WIP: Gamification as an Engagement Tool in ECE Courses

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Introduction

The current cohort of college students prefers visual and interactive learning environments [1, 2] and enjoys frequent and short educational stimuli. As a result, educators are exploring the integration of gamification principles into classrooms [3–5]. Particularly in engineering courses, abstract concepts often pose challenges for students' understanding. Gamification offers an approach to turning traditional, passive learning styles into more interactive and dynamic learning experiences [6–8]. Gamification reduces the personal association with mistakes and encourages mastery [9].

The objective of this study is to explore the impact of gamification on student engagement and performance in undergraduate engineering courses. In the long run, the goals of the study are focused on addressing the following questions: How does the implementation of gamification affect student engagement and learning outcomes in different types of ECE courses? Does gamification improve student performance and understanding of course material compared to traditional teaching methods? Gamification has many implementations, including points, badges, leaderboards, challenges, etc. Among these elements, which are the most effective in fostering learning and participation? What are the perceptions of both students and faculty regarding the use of gamified activities in the classroom? What challenges and obstacles do instructors face when implementing gamification, and how can these be mitigated? Is there a measurable difference in outcomes between gamified and non-gamified classrooms?

In order to address these questions, traditional teaching methods and gamified teaching methods were used in five engineering courses at a large R1 university. Each course modified the inclusion/exclusion of various versions of gamification strategies halfway through the semester. Students were surveyed near the end of the semester in order to assess the overall impact of gamification on learning outcomes, engagement, and student satisfaction. The survey sought to evaluate students' overall experience with gamification throughout the course, determine which elements were most/least effective, and analyze the impact on collaboration, competition, and stress levels. Students were also asked about the perceived impact on learning outcomes, and understanding of course material. Suggestions for improving gamification in future courses were collected in the survey as well.

General Overview of Gamification Platforms

Two platforms were used in the five courses by three instructors in Fall 2024: Kahoot! [10] and Mentimeter [11]. Kahoot! featured competitive quizzes with real-time leaderboards and prize options for top performers, fostering engagement and competition. Mentimeter enabled interactive polling and anonymous Q&A sessions, encouraging collaboration and reducing stress associated with competition.

Both platforms share common strengths, including:

- Free for students; instructors pay a subscription fee.
- A variety of assessment formats, such as multiple-choice, true/false, puzzles, sliders, polls, and open-ended questions.
- Real-time participation and feedback.
- Compatibility with smartphones, tablets, and laptops.
- Accessibility features, including high contrast modes and text scaling options.

Despite these shared features, there are some different strengths offered by the two platforms. A comparative summary is shown in Table 1 below.

Feature	**Mentimeter**	**Kahoot!**
Engagement Focus	Focuses on active learning and gathering feedback	Focuses on active learning and competition
Feedback Format	Mostly qualitative feedback like open-ended answers	Primarily quantitative feedback with scores and ranks
Competitive Element	None; focus is on feedback gathering	Friendly competition with leaderboards and points
Anonymity	Fully anonymous	Both anonymous and named participation

Table 1: Comparison of Features: Mentimeter vs. Kahoot!

Methodology

Gamification implementations

In the five engineering classes, various gamification instruction methods were implemented in Fall 2024. In a sophomore-level analog signal processing course, ECE 210, Kahoot! quizzes were used to promote student participation. During the first half of the course, no incentives were provided. However, for the second part of the course, prizes were offered to the three students with the highest total points in the quizzes: $25 for first place, $15 for second place, and $10 for third place.

Two undergraduate junior/senior level courses in the electromagnetic area, ECE 329 and ECE 477, began with traditional lecture-based instruction without any gamified features. In the second half of the semester, Kahoot! quizzes were introduced to incorporate gamification. Identical

prizes as those in ECE 210 were offered to the top three performers based on cumulative quiz scores.

