by developing a system to automate the T&L process by providing features such as a learning platform, automated peer evaluation system, and attendance monitoring system developed using the Google environment.

Innovation Details

One Stop Centre

The development of a Google Site for certain core chemical engineering courses is relevant and crucial to help both major stakeholders in T&L. Rather than only obtaining the knowledge from the instructor alone, an open-source learning material was developed to facilitate student learning. Together with the learning material, sample questions including past year questions for quizzes and final exams were also integrated into this one-stop center for learning material. Google Site was selected to be a content management site due to its simplicity and accessibility by the target market which is UiTM students. Not only is it accessible for students taking the course from the instructor, but it is also open to all who are keen to learn. Moreover, the material will also be useful for final-year students who will be developing their plant design. Conventionally, learners would consult with the lecturer and hope to be spoon-fed on the solution. However, with the availability of this one-stop center, it is expected that the learner can come to the discussion with basic knowledge in hand. This will make the discussion more meaningful and not depend entirely on the instructor. These are aligned with the active learning and flipped classroom initiative that will be discussed further in the learning theory applied in the next topic. Figure 1 shows the Google Site framework for easier reference.

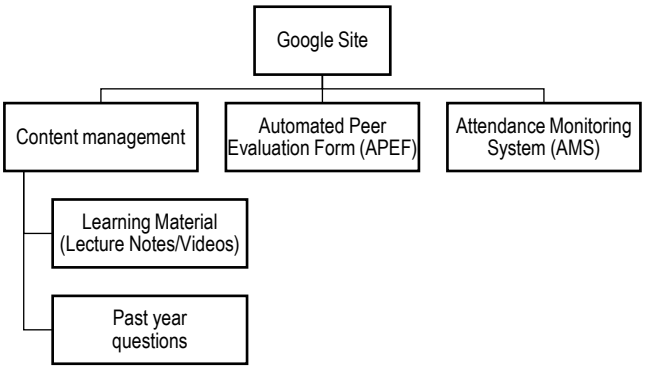

Figure 1. Google Site framework and main components of the innovation

Automated Peer Evaluation Form (APEF)

Included in the Google Site is an Automated Peer Evaluation Form (APEF) that can be used for subjects that utilize group work as a form of assessment. Peer evaluations are essential to ensure the weightage of work done by each team members are given appropriately. The APEF was developed using the available Google features (Google Forms and Google Sheet). The two apps ensure seamless experience for the user, administrator, and developer. This allows the data to be traced in real time and makes monitoring much easier compared to conventional methods. The APEF is equipped with security features to ensure that the learners are utilizing the correct link and reduce error by the student. On top of that additional features such as pre-filled form are the corner stone of the product. The framework of the APEF is illustrated in Figure 2.

