Engineering Students’ Engagement in a Hybrid Learning Mode: Comparative Study

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ABSTRACT

After almost two years since the COVID-19 pandemic hit the world, higher education institutions are adopting transitional strategies towards returning to normal campus life while respecting the health and safety regulations.

An example of such strategies is the hybrid teaching model where only half of the students attend their classes physically on campus while the other half attend their classes simultaneously but online, and their attendance alternates every week. A major challenge imposed by this strategy is the complexity of students’ engagement as instructors are exposed simultaneously to two different teaching styles. In this paper, the effectiveness of an Audience Response System in terms of boosting the students’ engagement in a hybrid learning environment is investigated. The collected data is analyzed at various stages and comparative conclusions are drawn about the Audience Response System’s effectiveness over the interaction of online and on-campus students. Furthermore, an anonymous detailed survey is conducted to verify the students’ satisfaction level and to link its results with the conclusions obtained from analyzing the data of the Audience Response System.

KEYWORDS

Audience response system, Active learning, Student-centered approach, Hybrid learning, CDIO Standard: 8.

INTRODUCTION

According to the World Health Organization, the COVID-19 pandemic is still threatening the lives of human beings with a concerning level of infection spread around the world. At the same time, over the past two years, the pandemic created an accumulation of socioeconomical problems which require immediate attention (Liguori & Winkler 2020). As such, our corrective actions towards remedying these problems should be implemented with a high level of caution. For instance, higher education institutions are adopting transitional strategies toward returning to normal campus life while maintaining the online teaching methodologies they invested in during the pandemic.

At the Australian College of Kuwait (ACK), a hybrid teaching model is adopted in Fall 2021 to ensure a smooth transition from online to face-to-face teaching while maintaining the health measures imposed by the ministry of health in the state of Kuwait. In this model, the students are divided in two groups, whereas the first group of students attends their classes physically on campus, the other group attends their classes simultaneously but through online streaming and the attendance method alternates every week.

Although this practice guarantees the requirements of local health authorities, it imposes some pedagogic challenges as it applies simultaneously two completely different teaching styles, face-to-face and online. For instance, it has been argued that students have an attention span of around 20 minutes in a normal class (Mayer et al., 2009) which becomes much less in an online streaming class because of the lack of face-to-face interaction, continuous distractions, and gazing at a screen for a long time. This will cause the student's mind to scatter while grasping the course material and lose the track of studying and following up with course content. Online students as well are less to speak and participate by opening their mics because of some surrounding noise and weak internet connections. This may also lead instructors to unintentionally give more attention to students attending and interacting physically on campus and ignore online students. As a result, unless active learning is assured for both groups of students, applying a hybrid teaching methodology may result in undesired unfairness and unequal learning opportunities.

In alignment with CDIO standard 8 which is related to "teaching and learning based on active experiential learning methods", innovative active student-centered learning approaches are inevitable in this situation to ensure the simultaneous engagement and involvement of both online and on campus students while addressing their various needs and learning styles. This requires a multi-modal learner-support technology that can operate in a range of time and place settings.

As assessments are one of the most efficient ways to grab the attention of students, (Brent & Felder, 2012) suggested an active learning approach called "Thinking-Aloud Pair Problem Solving or TAPPS" which allows the in-class lectures to be divided into chunks where the students will be exposed to short practices and exercises in the middle of the lecture distributed within the slides. The Audience Response System (ARS) emerged later as an efficient tool to facilitate this kind of active learning approach inside the class. It was used as a clicker (Bergtrom, 2006; Mayer et al., 2009; Niyadurupola, 2016), electronic voting system (Harris & Zeng, 2010; Kennedy & Cutts, 2005), or personal response system (Hinde & Hunt, 2006). It was also used to enhance student satisfaction, learning outcomes, engagement, and levels of confidence (Farhat et al., 2021). An ARS is a simple-to-use online interactive software enabling formative in class assessment with instant feedback. Its online nature makes it ideal for hybrid teaching scenarios as both the on-campus and online students can use it simultaneously.

Although the usage of Audience Response Systems as a powerful tool to implement active learning strategies was thoroughly studied in the literature, its effectiveness in keeping a balance and equal opportunities between online and in-class students who are simultaneously attending a hybrid online/face-to-face class is still not addressed. Therefore, in this paper, the efficiency of the Audience Response System is investigated in terms of boosting the students' engagement and learning in a simultaneous hybrid learning environment and comparative conclusions are drawn about the interaction of online and on-campus students.

