Enhancing Learning Experience in University Engineering Classes with Kahoot! Quiz Games

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Abstract: In this short paper we present a study examining students' experience using a gamification quiz platform, Kahoot!, in two engineering courses in a private Japanese university. We ran Kahoot! quiz game regularly at the end of each lecture session throughout a semester. Students were encouraged but not forced to engage in discussions with peers during gameplay. We evaluated our approach using an original questionnaire designed to probe students' opinions of the usability and usefulness of the quiz games as well as their preferred play mode. The results showed that overall students had positive experience playing the Kahoot! quiz games in class, though many of them had no prior experience using Kahoot! or any kind of online quiz platforms before taking the courses we offered. Surprisingly, their interest in the quiz games did not wear off, and they enjoyed the fun and competitive atmosphere throughout the semester. Consistent with findings in prior studies, our analysis showed that many students considered the quiz games useful in helping them to concentrate in class and to develop a deeper understanding into the technical content. To a less degree, students found the quiz games motivating them to learn more about the subject. Students' preference of the play mode split, which suggests the importance of diversifying the play modes to meet the needs of different types of learners. We reflected over the nature of our quiz questions using the revised version of the Bloom's taxonomy. Our current design was centered on the 'Remember', 'Understand', and 'Apply' levels of factual and conceptual knowledge. Future studies are needed to expand the quiz game design to support the development of higher-order cognitive skills at the 'Analyze', 'Evaluate' and 'Create' levels, as well as adding additional objective measures for the assessment.

Keywords: Kahoot!, gamification, quiz, active learning, engineering education, computing education

1. Introduction

Quiz is widely used as a tool for pre- and post-class assessment (Cavadas et al., 2017; Cook & Babon, 2017; Liang, 2019). In particular, online quiz was found to be effective in incentivizing students' completion of preparatory work in flipped classroom (Egan et al., 2017), and in engaging and motivating students in remote learning (Parte & Mellado, 2022). Quiz improves knowledge retention and is considered an effective strategy of active learning (Cook & Babon, 2017). However, traditionally quiz is often used as an asynchronous activity where students answer the questions on their own and receive feedback with a delay. Game-based quiz games such as Kahoot! were developed to address the limitations of traditional quizzes and to enhance students learning experience. Kahoot! is a web application that allows educators to create interactive quiz games. It does not require an installation and can be accessed through an Internet browser on any digital device. It has been widely used in classes from K-12 to higher education around the globe (Wang & Tahir, 2020). Kahoot! provides user-friendly graphic interface for instructors to create their quiz activities, and a separate interface for players to answer the quiz items. Kahoot! allows

instructors to add a variety of questions, including single- and multi-choice questions, true or false questions, and puzzles. With a premium subscription, instructors will also be able to embed slides, videos, audios in a quiz game as well as collecting opinions with polls, word cloud and open-ended questions. Allowing for real-time feedback is a main difference between a Kahoot! quiz game and a traditional quiz (either paper-based or digital). For each question, once all students have submitted their responses, the system automatically grades all students and projects the correct answer as well as the distribution of their responses to the whole class. It allows instructors to provide immediate feedback, to comment on common mistakes, and to ask follow-up questions as needed. Such instantaneous interaction is often more educationally effective than when delivered after a delay (Thelwall, 2000). Instructors can customize the time allocated to each question so that the time pressure can be adapted to students' levels. In addition, by projecting an updated ranking of students after each question, it creates a competitive atmosphere which helps boost students' motivation and engagement (Wang & Tahir, 2020; Licorish, et al. 2017). At the end of a game, players are ranked based on their final scores and response time. After playing a quiz game, the platform will generate a report summarizing the overall performance of the whole class, and players' overall scores and scores to each question.

