**Engaging Learners in Online Asynchronous Learning (OAL)**

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**Abstract**

**The pandemic has accelerated the adoption of technology-enabled learning in many educational institutes to allow students to continue their learning despite closure of the physical campus. One of Ngee Ann Polytechnic's responses to technology-enabled learning is to leverage flipped learning where students learn content via Online Asynchronous Learning (OAL) packages independently and apply that knowledge during In-Person Learning (IPL) sessions on campus.**

**This study aimed to investigate the effectiveness of OAL to engage learners using Learner-centered Learning (LcL) design to allow for multi-faceted feedback, use of gamification element, collaborative learning, opportunities for application of learning in OAL and the use of OAL features such as multimedia-rich resources and ease of access to learning materials in the Brightspace Learning Management System (LMS) environment.**

**The study adopted a mixed-method approach, which included an analysis of the student's perception of their engagement level with learner-centred OAL designs as well as data generated from the LMS. The results showed a significant increase in learner engagement in the OAL especially in learning activities such as discussion forums and quizzes. Feedback from students on the use of badges as a form of reward was generally positive, and they appreciated the weekly consultation hosted in the Bongo virtual classroom. The study provided reflections and insights into the effectiveness of the features and learner-centred approaches. One suggestion is to include different tiers of badges for different levels of participation as well as a system to exchange badges for rewards to further incentivise the students. For future enhancement, the author is considering further dividing the learning content into more manageable bite-size segments and exploring text-based AI, which could engage students in extending their learning.**

**The study concluded positively on the effectiveness of the features and learner-centred approaches used in engaging learners in OAL and highlighted the need for future research on the OAL implementation in courses and the efficacy of the platforms used.**

**Keywords:** *Student engagement, Online Asynchronous Learning, flipped learning*

**Introduction**

The COVID-19 pandemic has disrupted education systems worldwide, forcing many educational institutes to transit from traditional classroom settings to technology-enabled learning (Asgari et al., 2021). Ngee Ann Polytechnic (NP) is one such institute that has responded to this challenge by leveraging on flipped learning (Bishop & Verleger, 2013), which involved students learning content independently through Online Asynchronous Learning (OAL) packages and applying that knowledge during In-Person Learning (IPL) sessions on campus. This approach has gained traction due to its flexibility, which allows learners to engage with content at their own pace and convenience. However, for OAL to work, students need to actively engage with the materials before IPL.

In recent years, there has been a growing focus on the learner-centered approach, which prioritizes the learners' individual needs, interests, and experiences in the educational process (Moate & Cox, 2015). Learner-centered Learning (LcL) designs aim to provide a personalized and interactive learning experience that engages learners in various ways, such as through feedback, gamification, and collaborative learning. In this study, we aim to investigate the effectiveness of OAL in engaging learners using LcL design.

As such, this study aims to address the above by considering the following research questions:

1. What are the LcL design considerations in the OAL environment?

2. How to measure the effectiveness of OAL in engaging learners using LcL design?

**Module and Student Profile**

The Embedded Systems (ES) module is offered to second year students enrolled in two different diploma courses, namely the Diploma in Biomedical Engineering and the Diploma in Engineering Science. This module introduces students to the fundamentals of modern embedded systems, including the basic processor architecture and the concept of System-on-Chip (SoC). This module also covers the use of the C programming language in modern embedded systems and is supplemented by a microcontroller kitset, either in a physical or simulated digital form. The kitset utilizes a microcontroller unit (MCU) to demonstrate the basic hardware interfacing architecture of a typical integrated microcontroller SoC, including input/output, interrupts, analogue-to-digital converter (ADC), timers, and serial communication, among other concepts. Through the ES module, students would be able to gain a strong foundation in embedded systems, preparing them for a range of real-world applications in the biomedical engineering and engineering science fields. The period of study spanned two semesters, catering to 54 students from the Diploma in Biomedical Engineering in the April 2022 semester, and 107 students from both the Diploma in Biomedical Engineering and Diploma in Engineering Science in the October 2022 semester. The implementation of the LcL design varied between the two semesters, specifically, the award of badges and in-class readiness check quizzes was absent in the April 2022 semester. Additionally, the utilization of multiple platforms characterized the April 2022 semester, with Microsoft Teams used for online consultation, recording, and project peer review. In contrast, Brightspace LMS was utilized for the purposes of announcement dissemination and access to all learning materials. However, in the subsequent October semester, a concerted effort was made to streamline all educational activities within the Brightspace LMS, consolidating various functions into a single, comprehensive learning platform.