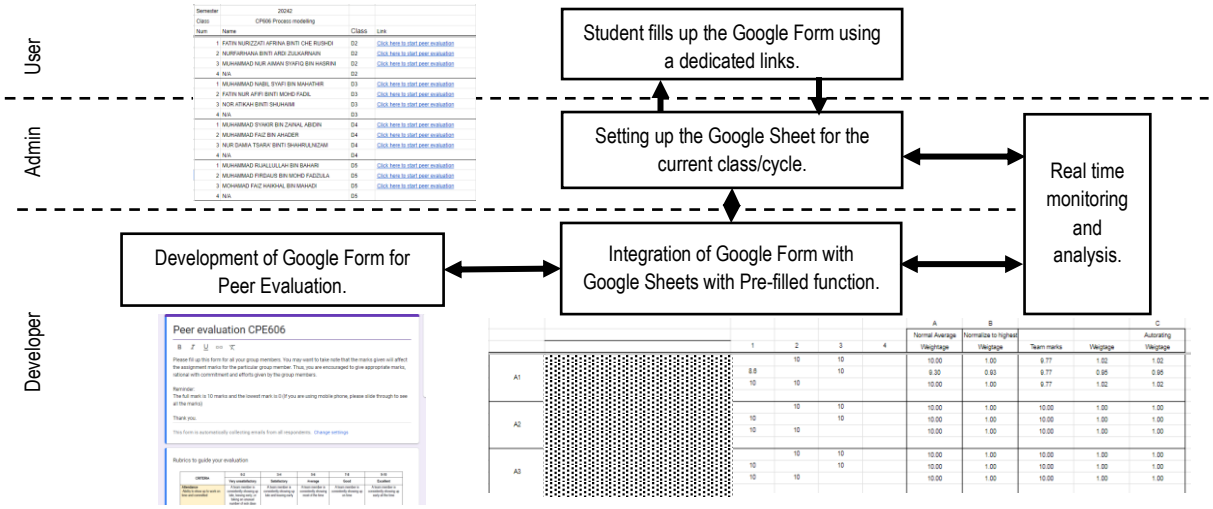

Figure 2: Working Framework of the Automated Peer Evaluation Form (APEF)

The completed peer evaluation form will be integrated with Google Sheets. The equations, coding, and hyperlinks have been embedded in the Google Sheet to ensure the pre-filled forms can be utilized by the user and the admins. Next, the admins are required to fill in the student's name and group that tally up with the class that will be using the form. After that, the dedicated link will be shared with the students as the user of the form. The user will have to log in using their institutional account to ensure they are selecting the correct links, and that it is matched with their user ID. After the data has been submitted, it will be recorded in the same Google Sheets. A series of equations and coding embedded on the sheets will calculate and populate the data in real-time to the peer evaluation marks table. This APEF provides 3 types of calculation which were normal average, normalization to highest, and autorating method. Conventionally, instructors will need to tediously extract individual marks before calculating the respective values for each person involved. Using this APEF, values are automatically calculated and instructors can simply extract the values needed. Additionally, administrators can monitor students who have not completed the evaluation or even those who did make an error in the evaluation using the analysis tab in the Google Sheets. Any anomalies in the table can also be cross-checked with the user's reasoning for every mark provided.

Attendance Monitoring System (AMS)

Other features that were added to the Google Site are the attendance monitoring system (AMS). Utilizing the same features as the APEF, learners can clock in using the personalized Google Form. This reduces the dependency on physical attendance form and transitions to a simplistic paperless system. On top of that, student attendance frequency can be made and to ensure the compliance toward Engineering Accreditation Council (EAC). The framework for the AMS is shown in Figure 3. Moreover, utilizing a Google Script, a warning letter can be generated seamlessly by comparing the attendance percentage to the compliance value. This aids instructors in not manually monitoring the students' attendance and being caught up with administrative tasks of making individual warning letters.

To date, the implementation of AMS has not been very wide, and it is currently exclusive to the author's class only. The practice has been ongoing for 2 semesters and a positive impact has been observed in the attendance monitoring practice. The author feels that attendance collection has been easier compared to manual form, easier collection of medical certificates submitted by absent students, and proper monitoring can be made by utilizing AMS. The most significant feature was the warning letter generation which includes a Google Script development to be integrated with the Google Sheets. Only with a click of a button, a warning letter for multiple students can be generated hassle-free. Embedded to the warning letter was an intelligent code that could be adapted to the date of the letter being generated to ensure an updated version of the letter was generated. The AMS system was not made available to the public due to several documentation that needed to be made before launching it to the masses such as an instruction manual for users and administrators.