While there is a large body of evidence that the Kahoot! quiz games enhance classroom dynamics and motivate students to engage in the class flow (Cameron & Bizo, 2019; Licorish, et al. 2017; Wang & Tahir, 2020), little is known in terms of whether the quiz games motivate them to learn more about the subject and whether they appreciate the collaborative opportunities enabled by the quiz games. In addition, Asian student populations were under-represented in previous studies. In this paper, we share our experience of using quizzes to enhance learning experience in an English-medium engineering faculty in a private Japanese university. Leveraging the Kahoot! quiz platform, we combined gamification and summative quizzes to create a fun and competitive atmosphere in class, with the main purpose of promoting learner-content interactions and little emphasis on assessment. We evaluated our approach by collecting students' feedback using a questionnaire. By analyzing their responses, we aimed to generate preliminary answers to the following questions:

- How did students like the Kahoot! quiz games? Did they enjoy competing with peers?
- How often did they engage in discussions with others during gameplay?
- Did students prefer playing individually or in groups?
- Did the quiz games help students concentrate in class?
- Did the quiz games deepen their understanding of the learning content?
- Did the quiz games motivate them to explore more on the subject?

2. Method

We used the Kahoot! quiz platform in two courses. One is a mandatory Android app development course (denoted as C1) designed for first year university students, and the other is an elective digital signal processing course (C2) for third year students. Both courses offered 15 weekly teaching sessions. A teaching session last 3 hours and consist of a lecture or tutorial and some hands-on exercises. Details of the courses can be found in (Liang, 2022; Liang et al., 2021). In the 2022 academic year, 56 and 21 students were enrolled in each course. We played Kahoot! live at the end of each lecture session and alternated between the two play modes: classic mode and group mode. In classic mode students answered the questions with or without peer-interaction and they were ranked individually. In group mode students formed teams and had a short period of group discussion before answering each question. In this play mode students were ranked by teams. In Figure 1 the left pane shows the user interface on students' device, and the right pane shows the question and options that are projected to the whole class. To avoid overtaxing students' cognitive resources, our quiz games usually consist of 5 questions that can be completed in less than 10 minutes.
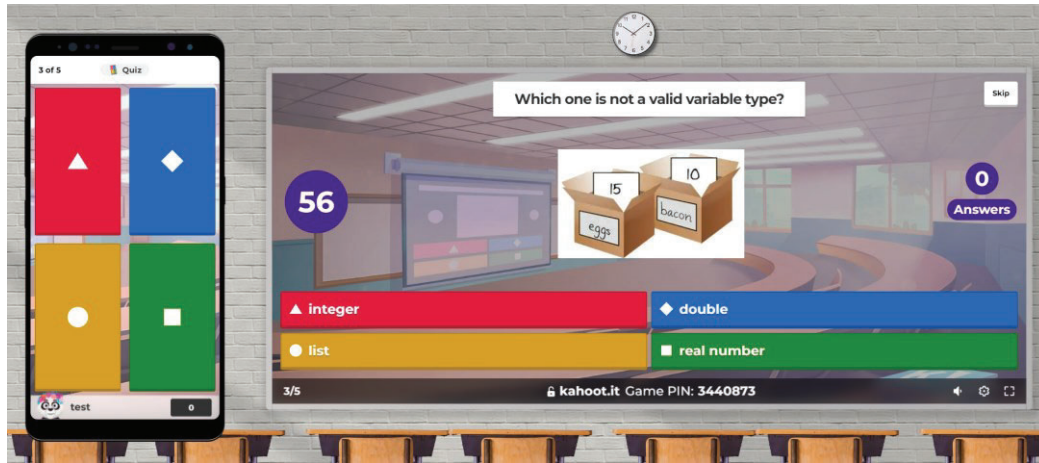
Figure 1. User interface of the Kahoot! quiz game platform.

We developed an original questionnaire to collect students' opinions of the Kahoot! quiz games. The questionnaire consists of 17 items as shown in Table 1 under the themes of usability, entertainment, competition, reinforcement, and motivation. Students rated each item on a Likert scale ranging from "strongly agree" (=5) to "strongly disagree" (=1). The question items were designed to probe students' opinions of the usability and usefulness of Kahoot! as well as their preference of collaboration with classmates during gameplay. The questionnaire was implemented using the Microsoft Form.