**Brightspace LMS**

Brightspace is a cloud-based Learning Management System (LMS) developed by D2L Corporation and is designed to support the delivery of education and training programs. This LMS offers a range of tools and features to assist educators in creating and managing online courses, delivering personalized learning experiences and monitoring student progress (D2L Brightspace, n.d.).

In Singapore, the five polytechnics and the Institute of Technical Education (ITE), collectively known as POLITE, have adopted Brightspace LMS since 2021. At Ngee Ann Polytechnic, all modules’ content was migrated to Brightspace LMS starting from the April 2021 semester. The author of the paper has utilized the tools provided in Brightspace LMS to create and organize module materials, which include lecture handouts, videos, practical and practice worksheets, quizzes, assignments, discussion forums, and virtual classrooms. In addition, the author has embraced the use of dashboard in Brightspace LMS to monitor class engagement and progress through real-time learning analytics captured within the LMS.

**LcL Design**

Learner-centered learning (LcL) is a teaching and learning approach that prioritizes the learner's needs and interests. In LcL design, the teacher becomes a facilitator, providing resources and guidance to support students in their learning journey. The key principles of LcL design include: (1) focus on the learner; (2) active learning; (3) collaboration; (4) feedback and reflection (Weimer, 2013). By incorporating these principles, LcL design fosters student agency, self-directedness, and engagement, which ultimately promotes learning and growth. The LcL designs in OAL were implemented according to these key principles, which were further elaborated below.

*1. Focus on the learner*

The LcL design aims to create a learning environment that is engaging, personalized, and tailored to the needs and interests of the learner. To achieve this, two considerations were incorporated in the OAL design, i.e. creating an enjoyable learning experience and making learning materials easily accessible to students on the mobile platform.

To make learning enjoyable, the gamification elements, such as badges and secret bits of media, i.e. Easter eggs (MakeUseOf, n.d.), were used to enhance the learning experience in the Brightspace LMS. These elements were used to increase motivation and engagement by providing students with clear goals and rewards for their achievements. For instance, badges will be issued to the learners when they participated in the discussion forum (e.g. post a question or answer a question), or when they obtained full marks for any of the revision quizzes. And the idea of Easter eggs (i.e. hidden media in the LMS) will further encourage students to explore the module content within the LMS. By incorporating these elements, the LcL design aims to create a fun and engaging learning experience that promotes extrinsic motivation and encourages students to take an active role in their learning.

According to Statista (Published by Statista Research Department & 19, 2023), the smartphone penetration share reached about 92 percent in Singapore, indicating that it is a leading country for the use and engagement of smartphones. Therefore, to effectively engage learners in the OAL environment, it is important to ensure ease of access to all their learning within one platform, and also options for students to access learning via their mobile devices. The Brightspace Pulse app (i.e. the mobile companion of the Brightspace LMS) enables students to “learn on the go”. The learning materials such as PowerPoint presentations, documents, and videos, as well as hyperlink virtual classroom recordings, can be accessed from within the app without the need to download them. This reduced the time and effort needed to find and access learning materials, enabling students to focus more on the learning itself. With the LcL design principles of making learning more accessible, it aims to increase student engagement and motivation, which ultimately promotes learning and growth.

*2. Active learning*

Active learning is generally defined as any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing, through hands-on activities, group discussions, and other interactive experiences (Prince, 2004). The goal of active learning is to promote understanding, retention and deepening of knowledge and skills, by providing students with opportunities to apply what they have learnt in meaningful ways.

Active learning strategies are utilized in the design of OAL to engage students learning during OAL. Some of these strategies include the use of web simulator (e.g. Tinkercad ("Tinkercad", n.d.) which has been found to be effective in improving students' programming & computational thinking, theoretical concepts and practical skills (Silva et al, 2019).