In two undergraduate junior/senior level courses in the power and energy systems area: ECE 330, Section X, and ECE 333, the instructor initially utilized Mentimeter for the first part of the semester to encourage student participation and provided opportunities to ask questions anonymously, as speaking in public often causes anxiety for many students. Mentimeter exercises included anonymous online quizzes without prizes or competitive elements. For the second part of the semester, Mentimeter was replaced by Kahoot! quizzes. The instructor also announced that prizes would be distributed at the end of the semester to the students with the three highest total scores.

Survey Design

Based on the gamification implementation in Fall 2024, three sets of surveys were created to evaluate the effects of gamification on five engineering courses. Each set of surveys consisted of 21 questions designed to address specific aspects of gamification. Each survey included questions on stress, motivation, understanding, competitive components, student participation, etc. For example, in ECE 210, the focus was placed on comparisons of gamified quizzes without and with prizes. For ECE 329/ECE 477, the emphasis was between non-gamified and gamified activities. Meanwhile, ECE 330/ECE 333 survey aimed to examine student preferences for different tools such as Kahoot! and Mentimeter.

The surveys were divided into two sections. The first section focused on student engagement and motivation under different instructional methods, with Likert-scale questions addressing their experiences with gamified activities. The second section explored deeper aspects, such as perceived learning outcomes, stress levels, and preferences for future gamification implementations.

Research Questions

In order to investigate student learning experiences for the five courses, both qualitative and quantitative data were analyzed. Survey questions were tailored to answer the following research questions:

1. How does gamification influence student engagement and motivation?
2. How do prizes in gamification affect student motivation?
3. How do different gamification platforms (Mentimeter vs. Kahoot!) impact the engagement, focus and understanding of the course material?
4. How do stress and anxiety levels vary under different gamification methods?
5. What is the perceived impact of competitive elements on learning outcomes?

Demographics

The survey was distributed at the end of the semester to measure students' reflections on their gamification experiences. Responses were collected from 94 students enrolled across the five courses. The number of responses for ECE 210, ECE 329, ECE 330, ECE 333, and ECE 477 course were 27, 31, 13, 16, and 7 respectively. On average, approximately 40% of the students enrolled in each course participated in the survey.

Analysis and Findings

This section examines the effects of gamification across five engineering courses. The analysis starts by evaluating students' engagement and motivation, and then investigating the perceived benefits of gamification on focus and understanding. The emotional impact of gamification is also evaluated by exploring stress and anxiety levels. Lastly, we investigate students' preferences for future offerings of gamified lectures.

1) Engagement

Table 4 presents the mean and standard deviation (SD) for Q1 and Q2, which measure engagement across different instructional methods or tools for five courses: ECE 210, ECE 329, ECE 330, ECE 333, and ECE 477. Both questions were multiple-choice questions using a Likert scale. Higher scores represented more positive responses, while lower scores reflected more negative ones. Although labeled Q1 and Q2, the specific content of each question varies by course number.

- ECE 210: Q1 and Q2 assessed engagement during Kahoot! quizzes without prizes and with prizes, respectively.

Course_ID	Q1 Mean	Q1 SD	Q2 Mean	Q2 SD
ECE 210	4.19	0.913	4.41	0.922
Total	**3.99**	**0.962**	**4.31**	**0.866**

Table 2: Mean and SD of Engagement Levels (Q1 and Q2) in ECE 210 course. Q1: Kahoot! without prizes, and Q2: Kahoot! with prizes.

- ECE 329 and ECE 477: Q1 and Q2 measured engagement during traditional lectures and during lectures with gamification, respectively.

Course_ID	Q1 Mean	Q1 SD	Q2 Mean	Q2 SD
ECE 329	3.90	0.970	4.32	0.742
ECE 477	4.21	0.579	4.57	0.514
Total	**3.99**	**0.962**	**4.31**	**0.866**

Table 3: Mean and SD of Engagement Levels (Q1 and Q2) Across Courses. Q1: non-gamified lectures, and Q2: gamified lectures.