3. Findings

Table 1. *The median and mode of students' responses for each item.*

Item ID	Questionnaire Item	Android App Development (C1)	Digital Signal Processing (C2)
Q1	It was easy to use the Kahoot! app on my device.	5 (5)	5 (5)
Q2	It was fun to play the Kahoot! quiz games.	5 (5)	5 (5)
Q3	It was fun to compete against other students.	4 (5)	4 (4)
Q4	I wished to score top 3 and always tried my best to compete.	4 (5)	4 (4)
Q5	I was frustrated when I didn't score well in a Kahoot! game.	4 (4)	4 (4)
Q6	I discussed with other students to come up with my answers.	3 (3)	3 (3)
Q7	I prefer playing the group battle mode.	3 (3)	3 (3)
Q8	I was initially excited about Kahoot! in the first classes but gradually lost interest.	2 (2)	2 (1)
Q9	Playing Kahoot! helped me stay concentrated.	4 (3)	4 (4)
Q10	Playing Kahoot! deepened my understanding of the learning contents.	4 (4)	4 (4)
Q11	Playing Kahoot! motivated me to learn more about the subject.	3 (3)	4 (3)
Q12	I wished Kahoot! was used in other lectures.	4 (5)	4 (4)
Q13	Overall, the Kahoot! quizzes were helpful.	4 (4)	4 (4)
Q14	Overall, I like playing Kahoot! quiz.	4 (5)	4 (4)

We received responses from 47 and 21 students, which translates to a response rate of 83.9% and 100%, in C1 and C2, respectively. As for prior experience with Kahoot!, more than half of the students (N=25) in C1 had no prior experience using Kahoot! before taking the course. Among those 25 students, some had used other quiz platforms such as Quizlet (N=2) and Everyone's Quick Quiz/ Min'na de hayaoshikuizu (N=6). Similarly, the majority of the students in C2 (N=19) had no prior experience using Kahoot! but a few had used Quizlet (N=2) and Everyone's Quick Quiz/ Min'na de hayaoshikuizu (N=1). This implies that gamification is not yet widely used in educational institutions prior to university.
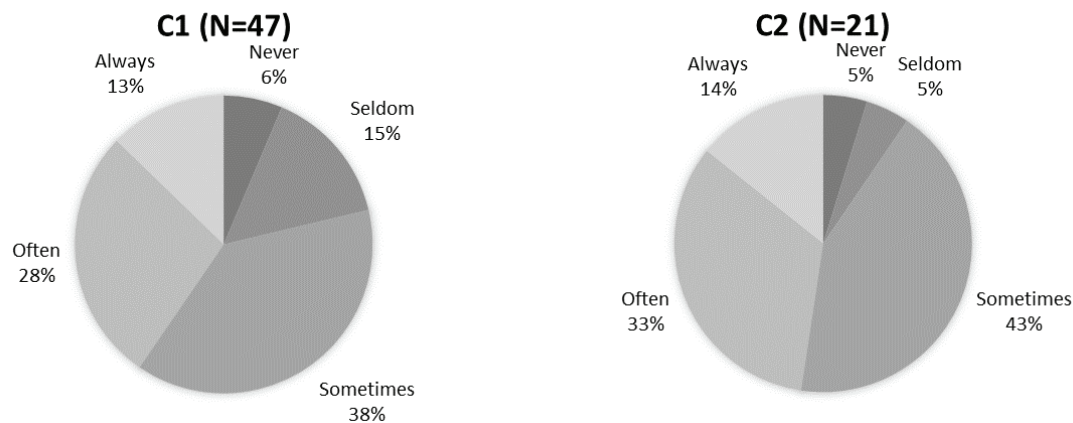