In addition, other active learning strategies such as the use of a variety of multimedia resources, such as embedded videos, documents, quizzes, and discussion forums encouraged interaction and student participation in the learning process. A diversity of resources can be used to provide students with different types of learning experiences, such as visual, auditory and kinesthetics, which can help to engage students with diverse learning styles. LcL design principles of providing a variety of resources, it can help to create a dynamic and interactive OAL environment, where students can engage with the material in meaningful ways.

*3. Collaboration*

Collaboration emphasizes the importance of cooperative interactions among students and between students and teachers to achieve learning goals. Collaboration is essential in creating a learning environment that promotes LcL, fosters a sense of community and shared responsibility for learning. (Bruffee, 1993). In an OAL environment, the collaborative learning would have to take into consideration the online tools & resources to enable collaboration.

Discussion forums is one way to bring students together to discuss/comment/ share their views on specific topics. To better organize the discussion threads, topics were created in the discussion forum according to the units covered in the module. Students can then post their questions accordingly. Discussion forum had been used to promote student engagement, facilitate peer-to-peer learning and provide opportunities for teachers to provide feedback and guidance. They also provide a space for students to ask questions and receive support from their peers and teachers.

Another approach to promoting collaboration is through peer review activities. Peer review enables students to learn from one another by providing feedback on one another’s work. In this module, peer review was infused into the individual project component by integrating FeedbackFruits ("FeedbackFruits," n.d.) into Brightspace LMS, which allows for anonymous and structured peer feedback. Through peer review activities, students can develop important skills such as critical thinking, communication and collaboration.

*4. Feedback and Reflection*

Feedback is an essential component of the learning process and provides students with the information they need to understand their progress and make improvements (Boud & Molloy, 2013). Reflection, on the other hand, enables students to think critically about their learning experiences and make meaning of their learning.

In LcL design, feedback and reflection can take many forms. Underpinned by the flipped learning approach, this module offers multi-faceted feedback for in-class readiness check quizzes, end of topic revision quizzes (with unlimited attempts) as well as additional worksheets to extend learning. On top of that, discussion forums, activity feeds, and virtual classroom sessions provide students with opportunities to receive feedback and guidance from the teachers or peers. These platforms can be used to discuss course content, ask questions and receive feedback on assignments and assessments.

In addition to feedback, reflection is also an important component of the LcL design. This was covered in the individual project of the module in the forms of double-blind peer review, where students rated each other project presentation video anonymously. With the feedback that comes from a peer, it increases the acceptance of the students and triggers reflections which leads to a deeper understanding of their learning processes, areas for improvement as well as the promotion of ownership and self-regulatory.

Quizzes are one form of feedback that can be utilized by both educators and learners to evaluate their performance. Regular feedback enables students to understand how well they are progressing, which in turn may inspire them to become more motivated and engaged in their studies. In the context of OAL, in-class readiness check quizzes can offer a swift and convenient method to assess students' comprehension of the course content. With real-time quiz statistics, educators can swiftly address any misunderstandings or misconceptions and provide specific feedback to enhance students' understanding. Additionally, asynchronous revision quizzes can be implemented to reinforce students' comprehension of each topic. These quizzes provide an opportunity for students to review the material, identify areas of weakness, and make necessary improvements to their learning progress.

**Results and Discussion**

*Increased Discussion Forum Participation*

One notable outcome of the LcL design was increased participation in the discussion forum as shown in Figure 1. Throughout the October 2022 semester, a total of 39 threads were created and 81 replies were posted across 7 topics covered in the module. This represented a significant increase in participation compared to the previous semester in April 2022, where only 1 thread was created and 1 reply was posted across the same number of topics.

The average read (number of posts) per learner in the October 2022 semester was 11.0833, indicating that students were actively engaging with the content and one another in the discussion forum. In contrast, the average read (number of posts) per learner in the April 2022 semester was only 0.4629, highlighting the impact of the LcL design in promoting increased participation and engagement.

Discussion forum plays a critical role in promoting active learning and collaboration among learners. Through the discussion forum, students have the opportunity to engage in meaningful conversations on module content, share their perspectives and receive feedback from their peers and teachers. The increased participation in the discussion forum is a positive indicator of the effectiveness of the LcL design in promoting active learning and collaboration among students.

Figure 1 –Discussion Forum Participation Data

*Better Performance in Revision Quizzes*

Another positive outcome of the LcL design was the improved performance of students in the revision quizzes. The module design included seven revision quizzes, one at the end of each topic, with unlimited attempts. Only the highest attempt was captured, and students were given one semester to work on the quizzes.