- ECE 330 and ECE 333: Q1 and Q2 evaluated engagement during Mentimeter activities and Kahoot! quizzes, respectively.

Course_ID	Q1 Mean	Q1 SD	Q2 Mean	Q2 SD
ECE 330	3.77	1.070	4.00	1.058
ECE 333	3.94	1.045	4.25	0.916
Total	**3.99**	**0.962**	**4.31**	**0.866**

Table 4: Mean and SD of Engagement Levels (Q1 and Q2) Across Courses. Q1: Mentimeter during lectures, and Q2: Kahoot! with prizes.

The results showed that the mean engagement levels for Q2 were consistently higher than those for Q1 across all five courses. This finding suggested that, in ECE 329 and 477, students reported higher engagement during gamified activities (such as Kahoot! quizzes with prizes) than in non-gamified ones (like traditional lectures or activities without prizes). The higher Q2 scores for courses ECE 330 and 333 may be due to the different nature of the tools. Mentimeter was effective for interactive polling, while Kahoot! had more competitive quizzes, especially when prizes were offered.

ECE 330 and ECE 333 also had notably higher SD (1.070 and 1.045) for Q1 and Q2 compared to the other courses. This increased variability could be related to the time frame in which these tools were implemented. Mentimeter was used during the early part of the semester, while Kahoot! was introduced later. The survey was conducted at the end of the semester, which may have influenced students' reflections on their engagement levels across these different tools.

In a follow-up question (Q3) about student engagement levels, we asked students to self-reflect on their experiences with transitioning to Kahoot! with prizes. Overall, 67.6% of students across all courses rated their experience positively, aligning with the findings from Q1 and Q2. These findings suggested that gamified lectures can significantly increase students' engagement level, especially when prizes were offered.

2) Motivation

Next, we analyzed the mean motivation levels and their SDs across the five courses, as illustrated in Figure 1. In the figure, SDs were capped at 5 to align with the Likert scale. Similarly to Q1 and Q2 across different courses, Q4 and Q5 measured students' motivation with respect to different gamification strategies.

The survey for ECE 210 course focused on the motivation levels of Kahoot! quizzes without (Q4) and with prizes (Q5). The increased mean for Q5 suggested that adding prizes to gamified tasks could increase students' motivation. Paired-samples t-test also had p-value less than 0.001, indicating that the differences in the means of Q4 and Q5 are statistically significant.

Q4 and Q5 for ECE 329 and 477 compared students' motivation levels for non-gamified lectures (Q4) and gamified lectures (Q5). The students in ECE 477 reported the highest mean (4.36) motivation level for gamified lectures. This could be because ECE 477 lasted 1 hour and 20

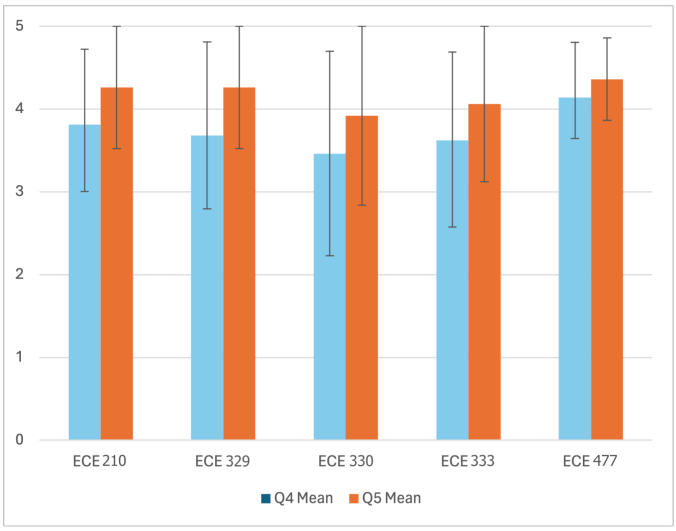

Figure 1: Mean and SD of Motivation Levels Across Surveys.

minutes, while all other courses were 50 minutes. Gamification may have served as a helpful break during a longer lesson, helping students stay motivated.