IMPLEMENTATION

In this study, I-Vote application is selected as the ARS software and is implemented in four Engineering Diploma courses at the School of Engineering at ACK: Electrical Circuit Analysis I, Electromagnetism Fundamentals, Instrumentation and measurements, and Analog Electronics. I-vote is installed on the instructors' personal computers or tablets as an add-on to Microsoft Power-Point presentations and is used through the web or the pre-installed application on tablets or any other mobile device from the student side. I-Vote app is used in this study, in the same way it was implemented previously at ACK by (Farhat et al., 2021). The main aim is now increasing the instructor-student interaction simultaneously for both online and on-campus students in an equal manner in a hybrid teaching context in contrast to the pure face-to-face context it was initially implemented in by (Farhat et al., 2021).

At the beginning of the class, the instructor shares the session ID with the students through the instruction page which allows them to access the questions predefined by the instructor and respond to them online one by one when prompted (e.g. Figure 1). To differentiate online from on campus students, the students are also required to specify their attendance mode. One question is posted by the instructor at a time (e.g., multiple choices, true/false and calculation). After a predefined time, the students' responses were posted on the board which is accessible physically to on campus students and though streaming for online students, both groups also receive feedback on their devices. The anonymous feature in i-vote is enabled and students are allowed to save all their activities for future study. Using the i-vote ARS this way would motivate in-class shy students to participate and share their thoughts (Farhat et al., 2021) and is expected to increase the attention span of online students as they will be frequently exposed to pop up questions. Moreover, the instructor benefits from an in-class rough estimation of students' understanding without the need to waste the lecture time in addressing the questions individually neither for online nor for face-to-face students. On the contrary, and depending on the results, he/she would invest more time in beneficial discussions and ideas sharing (Hinde & Hunt, 2006). Having the responses displayed anonymously on their screens would also assure students who answered incorrectly that they are not the only ones and would hence encourage them to be more active in these discussions.

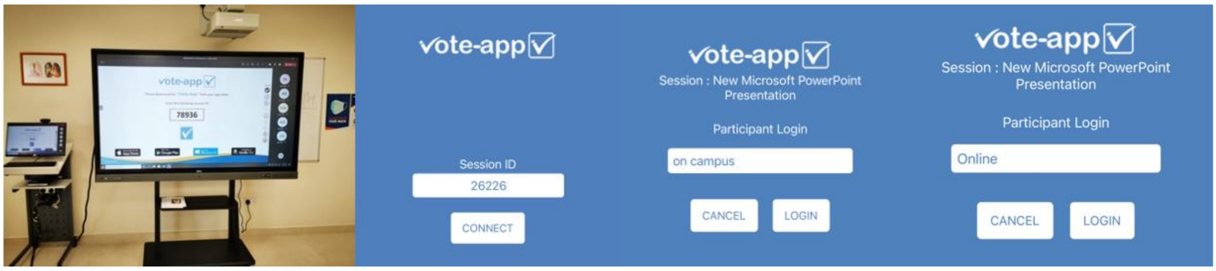


Figure 1. ARS instruction page includes session ID.

Pedagogically speaking, a combined teaching method was implemented in classrooms: some passive transmission of knowledge followed by individual work, then discussions. All classes were following the operational flowchart depicted in Figure 2.a. The lecture material was shared with students ahead of the session. A diagnostic assessment and pre-class preparation were conducted before the teaching session to tailor the teaching activities to students' requirements and use the instructional time in an optimal way. This has shown to be very helpful and motivating the students for more pre-class preparation. The session started traditionally, as the teacher explained some concepts for around 15 minutes, then moved on to ARS questions.

As indicated in Figure 2.b, students had to think individually, then discuss in peers their findings and opinions, communicate, justify their point of view, co-operate with each other, learn, and help each other to clarify any concerns arising from the presented questions. When in doubt, peer discussions moved to classroom discussions to seek the instructor's help and advice. The shift from traditional teaching after 15 minutes of lecture to active teaching strategies is underlined by the evidence that student attention wanes after about 15 to 20 minutes in a traditional classroom environment.