Analysis of the results in Table 1 indicated that the performance of students in the revision quizzes was better in the October 2022 semester compared to the April semester 2022. Specifically, the average mark and standard deviation of each revision quiz were better in the October semester compared to its counterpart in the April semester. The improved performance of students in the revision quizzes is a positive outcome of the LcL design. It suggests that the design may have helped students better retain and apply the knowledge they acquired throughout the course.

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| --- | --- | --- | --- | --- |
|  | Apr 2022 Sem (N=54) | | Oct 2022 Sem(N=107) | |
|  | Avg [%] | Std Dev [%] | Avg [%] | Std Dev [%] |
| Quiz 1 | 96.98 | 10.2 | 98.32 | 9.22 |
| Quiz 2 | 97.48 | 7.04 | 98.44 | 6.16 |
| Quiz 3 | 95.64 | 13.28 | 98.48 | 6.54 |
| Quiz 4 | 98.08 | 11.32 | 99.65 | 2.81 |
| Quiz 5 | 96.98 | 9.43 | 98.45 | 7.47 |
| Quiz 6 | 96.44 | 11.78 | 99.35 | 4.88 |
| Quiz 7 | 96.86 | 10.44 | 99.78 | 2.19 |

Table 1 – Performance of Revision Quizzes in Two Semesters

*Student's perception of their engagement level with LcL designs in the OAL environment*

To gain insights into students' perceptions of their engagement level in the OAL environment which are attributed to the LcL designs, in-class anecdotal feedback was collected from students. Generally, students found the use of badges as a form of reward a positive experience. It was a motivating factor and a source of recognition for their efforts in completing various learning activities, as evident in both the discussion forum participation and the better performance of the revision quizzes.

Another source of evidence is the Student Experience of Teaching (SET) survey. It provided valuable feedback on the effectiveness of LcL designs in promoting student engagement. Some extracted comments are as follow:

*“he made brightspace somewhere very interactive and we are able to find solutions and recordings to help us understand in times of uncertainty“*

*“Mr Soon provides great feedbacks and also conducts consultation every week so that we can understand the topics better”*

*“Pre-recorded video lectures were very detailed and clear.“*

The survey showed that learners appreciated the weekly consultation hosted in the Bongo virtual classroom, with recordings made available in the LMS. This provided them with an opportunity to clarify their doubts and interact with their peers and instructors:

Additionally, pre-recorded video lectures were commented positively for its clarity and detail. However, some students also provided feedback that the video duration was a little too long, which may have negatively affected their engagement in the learning process.

It is worth noting that all the class sessions were recorded using Bongo virtual classroom, and the recordings were made available in the LMS. This feature was positively received by students as it allowed them to revisit class sessions at their convenience and their own pace.

*Reflections: Impact of Badges & Practicality*

The implementation of badges as a form of reward reinforces the LcL design as it showed promising results in terms of improving discussion forum participation and better performance in all seven revision quizzes. Students found the badges to be motivating and a source of recognition for their efforts in the learning process.

However, there is room for further improvement in terms of the practicality of badge usage. While the badges were effective in incentivizing students, more thought needs to be put into exploring additional practical uses of badges to further enhance student engagement. For example, incorporating small gifts or snacks as rewards in exchange for badges could potentially provide additional motivation for students to actively participate in discussions and complete quizzes.

Another dimension to consider is the establishment of a more sophisticated awards system for badges. For instance, implementing different tiers of badges based on different levels of participation in the discussion forum could provide additional incentives for students to actively engage and contribute to the discussions. This could be inspired by platforms like Stack Overflow ("Stack Overflow", n.d.), where users earn different privileges and badges based on their level of participation and contribution.

*Reflections: Discussion Forum*

The increased participation in the discussion forum is an encouraging sign of engagement among students in the OAL environment. However, a closer inspection reveals that the majority of the replies were posted by teachers, indicating that peer-to-peer collaboration and learning may still be lacking. This highlights the need to further promote and facilitate student-to-student interactions in the discussion forum to foster meaningful peer learning experiences.