In ECE 330 and ECE 333 courses, we asked the students to examine their motivation level for gamification activities using Mentimeter (Q4) versus Kahoot! quizzes (Q5). According to this comparison, students were more motivated by the competitive aspect of Kahoot! than the interactive polling feature offered by Mentimeter.

Gamified activities raised motivation levels in each course, but Kahoot! quizzes with prizes were an effective motivator. The increased motivation observed in ECE 477 demonstrated the advantages of gamifying longer classes to maintain student engagement.

3) Focus

Students answered two survey questions about gamification's effect on focus - (Q7) how easy it was for students to stay focused during Kahoot! without prizes, non-gamified lectures, and Mentimeter classes, compared to (Q8) how easy it was to stay focused during gamified lectures using Kahoot! quizzes with prizes.

A paired-samples t-test was used to compare the differences in student focus levels between Q7 and Q8. Students reported that gamified lectures had a higher mean on focus level of 3.95 (SD = 0.974) than the first half of the semester, which had a mean rating of 3.43 (SD = 1.119). This implied that students were able to focus better during gamified lectures using Kahoot! with prizes. A paired samples t-test, which showed a mean difference of -0.521 (t(187) = -8.176), further verified the statistical significance $p < 0.001$. There was a consistent improvement in focus throughout the five courses, as indicated by the 95% confidence interval for the difference, which varied from -0.647 to -0.395.

These results highlight the effectiveness of gamification, particularly using Kahoot!, in enhancing student focus. Compared to traditional lecture methods, gamified approaches appear to provide a

more interactive and engaging environment that helps students maintain their attention. This finding is particularly significant in courses where maintaining student focus has traditionally been challenging.

These findings highlight that gamification in lectures was effective to improve student focus, especially when Kahoot! with prizes was used. Gamified teaching strategies seem to offer a more dynamic and captivating setting than conventional lecture techniques, which aids in maintaining students' interest.

4) Understanding

Student understanding of course material is a core objective of any instructional method, particularly in engineering courses where comprehension directly impacts students' ability to solve complex problems and succeed in real-world applications. In all courses, we designed in-class gamified quizzes to provide immediate feedback and check students' understanding of the topic just discussed. Instructors could also use the results from the quizzes to access students' levels of understanding and adjust the following lecture contents accordingly.

In the survey, students were asked to reflect on how instructional strategies influenced their understanding of the material. Table 5 summarizes the percentages of students who reported improved understanding (Option 4: "Somewhat better" and option 5: "Much better") across all courses.

Course_ID	Option 1	Option 2	Option 3	Option 4	Option 5	Total
ECE 210	51.9%	40.7%	7.4%	-	-	100.0%
ECE 329	3.2%	19.4%	38.7%	38.7%	-	100.0%
ECE 330	7.7%	15.4%	7.7%	53.8%	15.4%	100.0%
ECE 333	6.3%	18.8%	12.5%	43.8%	18.8%	100.0%
ECE 477	28.6%	14.3%	14.3%	-	57.1%	100.0%
Total	2.1%	6.4%	26.6%	40.4%	24.5%	100.0%

Table 5: Percentages of Students Reporting Improved Understanding Across Courses. Opinion 1 was "Much worse", 2 was "Slightly worse", 3 was "No difference", 4 was "Slightly better", and 5 was "Much better".

In ECE 210, students were using Kahoot! quizzes for the entire semester. After we implemented Kahoot! with prizes, 48.1% of students reported improved understanding, while 51.9% were neutral. This suggests that the introduction of prizes heightened the perceived benefits of gamification, though the relatively low percentage among all five courses indicated that prizes alone may not have a significant impact.