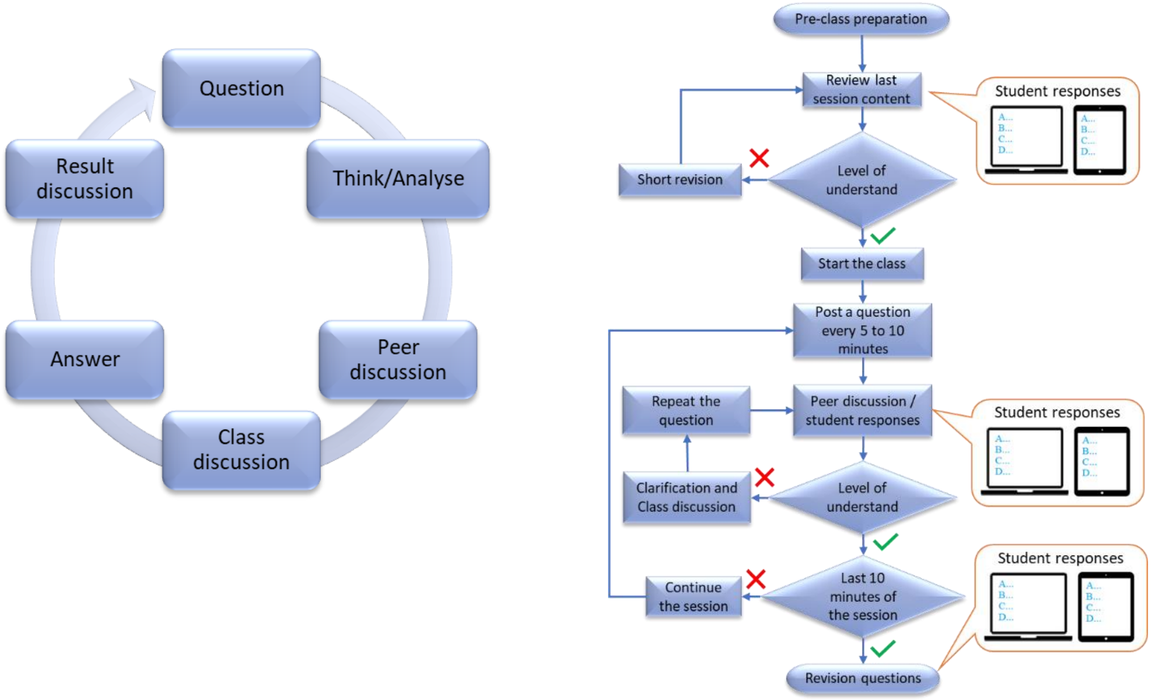


Figure 2. (a)The response sequence for most ARS questions. (b) Operational flowchart of ARS in active learning environment.

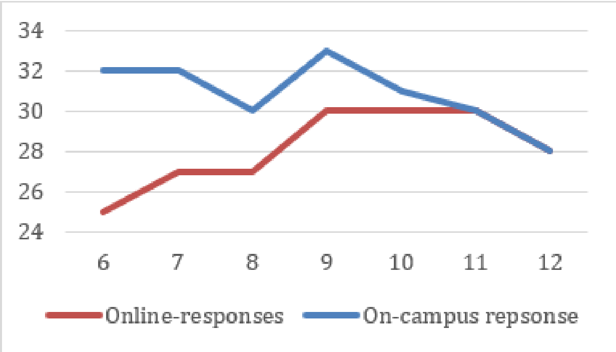
RESULTS AND DISCUSSION

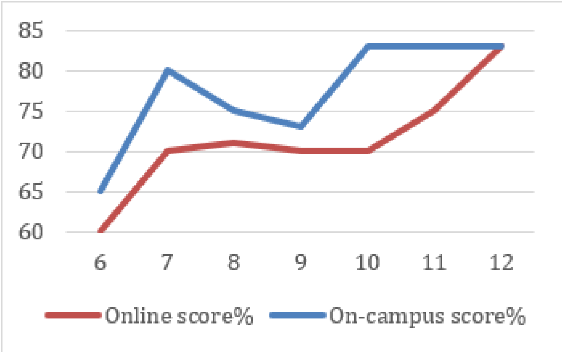
The effectiveness of the ARS in enhancing active learning in hybrid mode was evaluated in two phases. First through several meetings conducted between the involved instructors to share their experiences, analyse the ARS results and remarks on the most successful method of using the ARS. Second phase is by conducting an anonymous survey to examine the student satisfaction level with the new teaching style, and to assess different elements that were involved to enhance active learning.