During the in-class survey, students expressed concerns about their visible identities in their discussion forum postings. Many students reported feeling hesitant to post or provide feedback for fear of misleading their peers or making mistakes that may be visible to others. This indicates that the current setup of the discussion forum may not be conducive to fostering an open and supportive learning environment.

Therefore, one possible improvement could be to allow students to post anonymously in the discussion forum. This would provide students with a sense of privacy and freedom to express their opinions and ideas without the fear of being judged or identified. This anonymity could potentially encourage more active participation from students, as they may feel more comfortable sharing their thoughts and engaging in discussions.

Furthermore, anonymous posting in the discussion forum could also promote constructive feedback and critical thinking, as students may be more inclined to provide honest feedback and engage in meaningful discussions without the fear of repercussions or embarrassment. This could enhance the quality of peer interactions and promote a supportive and inclusive learning environment where students can learn from one another.

*Reflections: Future Enhancements – Byte-Size Content and the Role of Generative AI in the OAL Environment*

To effectively engage learners in the OAL environment, careful consideration must be given to the chunking of learning content into manageable, byte-sized pieces for easy consumption. This is supported by findings from the SET survey, which revealed that some students were discouraged by lengthy lecture videos. Besides shortening the videos, another approach to mitigate monotony and promote active engagement is to create interactive videos by incorporating questions, such as multiple-choice or open-ended, within the video. And when students build on the responses of other students, it presents opportunities for social learning, and also the sense of being part of the class and not isolated on their own during the OAL.

Generative artificial intelligence (AI) has emerged as a promising tool with the potential to transform the online learning experience for tertiary students. Leveraging technologies such as natural language processing, machine learning, and deep learning, generative AI has the capability to generate content that can facilitate learning and promote engagement in the online learning environment.

Moving forward, students are encouraged to tap onto the strengths of generative AI in the OAL environment to create personalized learning materials that are tailored to the unique needs and preferences of individual students. For instance, generative AI can generate adaptive learning modules that adjust to the pace and learning style of each student, providing them with a customized learning path. This personalized approach can enhance student engagement and motivation, as students are more likely to be interested and invested in materials that are specifically designed for their individual learning needs. Furthermore, personalized learning materials can foster improved understanding and retention of content, as students can learn at their own pace and receive targeted feedback based on their performance.

Another advantage of generative AI is its potential to facilitate the creation of interactive and immersive learning experiences. For example, generative AI can generate additional sample questions or exercises that offer students extra practice opportunities, reinforcing their understanding of complex concepts and enabling them to apply their knowledge in different contexts. These interactive and immersive learning experiences can enhance student engagement and promote active learning, as students are encouraged to actively participate and apply their knowledge in meaningful ways.

However, it is important to note that the use of generative AI in the OAL environment also presents challenges, particularly in terms of potential bias in the generated content. Generative AI models are trained on large datasets, which may contain biased or incomplete information. As a result, the content generated by these models may unintentionally perpetuate existing biases or misinformation, leading to inaccurate or misleading educational materials. This underscores the importance of thorough review and verification of generated content by educators and institutions to ensure its accuracy, reliability, and fairness.

**Conclusions**

In this paper, we have examined different LcL designs and evaluated their effectiveness in engaging learners in OAL based on four key principles: learner focus, active learning, collaboration, and feedback/reflection. We found that discussion forums can effectively promote student engagement through peer-to-peer interaction and collaboration, but it is crucial to ensure that discussions are student-led and that students take ownership of their learning. Badges can incentivize student participation and foster a sense of achievement, but their design and implementation must align with the course's learning goals. Further exploration of creative badge usage, such as exchange for small gifts or snacks, can enhance its impact. Byte-sized content with interactivity elements could be introduced to further engage learners. Generative AI has emerged as a promising tool for creating personalized learning materials and facilitating interactive learning experiences, but caution must be exercised to address potential biases and ensure content accuracy, reliability, and fairness.

In conclusion, engaging learners in OAL requires careful consideration of strategies and approaches that promote active participation, meaningful interactions and alignment with learning goals. Discussion forums, badges and generative AI can enhance student engagement and learning outcomes, but thorough planning, implementation, and evaluation are necessary to ensure their effectiveness. By continually refining these strategies, educators can create engaging online learning experiences that promote deep learning and achieve desired learning outcomes.

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