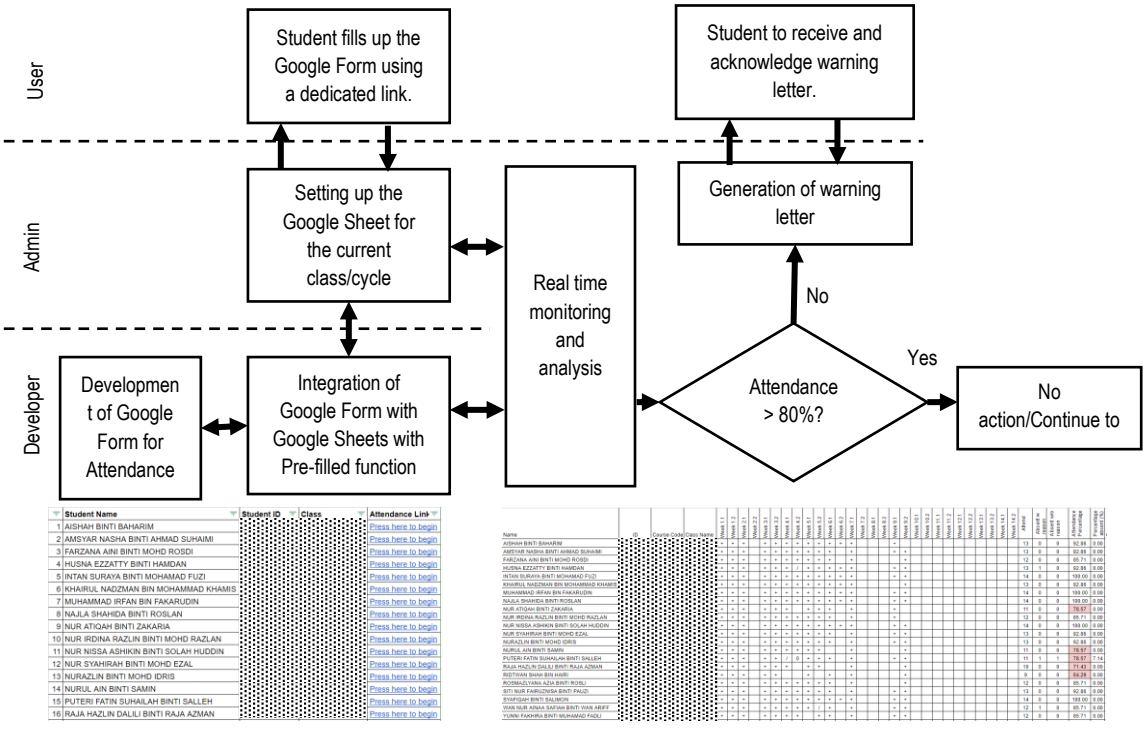

Figure 3: Working Framework of the Attendance Monitoring System (AMS)

Learning Theory and Pedagogical Approach

Student-centred learning theory was applied to ensure learners gain the most out of the learning experience. The learners oversaw their learning while the instructor was facilitating the learning process. Furthermore, the instructor must heighten the learning experience by developing activities that can engage the learners not just cognitively but also psychologically and emotionally. Developing the learning activity according to several principles such as constructivism approach (Do et al., 2023; Pande & Bharathi, 2020), how people learn (HPL) framework (Funes-Lora et al., 2022) and constructive alignment (Yusof et al., 2012) allows a proper mapping between the intended learning outcomes, learning activities, and assessment. Several studies has shown the effectiveness of active learning and flipped classroom approaches in several disciplines such as engineering (Lewin & Barzilai, 2022; Ożadowicz, 2020), computer science (Mirkouei et al., 2016), medical (Phillips & Wiesbauer, 2022; Scholte & Strehler, 2025), business (El-Bassiouny & El-Naggar, 2023), and psychology (Wittmann & Wulf, 2023).

Active learning has shown its capabilities to increase the student level of understanding and motivation in engineering (López-Fernández et al., 2019; von Blottnitz, 2006). It leverages in making the learner actively engaged during the learning session. Activities such as think-pair-share, focused listing, active listening, and one-minute paper were conducted to engage the learner. The implementation is quite straightforward and does not require much resources.

Conversely, a flipped classroom requires the learners to learn before the class starts. Instructors will have to provide additional resources such as books, and videos for the learners to learn so that the discussion and activity in class would be lively and engaging. The resources to the learning materials were provided in the learning management system (LMS) or any content management system available such as Google Classroom, Moodle, and Microsoft Teams to name a few. Instruction was made for the students to prepare peer teaching notes or summaries of the material to be presented and discussed in class. The framework for the flipped classroom was discussed thoroughly by Abdullah and Azizan 2018 and Ruslan et al. 2022. The synchronous and asynchronous sessions were adopted in the implementation plan of the approach. It was designed to engage higher cognitive levels during the discussion with the instructor Many studies have successfully shown that a flipped classroom is often the choice to enhance the learning experience, especially during pandemic times (Awuor et al., 2022; Lewin & Barzilai, 2022; Ożadowicz, 2020). Even though the preparation for the flipped classroom approach is demanding to learners and instructors, the outcome speaks volumes as it is more impactful.

Additionally, proper scaffolding activities were included in the learning process to ensure learners at a lower level were able to understand and appreciate the course. Scaffolding activities such as peer teaching, team quizzes, and formative assessments were included in the lesson plan and executed. Several studies have shown that scaffolding activities can increase learners' engagement. (Bill Ferster, 2014; Mirkouei et al., 2016; Yusof et al., 2012).