In ECE 329 and 477, gamification was introduced to replace traditional lecture methods. A significant majority of students—77.5% in ECE 329 and 71.4% in ECE 477—reported improved understanding. The gamified activities introduced mid-session may have also provided a cognitive reset, helping students process earlier content while maintaining focus on the remaining lecture material.

In ECE 330 and 333 courses, two gamification methods were used. Students started using Mentimeter and switched to Kahoot! quizzes later. Figure 2 illustrated how Mentimeter was utilized. The ”entry ticket” was used to gauge students’ prior knowledge and ”exit ticket” was adapted to examine the learning outcomes at the end of a lecture. Kahoot! quizzes, however, was adapted in multiple-choice questions, true-false questions and other formats, to revisit course materials.

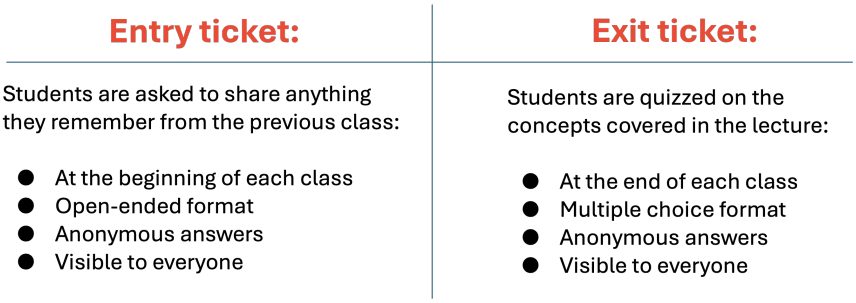

Figure 2: Mentimeter Usage in ECE 330 and 333 Courses.

The survey results showed that 69.2% of students in ECE 330 and 62.7% in ECE 333 reported improved understanding when switching to Kahoot! quizzes compared to Mentimeter. While both tools were useful and effective gamification tools, the higher engagement with Kahoot! due to its competitive format and/or the prized offered may be more attractive to students.

These findings showed that gamification could be utilized to enhance student understanding. ECE210 showed that half of the students found the prizes impactful enough to enhance their understanding. This result might reflect that gamification with prizes is beneficial but not a standalone solution. ECE 329 and ECE 477 showed strong positive responses to adapting gamification compared to traditional, non-gamified lectures. The comparisons in ECE 330 and ECE 333 between Mentimeter and Kahoot! demonstrate how different ways of gamified tools could influence their effectiveness in enhancing students’ level of understanding.

5) Stress Level

Developing successful classroom experiences requires an understanding of how gamified learning settings affect students’ stress levels. Although gamification can increase motivation and engagement, some students may experience anxiety due to the competitive nature of games. In this section, we aim to examine the stress levels of students in relation to gamification.

Table 6 and 7 summarize the crosstabulation analysis of two stress-related survey questions Q13 and Q14, respectively. Q13 focused on whether the competitive elements of Kahoot! quizzes enhanced students’ learning, while Q14 assessed the stress or anxiety induced by the competitive nature of these activities.

In ECE 210, 62.6% of students felt that the competitive aspect of Kahoot! improved their learning, according to Q13 responses 4 and 5. Further, 92.6% of students said they had little to no

Course_ID	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
ECE 210	7.4	22.2	7.4	37.0	25.9
ECE 329	3.2	19.4	9.7	41.9	25.8
ECE 330	7.7	23.1	30.8	38.5	-
ECE 333	12.5	6.3	18.8	18.8	43.8
ECE 477	14.3	14.3	-	14.3	57.1
Total	7.4	13.8	12.8	33.0	33.0

Table 6: Crosstabulation of Q13 (Perceived Learning Benefit) Across Courses. Likert scales 1-5 represented "Not at all", "Slightly", "Moderately", "Fairly", and "Very much", respectively.