Figure 2. Distribution of responses to "Q6: I discussed with other students to come up with my answers" in C1 (Left) and C2 (right).
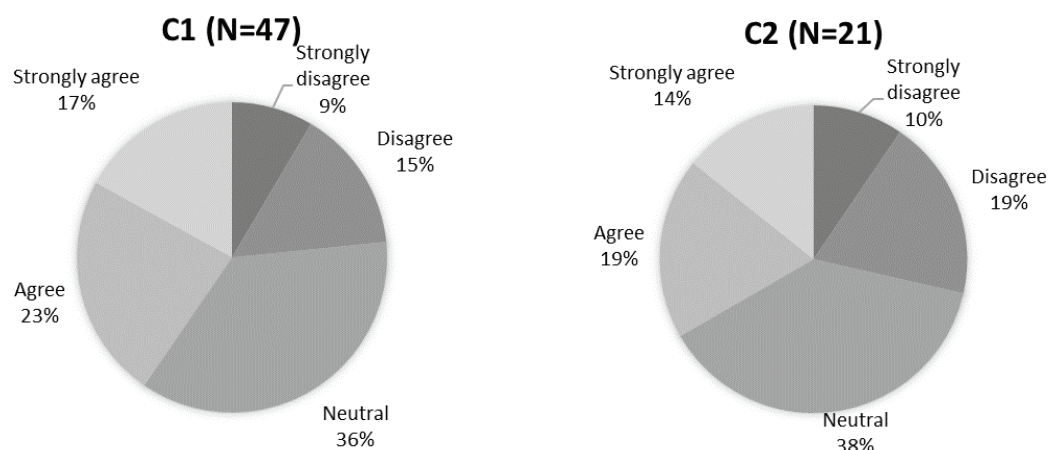

Figure 3. Distribution of responses to "Q7: I prefer playing the group battle mode" in C1 (Left) and C2 (right).

Given the ordinal nature of the data, we calculated the median and mode (instead of average and standard deviation) of students' responses for each item, as shown in Table 1. Overall, students' experience with Kahoot! was positive in both courses. Students considered the quiz games easy to use (Q1), fun to play (Q2, Q14), and helpful (Q13), and many of them wished that Kahoot! was used in other courses (Q12). While we hypothesized that students' interest in the quiz games would wear out gradually, the result suggested something opposite (Q8). Students in both courses perceived the competitive atmosphere as fun (Q3) and motivating (Q4), though they may feel frustrated if they did not score well (Q5). The opinions split when it comes to collaborating with classmates (Q6, Q7). As shown in Figure 2, 21% and 10% of the students never or seldom discussed with others during gameplay despite of being encouraged to. At the other end of the spectrum, 41% and 47% often or always engaged in discussions with others to come up with answers. As for the

preference of play mode, both courses showed similar tendency. As shown in Figure 3, 33%-41% students preferred group mode over classic mode, 24%-29% students had the opposite opinion, and the rest had no preference. This implies that instructors should alternate between the two play modes to meet the needs of students with different preferences. Initially we feared that the Kahoot! quiz game may be perceived primarily as an entertainment activity but with limited effect on learning because a quiz game was only a brief activity in each class. Nonetheless, in both courses many students agreed that the quiz games deepened their understanding (Q10), and to a less degree, helped them stay concentrated (Q9) and motivated them to explore more about the subject (Q11).