Besides that, project-based learning was also embedded in the learning process. Subjects such as process modelling and process simulation which emphasis project delivery were considered for this approach. The framework applied was according to previous researcher (Ruslan et al., 2022). All the necessary materials and steps such as personality checks, team formation, peer evaluations, reflections, and assessments were embedded in the Google Site and APEF to ensure the smooth operation of the learning pedagogy.

Problem Solutions

Conventionally, the learning materials were provided depending on the pace of the instructor. It can be provided either physically or digitally to the learner according to the instructor's lesson plan. In view of the learning management of these learning pedagogies, the availability of learning materials is critical. Accessibility to question banks as scaffolding and formative assessment allows for a better understanding and engagement during the learning activities. Furthermore, digitalized learning material such as lecture notes, online quizzes, lecture videos, and guest lectures is an additional plus point, especially for flipped classroom implementation.

Thus, the one-stop center serves as a library of learning materials to ease up the learning management process by the instructor. Availability and accessibility to the learning materials, question banks, and formative assessment tools such as 'Quizziz' and 'Padlet' allow for on-demand activities to be conducted. The AMS acts as a tool to ease up the attendance monitoring process making it paperless and seamless. Generation of warning letters can be done with a click of a button. Furthermore, for team-based assessment, APEF assists the instructor in automatically collecting, populating and calculating the peer evaluation provided by the learners. This ecosystem allows for peace of mind for the instructor because some of those processes have been automated. Instructors can focus on delivering and designing an impactful learning experience for the learners.

Current Limitation of the Innovation

Although the ecosystem has been automated, there are still flaws and limitations. The one-stop center and AMS are easy to use due to their intuitive nature. All information is readily accessible to the user. The information and syllabus will have to undergo revision over the years to ensure the information is valid,

relevant, and upgraded in terms of presentation and look and feel of the site.

However, the APEF system requires the user to pay close attention to the instruction. Since the form was pre-filled, some users tend to re-fill the name of the student. This can cause mismatches in the system and problems during the data population process. To solve this issue, proper instruction and explanation was given to the user to reduce this error.

Results and Discussion

Google Site Case Study

Using the Google Site developed, active learning and flipped classroom (FC) approach were utilized for two cohorts of students. The first cohort in March 2021 was the process simulation class which utilizes software (Aspen Hysys). The learning material was made public to the students and FC was applied to this group of students. A comparison was made between the students who underwent the FC approach and those who did not. Results in Figure 4 show a significant difference between the two groups. The *t*-test analysis comparing the method shows a *p*-value of 0.01. This shows that the introduction of the FC approach coupled with the digital content is significantly different compared to conventional delivery with a conference level of at least 95%. In this case study, the FC method with digital content has been shown to improve learner performance. The average marks for the conventional group and the FC students are 70.73% and 74.23%, respectively. The data shows that 32.29% of FC students achieve A and A- while 19.33% of the students with the conventional method achieve the same grade. This shows that the Google Site coupled with an effective learning pedagogy can increase student performance. Some reflection by the students did mention that they are able to explore more on the software as shown below:

"*The pros from this experience is I actually push myself to explore more about the Aspen HYSYS and read more the research paper.*"

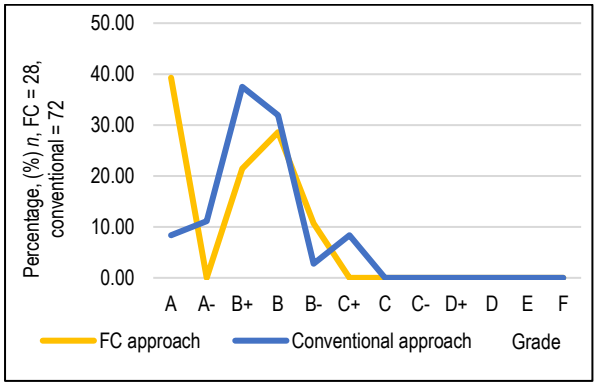

Figure 4. Students grade based on method of delivery utilizing the Google Site.