Course_ID	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
ECE 210	7.4	25.9	-	25.9	66.7
ECE 329	9.7	19.4	3.2	-	67.7
ECE 330	7.7	7.7	15.4	-	69.2
ECE 333	25.0	50.0	25.0	-	-
ECE 477	14.3	14.3	-	14.3	71.4
Total	1.1	4.3	14.9	20.2	59.6

Table 7: Crosstabulation of Q14 (Stress Levels) Across Courses. scales 1-5 was "Very stressful", "Fairly stressful", "Moderately stressful", "Slightly stressful", and "No stress at all", respectively.

stress (Q14 answers 4 and 5). These suggested that the gamified activities with competition did not create significant stress for most participants.

Students in ECE 329 and ECE 477 reported the highest levels of perceived benefits from competition, with 67.7% and 64.3% selecting categories 4 and 5 of Q13, respectively. Correspondingly, stress levels were notably low in these courses. 70.9% and 71.4% reporting low or no stress (Q14 responses 4 and 5). For the longer ECE 477 lectures (80 minutes), gamification likely provided a motivational break that maintained focus without inducing stress.

In ECE 330 and ECE 333, students were exposed to both Mentimeter and Kahoot!. 69.2% and 62.7% of students in these courses found Kahoot!'s competitive aspects were beneficial for learning (Q13). In addition, most the students reported low or no stress in Q14 (57.7% and 75.0%, respectively). The combination of competitive and interactive elements from both tools may have mitigated stress while supporting effective learning engagement.

The Pearson correlation analysis between Q13 and Q14 revealed a weak positive correlation ($r = 0.046$, $p = 0.657$). This indicated that the perceived benefits of competition and reported stress levels were not strongly related. While students may recognize the learning advantages of competition, these benefits didn't correlate with increased or decreased stress levels.

6) Student Preferences

To evaluate student preferences for different lecture formats with respect to gamification, we asked students to rate their preferences for three different formats. Table 8 summarizes the

ranking system used in the survey for the three formats in the five courses.

Q10 Ranking	ECE 210, ECE 329, and ECE 477	ECE 330 and ECE 333
Option 1	non-gamified lectures	non-gamified lectures
Option 2	Kahoot! wo. prizes	Mentimeter
Option 3	Kahoot! w. prizes	Kahoot! w. prizes

Table 8: Q10 Ranking for Lecture Formats Preference Across Courses.

Table 9 summarizes the percentages of students in each course of their most and least preferred lecture formats. Note that not all gamification methods were used in one course, so students might refer to their own experience if the option was not used. This provides a clear comparison of student preferences for gamified and non-gamified approaches.

Course ID	Top Rank: Option 3 (%)	Middle Rank: Option 2 (%)	Least Rank: Option 1 (%)
ECE 210	81.5	74.1	88.9
ECE 329	71.0	64.5	51.6
ECE 330	76.9	69.2	76.9
ECE 333	68.8	50.0	62.5
ECE 477	78.6	64.3	78.6
Overall	75.0	65.4	69.7

Table 9: Top, Middle, and Least Rankings for Each Option Across Courses

Across all courses, the data highlights a strong preference for gamified lectures with prizes (Option 3). This option was rated as the most favorable by 75% of students overall, with particularly high preferences in ECE 210 (81.5%), ECE 477 (78.6%), and ECE 330 (76.9%). In ECE 329 and ECE 333, although preferences were slightly lower, a majority (71% and 68.8%, respectively) still identified this format as their favorite.

In contrast, 69.7% of students chose non-gamified lectures (Option 1) as their least preferred alternative. In ECE 210, where 88.9% of students thought non-gamified lectures were the least favorable format. Likewise, ECE 477 and ECE 330 showed a considerable dislike for lectures that weren't gamified, with 78.6% and 76.9% of students placing them last, respectively.