4. Discussions

We have presented our experience of using Kahoot! quiz games in class to engage and motivate students. Our findings echo previous studies that Kahoot! quiz brings the benefit of enjoyment and engagement, which is likely due to the competitive atmosphere created by the point system and the background music (Wang, 2016; Licorish, et al. 2017; Cameron & Bizo, 2019). While previous studies have demonstrated the effect of Kahoot! in motivating students to engage with current learning, our results demonstrate that Kahoot! may also motivate students to explore more of the subject in the near and far future.
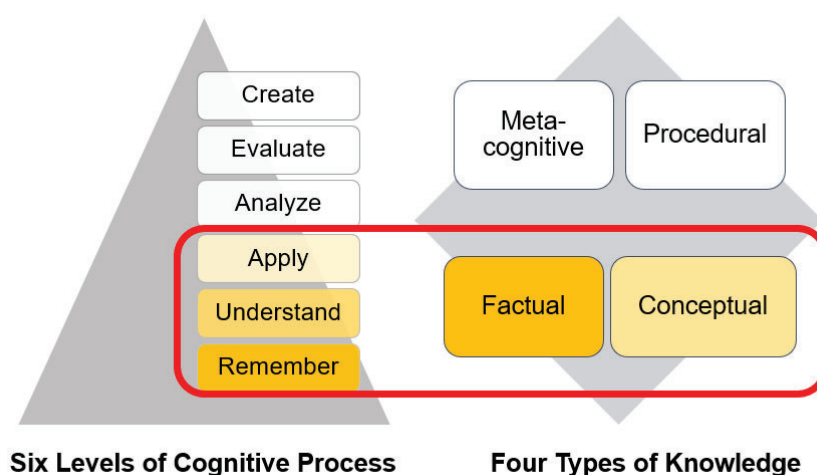

Six Levels of Cognitive Process   Four Types of Knowledge

Figure 4. The design of our Kahoot! quiz games was centered on the 'Remember', 'Understand', 'Apply' levels of factual and conceptual knowledge.

In what follows we discuss the role of the Kahoot! quiz games through the lens of the revised version of the Bloom's taxonomy (Krathwohl, 2002). As shown in Figure 4, the revised taxonomy consists of four types of knowledge and six levels of cognitive process organized in hierarchy. The design of our Kahoot! quiz games was centered on supporting students' learning on the 'Remember', 'Understand', and 'Apply' levels of factual and conceptual knowledge. In particular, the single-choice and true-or-false questions prompted students to recollect the factual and conceptual knowledge covered in the lecture sessions to boost knowledge retention. As indicated by students' responses to Q10, the quiz games were perceived as effective in helping deepen their understanding of the learning contents, hence supporting the 'Understand' level of cognitive process. Given the time pressure for students to answer the questions synchronously, it is challenging to design questions that support the development of higher-order thinking skills at the 'Analyze', 'Evaluate', and 'Create' levels, particularly those related to the procedural and metacognitive knowledge dimensions. Acknowledging the limitations of our quiz game design, we incorporated other activities as a complement. For example, in both courses students were required to work on a self-directed final project towards the end of the semester. The planning, execution,

implementation, and monitoring of the project provided great opportunities for students to acquire procedural and metacognitive knowledge while developing higher order thinking skills. There are several limitations of this work that should be addressed in future studies. First, this study was conducted in a private university and thus may not generalize well to other types of educational institutions. Second, the findings relied on self-reported data from the questionnaire, which may subject to recall bias or social desirability. Objective measures or additional assessment could be used in the future to strengthen the study. Third, we did not delve deeper into the design opportunities for supporting higher-order cognitive skills and collaborative learning using the Kahoot! quiz game platform.

5. Conclusion

We have shared our learning design with the Kahoot! quiz game platform in two engineering courses targeting first- and third-year university students. The quiz games created a fun and competitive atmosphere to engage and motivate students. The questionnaire results demonstrated that students had positive experience with the quiz games. Students found the quiz games useful in helping them concentrate in class and deepening their understanding of the technical contents. Students' preferences split when it came to whether to engage in discussions with peers and the play mode, which implies the importance of diversifying the play settings to meet the needs of different types of learners. According to the revised version of the Bloom's taxonomy, our current quiz game design was centered primarily on supporting the development of lower-order cognitive processes including 'Remember', 'Understand' and 'Apply' factual and conceptual knowledge. In our next step we will evaluate our learning design with a large cohort using both subjective and objective measures. We will also expand our quiz design to support the development of higher-order cognitive processes at the 'Analyze', 'Evaluate' and 'Create' levels and collaborative learning.

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