The same Google Site was applied to 24 repeating students for the process integration course in September 2022. The course is well known to be a tough subject and has a high failure rate amongst chemical engineering students. This provides the perfect opportunity for the implementation of student-centered learning. Since the student background is repeating students and normally being taken by final year students, active learning was selected for the learning pedagogy as it is not too demanding to the students. However, the engagement during the class is maximized to ensure that students can get the full experience. Activities such as jigsaw, peer teaching, gallery walk, reflection, think-pair-share, and one-minute paper were utilized. The student performance between the 2 semesters was evaluated and illustrated in Figure 5. Data shows 22 out of 24 students who retake the class managed to pass the course with 1 student able to score an A. The median increased from 40.01% to 58.40% and a 4-grade leap was observed from D to C+. A one-tailed *t*-test analysis of the result shows that the two data are significantly different with a *p*-value of 2.73 × 10-9 which is way lower than the threshold value of $\alpha = 0.05$. This means that the method is significant in improving student performance. This shows an engaging learning method with a proper content management setup can increase learners' performance and keep the student motivated for the course as mentioned in the reflection of the student: "*Studying is stressful, especially when you're taking more than 1 subject per semester. The fact that I got excited and anticipate to be in Sir XX's class speaks a lot of volume. His classes are very entertaining and insightful.*"

Figure 5. Comparison of student performance utilizing two different learning methods of delivery.

Furthermore, data collected from student reflection as shown in Figure 6 also shows that 100% of the learners exposed to the Google Site agree that the platform was easy to navigate and accessible. The student also agrees that the content provided on the site is easy to follow, the duration is decent, and they

can prepare before attending class. In the context of T&L automation, having the learning material ready for student accessibility coupled with proper instruction and planning, the teaching and learning process can be more effective. As the materials are readily available for the students, it is expected that the students come to class with a general idea of the topics. Instructors take the role of reinforcing the learners understanding. The automation process was initiated when the learning process became a norm that learners seek information through questioning, inquiries, and discussion in the classroom making it cognitively engaging. Moreover, scaffolding and interactive activities can be introduced such as in-class discussions, gallery walks, and team quizzes. These activities have been shown to increase student motivation and knowledge attainment.

APEF Case Study

The development of APEF aims to reduce the instructor's workload by having an automated collection, calculations, and monitoring system. The first draft of the system was proposed in August 2023 whereby students were given links to evaluate each team member. However, this approach was not fully optimized and received a lot of criticism regarding the system by the students. Comments such as requests to add reasoning for the rating, adding the evaluation rubrics to the form, and combining the link so that each person is only provided with one link were addressed. Additionally, 19 out of 94 students (20.21%) face difficulty utilizing the system. Inputs provided are not in the right field or even changing the information that has been pre-filled for them.

Consequently, an improved and optimized system was introduced to the students. For this cycle, all the previous comments were addressed accordingly. The rubrics were provided at the beginning of the Google form, clear instructions were provided to the user, reasoning for the evaluation was also added to the form and verbatim analysis were conducted. In January 2024, the APEF system was handed to users to cater for 295 students which obtained more than 1200 data points for the calculation. Utilizing real-time monitoring and proper instruction to the students, only 2 input errors were found (0.002%). The adjustment has shown a significant improvement in the APEF system. Additionally, the response from the users was extremely positive as it reduced their days' work to only a few minutes of analysis. This shows an increase in productivity and reduces the data management procedures.

Based on the user experience survey that has been conducted on the user (students) as well as the administrator (lecturers), all the respondents agree that the APEF is performing better than the current peer evaluation form as shown in Figure 7. A total of 90 users were surveyed for this study and the data shows that 93.33% of the respondents strongly agree that the form can easily be used, 89.89% of the respondents strongly agree that the APEF is intuitive and can be used with minimal instruction and 95.51% of respondents strongly agree that the APEF form can be completed faster compared to the conventional forms. From the administrator perspective, 60% of the respondents strongly agree that by using the APEF system, the form is easier to manage, the analysis is seamless, the reporting of the form is easily understood, and they did not utilize as much time to analyze the peer evaluation compared to the previous practice. Note that even though 60% rate the form in the "Strongly agree" region on the Likert scale, the remaining maintained on the "Agree" region, and no negative response was received throughout the study. However, some constructive comments were received such as it is hard to find their names in the APEF list. This can be easily addressed by using the filter function in Excel to find their personalized links. Thus, it is believed an instruction to utilize the filter or search function can be introduced to cater to this issue.