ARS Analysis

As mentioned earlier, the ARS i-vote system is implemented in four different courses which involve a total of 90 students. The ARS data was collected, merged, and analyzed on weekly basis. Every week's data includes: the number of attendees whether online or on-campus, namely "attendees", the number of attendees who answered all the ARS questions during the classes, namely "responses", and the average percentage of correct answers of these participants, namely "scores". The implementation of the ARS i-vote system and the collection of data started in the 6th week of study and endured for 7 weeks until week 12. Figures 3.a and 3.b present the obtained results for online and on-campus students.

In regards to Figure 3.a to Figure 3.b, one may obtain several conclusions. At first, at the beginning of the ARS implementation, the online students' responses were relatively less than their on-campus counterpart as students were still not used to the formative assessment approach, whereas towards the end of the semester, the response rates of online and on-campus students became almost equivalent. The same pattern may be observed on the scores achieved by online and on-campus students which started to stabilize after almost four weeks of implementing the ARS system. These results suggest that, at the beginning of the ARS implementation, on campus students were more attentive and engaged then online students. After the transitional period of almost four weeks, i.e. after each group had been exposed twice to the ARS system in its online and on-campus form, the engagement and scores of both group of students became almost the same. This is clear evidence of the effectiveness of the ARS system in creating equal learning opportunities in a hybrid learning mode. The survey results presented in the next section further support this conclusion.





(a) (b)

Figure 3. (a) ARS analysis of students' responses. (b) ARS analysis for students' score.

Survey

To further support the conclusions derived from the ARS data analysis, a survey was conducted over all the students who took part of this study. The first part of the survey was for demographic data collection, followed by several questions related to ARS technology in general, student's satisfaction and engagement, hybrid learning, formative assessment, and the overall instructor performance. The survey ends with two open-ended questions asking the students to express their thoughts about ARS effectiveness in both on-campus and online situations.

The survey was created on Microsoft Forms to simplify data collection. The students responded within a scale ranging from strongly disagree, disagree, neutral, agree to strongly agree.

The summarised aims of the survey were sent to the students via the official communication platforms of ACK. The students were notified that the collected data is anonymous, not including any personal or sensitive data, the privacy of their responses is protected, their participation is voluntary, the survey is not part of any assessment, and that they cannot withdraw from the survey once submitted.

Sixty students from the four courses responded to the survey. Almost half of the participants shared their feedback on the last two questions covering their thought of using I-Vote app either on-campus or on-line.

Figure 5 illustrates the respondents' demographics. There is a good variation of ages, but males count was higher than females' as more males join engineering programs than females here in Kuwait which is also a common pattern in many other countries. Also, there is a good variation in GPA and the academic level.

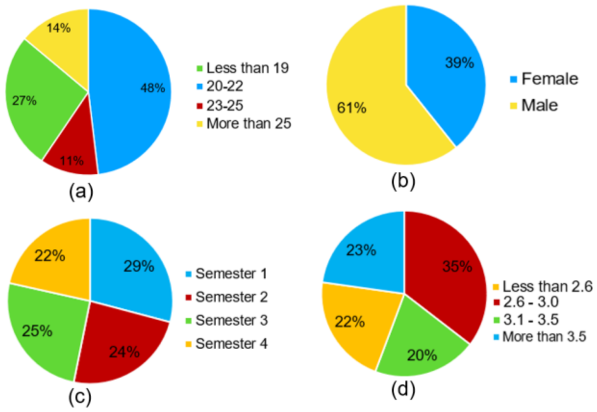


Figure 5. Demographic results (a) Age (b) Gender (C) Academic level (d) GPA

Figure 6 reflects the students' feedback and satisfaction level on implementing ARS in their classes using their mobile phones. Most students agreed that ARS helped them in general to be more interactive, engaged, and attentive, and they do not consider it is as a waste of time. While most of the students as well did not face any technical issues, a considerable amount stated that they did during the classes and that might be related to network connection stability.