Conclusion

This study shows that the Google Site developed is a learning tool that may assist lecturers and instructors in delivering an impactful learning experience to the learners. The development of a simple and intuitive one-stop center is key to having it be used by the users. On top of that, the development of additional tools such as AMS and APEF is important to improve the learning experience for the learners and the instructor. Continuous quality improvement and feedback are most important in ensuring the Google Site is up-to-date and relevant to the current demand. More courses can be included together in the one-stop center to increase the number of courses that can be offered. Moreover, a complete collection of chemical engineering courses can foster a learning community and provide learners with a comprehensive knowledge of the program. Additionally, implementing APEF and AMS as standard practice in the institution is projected to assist academician in managing their classroom. However, the current limitation on the number of instructors involved, storage limitation as well as lack of exposure to the community contributes to the setback of the initiative. These are the challenges that if can be solved can propel the implementation of Google Site to the departmental or institutional level.

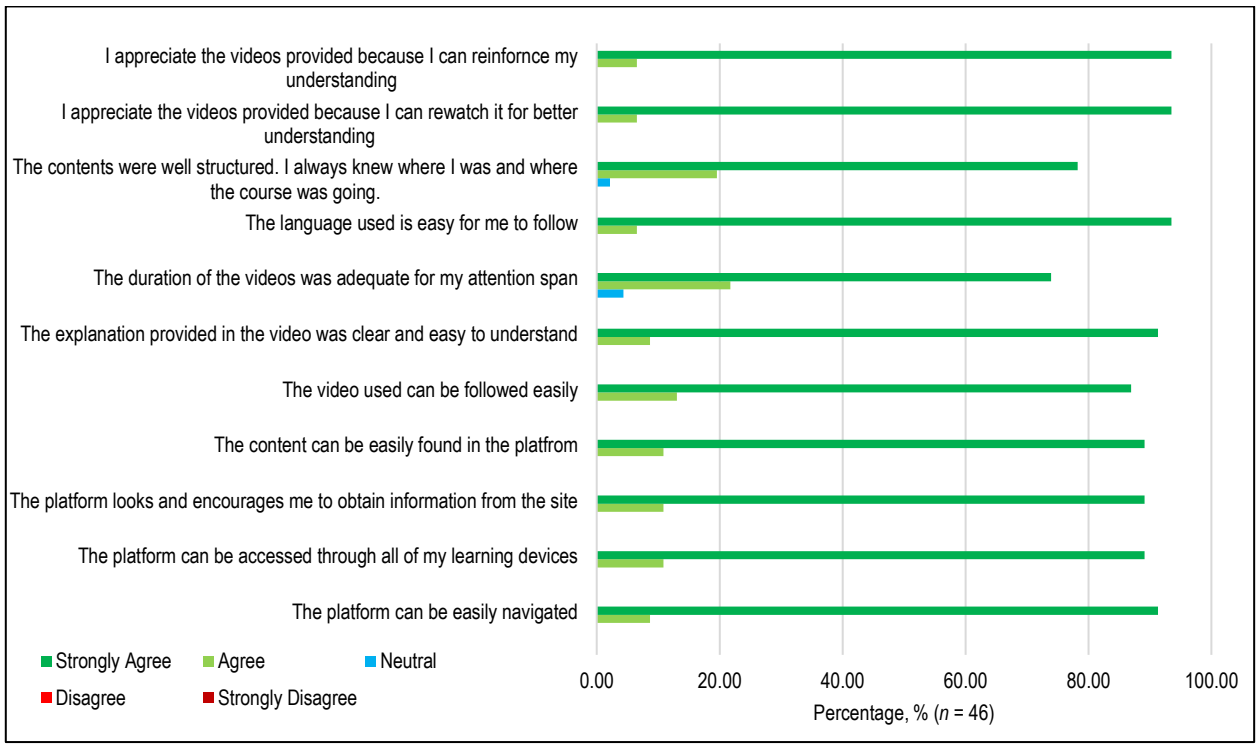

Figure 6. Student reflection and course exit survey after using the Google Site.

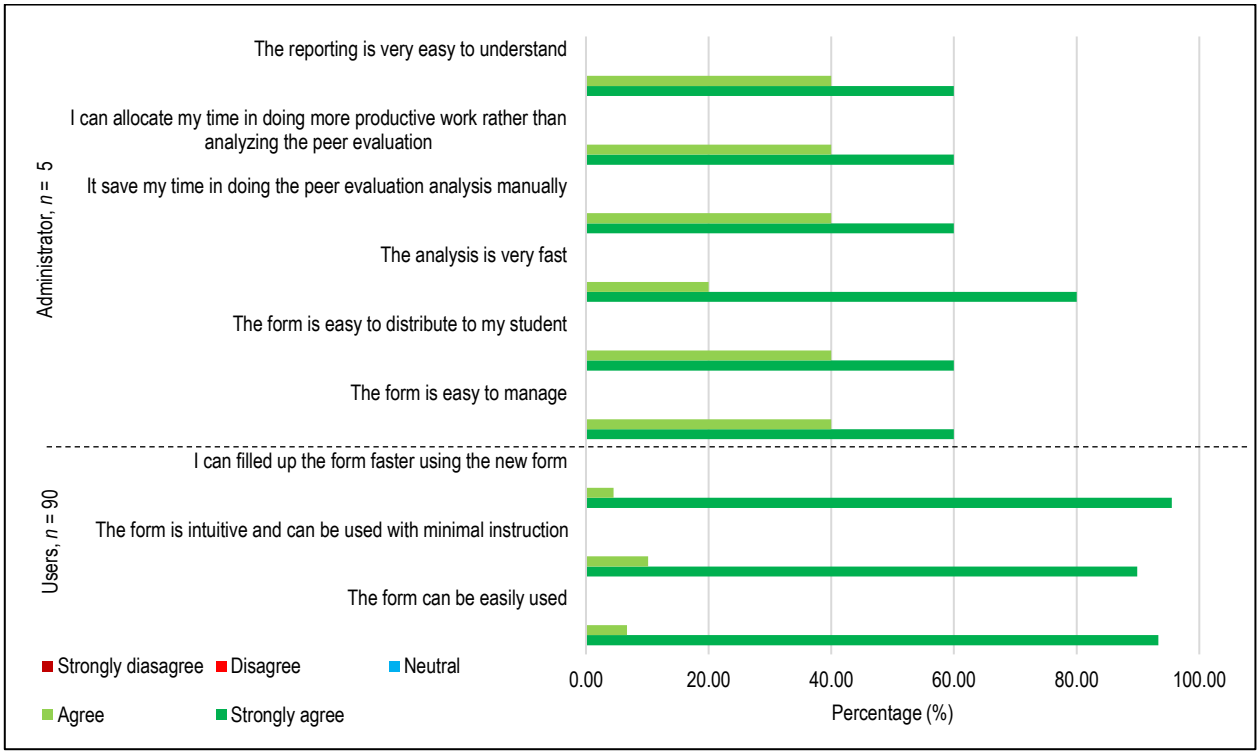

Figure 7. APEF user experience survey analysis

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Conflict of Interest

The authors declare no conflict of interest.

References

Awuor, N. O., Weng, C., Piedad, E. J., & Militar, R. (2022). Teamwork competency and satisfaction in online group project-based engineering course: The cross-level moderating effect of collective efficacy and flipped instruction. *Computers and Education*, *176*(April 2021), 104357. https://doi.org/10.1016/j.compedu.2021.104357

Bill Ferster. (2014). *Teaching Machines: Learning from the Intersection of Education and Technology*. JHU Press.

Do, H. N., Do, B. N., & Nguyen, M. H. (2023). 3How do constructivism learning environments generate better motivation and learning strategies? The Design Science Approach. *Heliyon*, *9*(12), e22862. https://doi.org/10.1016/j.heliyon.2023.e22862

El-Bassiouny, N., & El-Naggar, D. H. (2023). Flipped classroom application in an advanced research methods course: Insights from social cognitive theory and self-determination theory. *International Journal of Management Education*, *21*(3), 100881. https://doi.org/10.1016/j.ijme.2023.100881