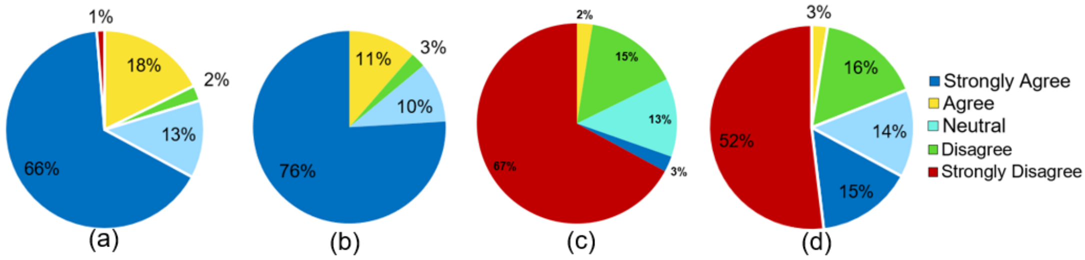


Figure 6. Using ARS in classes (a) ARS increased my interaction in class (b) ARS helped me to be more active, engaged, & attentive during the class (C) ARS wasted too much time (d) I faced technical problems when using ARS

Figure 7 illustrates the students' feedback and satisfaction level on the hybrid learning model and implementing ARS to enhance their engagement, attention and improve their hybrid learning experience. Most students agreed that they are more distracted while they are attending their classes online unlike on campus classes where they are more attentive and active. A significant number of responses confirmed that ARS helped the students to be more active and attentive during their online classes and helped them understanding the material.

Samples of students' responses to the first open ended question "How far did using ARS was helpful during your On-Campus lectures?"

- "Helped me be active and focus"
- "Using ARS was so helpful for me to understand the course clearly on campus and improved my learning skills, also it was helpful to get the idea of how the exam would be"
- "On campus is much easier to focus and learn better"

- “It was very useful to me as I was able to discover where my weaknesses were and learn from my mistakes. Participation during the semester at the university was more useful so that it is fixed in my memory.”

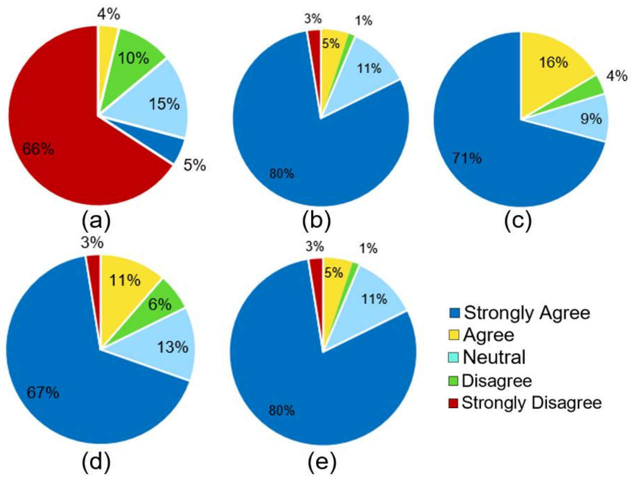


Figure 7 ARS in Hybrid Learning a) I pay more attention when I study online b) I pay more attention when I study on campus c) The hybrid learning process gets better when my instructor uses ARS technology d) ARS helped me to pay more attention when I am attending the class online e) ARS helped me to pay more attention when I am attending the class on campus.

Samples of students’ responses to the second open ended question “How far using ARS was helpful during your Online lectures?”

- “Online we usually get distracted easily but with ARS we don’t”
- “It made me pay more attention to the lecture since attending lectures online you can easily get distracted”
- “It was helpful because it makes me pay more attention to the class”
- “Helped me to focus and interact.”
- “It same as on-campus but I vote app is a little bit laggy so I suffer when I switch between teams and I vote specially when I use single device for both”

CONCLUSION

The use of technology in classroom activities facilitates interactivity whether is it used to acquire information or as a formative assessment tool. The wide availability of smart devices nowadays makes this possible anytime anywhere as they support a wide range of tools and applications that can be integrated into the classroom for different courses at all levels. Students can now engage with their learning process through the technology sitting in their own pockets.

In this paper, an ARS system has been applied in a hybrid learning model at ACK in Fall 2021 semester with the aim of enhancing students’ in-class participation and engagement equally whether they were attending their classes online or on-campus. A noticeable difference in the engagement and attention levels between online and on-campus students was observed by the instructors and concluded from the ARS data analysis at the beginning of the study for a transitional period of almost four weeks. However, the results later converged to an almost balanced participation and success scores of both online and on-campus students which is a clear proof that ARS is an effective way to enhance and maintain equal students' engagement in a hybrid learning context.

The student survey results presented in this paper further support this conclusion. It shows that ARS-based activities enabled a beneficial collaborative learning style. Engineering students positively accepted the ARS as it enhanced their engagement and participation in answering questions as well as their involvement in peers and classroom discussions. They also acknowledged that the anonymous environment of this type of activity is more encouraging to their participation in the learning process.

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