Funes-Lora, M. A., Fu, A. Q., Webster, N., Burcon, S., & Shih, A. J. (2022). A Common First-Year Undergraduate Engineering Course in Manufacturing based on Industrial Robots and Flipped Classroom. *Manufacturing Letters*, *33*, 970–981. https://doi.org/10.1016/j.mfglet.2022.07.118

Howell, R. A. (2021). Engaging students in education for sustainable development: The benefits of active learning, reflective practices and flipped classroom pedagogies. *Journal of Cleaner Production*, *325*(June), 129318. https://doi.org/10.1016/j.jclepro.2021.129318

Lewin, D. R., & Barzilai, A. (2022). The flip side of teaching process design and process control to chemical engineering undergraduates – And completely online to boot. *Education for Chemical Engineers*, *39*(February), 44–57. https://doi.org/10.1016/j.ece.2022.02.003

López-Fernández, D., Ezquerro, J. M., Rodríguez, J., Porter, J., & Lapuerta, V. (2019). Motivational impact of active learning methods in aerospace engineering students. *Acta Astronautica*, *165*(September), 344–354. https://doi.org/10.1016/j.actaastro.2019.09.026

Mirkouei, A., Bhinge, R., McCoy, C., Haapala, K. R., & Dornfeld, D. A. (2016). A Pedagogical Module Framework to Improve Scaffolded Active Learning in Manufacturing Engineering Education. *Procedia Manufacturing*, *5*, 1128–1142. https://doi.org/10.1016/j.promfg.2016.08.088

Nations, U., & Affairs, D. of E. and S. (2021). *Goal 4: Quality Education*. Quality Education. https://sdgs.un.org/goals/goal4

Ożadowicz, A. (2020). Modified blended learning in engineering higher education during the COVID-19 lockdown-building automation courses case study. *Education Sciences*, *10*(10), 1–20. https://doi.org/10.3390/educsci10100292

Pande, M., & Bharathi, S. V. (2020). Theoretical foundations of design thinking – A constructivism learning approach to design thinking. *Thinking Skills and Creativity*, *36*(October 2019), 100637. https://doi.org/10.1016/j.tsc.2020.100637

Phillips, J., & Wiesbauer, F. (2022). The flipped classroom in medical education: A new standard in teaching. *Trends in Anaesthesia and Critical Care*, *42*, 4–8. https://doi.org/10.1016/j.tacc.2022.01.001

Ruslan, M. S. H., Bilad, M. R., Noh, M. H., & Sufian, S. (2021). Integrated project-based learning (IPBL) implementation for first year chemical engineering student: DIY hydraulic jack project. *Education for Chemical Engineers*, *35*, 54–62. https://doi.org/10.1016/j.ece.2020.12.002

Ruslan, M. S. H., Sapiee, N. H., Kurnia, K. A., Amran, N. A., & Abd Rahman, N. (2022). Student Adoption and Effectiveness of Flipped Classroom Implementation for Process Simulation Class. *Education Sciences*, *12*(11). https://doi.org/10.3390/educsci12110763

Scholte, J. B. J., & Strehler, J. C. (2025). Weekly flipped classroom modules in intensive care medical training : Feasibility and acceptance. *Journal of Critical Care*, *86*(October 2024), 154986. https://doi.org/10.1016/j.jcrc.2024.154986

von Blottnitz, H. (2006). Promoting active learning in sustainable development: experiences from a 4th year chemical engineering course. *Journal of Cleaner Production*, *14*(9–11), 916–923. https://doi.org/10.1016/j.jclepro.2005.11.034

Wittmann, S., & Wulf, T. (2023). Effects of flipped classes on student learning: The role of positively perceived instructor attitude towards students. *International Journal of Management Education*, *21*(1), 100735. https://doi.org/10.1016/j.ijme.2022.100735

Wu, Y. (2016). Factors impacting students' online learning experience in a learner-centred course. *Journal of Computer Assisted Learning*, *32*(5), 416–429. https://doi.org/10.1111/jcal.12142

Yusof, K. M., Hassan, S. A. H. S., & Phang, F. A. (2012). Creating a Constructively Aligned Learning Environment using Cooperative Problem Based Learning (CPBL) for a Typical Course. *Procedia - Social and Behavioral Sciences*, *56*, 747–757. https://doi.org/10.1016/j.sbspro.2012.09.712.