Gamified lectures without prizes (Option 2) and Mentimeter (used in ECE 330 and ECE 333) received more mixed responses. In ECE 333, 50% of students ranked Mentimeter as their middle preference, while 37.5% rated it as their least favorite. Meanwhile, in ECE 330, 69.2% of students placed Mentimeter in the middle rank. In ECE 329, where Kahoot! without prizes was used, 64.5% ranked it as their middle choice, and 16.1% still rated it as their most favorable, indicating some variation in preferences.

The results clearly showed that gamification greatly raised student satisfaction and participation in all courses, especially when prizes were offered. Since students strongly disliked non-gamified lectures, it emphasized the need to transition from traditional methods to more interactive teaching strategies.

Faculty's perspectives on gamification implementation

The student survey clearly showed positive effects on student engagement and motivation. However, instructors faced several challenges when integrating these tools into their courses. One primary concern is the additional time required to design the quizzes prior to lectures. This included the time spent preparing interactive activities. Although these quizzes could be reused in future semesters, it still requires instructors to continuously update the quizzes to ensure that the quizzes align with each lecture.

Another concern is that extra time is needed to implement gamified activities during classes. Gamification activities require pausing for quizzes and reviewing answers. In addition, managing student participation and ensuring smooth transitions between activities can add more time. This could reduce the time available for other instructional activities. If the course has tight schedules, this challenge can require adjustments in lesson planning to accommodate gamified elements.

Despite these challenges, all instructors who have successfully implemented gamification in Fall 2024 reported increased student engagement and improved classroom participation. In many lectures, instructors observed that students sit closer to the front. Students actively participated in the lectures, and the higher attendance rates were also improved.

Future Work

This paper is a work in progress. To build on top of the findings of this study, future work may include the following.

- Longitudinal studies: Various gamification methods could be adopted and applied over multiple semesters on a wider range of ECE courses.
- Evaluate impact on learning outcomes: Institutional Review Board (IRB) has approved our proposal to compare students' academic performances vs. gamification in December 2024. Several measurable outcomes could be used, such as grades and course completion rates. Future studies can explore whether students self-reported higher engagement and motivation levels are correlated with better learning outcomes.
- Faculty trainings: Develop workshops to help faculty implement gamified activities that are tailored for their specific course needs.

Conclusions

This study showed how gamification can improve engineering course students' motivation, engagement, focus, and understanding through the study of gamification in five undergraduate engineering courses. In Fall 2024, three instructors created dynamic and interactive learning experiences by incorporating tools like Mentimeter and Kahoot! into regular class activities. According to student feedback, gamification can positively influence engagement and motivation, and its impact can vary depending on how it is implemented. The presence of prizes (ECE 210) or the choice of gamification tools (ECE 330 and 333) can also significantly affect the outcomes.

However, for longer class sessions like ECE 477, gamification may be helpful to keep students focused and engaged. These insights can be used to guide instructors in tailoring their gamification strategies to maximize the effectiveness.

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Appendix

1 Survey for ECE 210

Q#	Survey Question
1	How engaged did you feel (e.g., paying attention, participating) during Kahoot! quizzes without any prizes?
2	How engaged did you feel during Kahoot! quizzes with the potential to win prizes (e.g., gift cards for top scorers)?
3	How would you compare your level of engagement between Kahoot! quizzes without prizes and with the potential to win prizes?
4	How motivated were you to participate in Kahoot! quizzes when no prizes were offered?
5	How motivated were you to participate in Kahoot! quizzes when prizes were offered for top scorers?
6	How would you compare your level of motivation between Kahoot! quizzes without prizes and with prizes?
7	How easy was it for you to stay focused during non-gamified (traditional) lectures?
8	How easy was it for you to stay focused during gamified lectures with Kahoot!?
9	How would you compare your ability to focus between non-gamified (traditional) and gamified lectures using Kahoot!?
10	Rank the following options in order of preference: non-gamified lectures, gamified lectures without prizes, gamified lectures with prizes.
11	How helpful do you think Kahoot! (e.g., quizzes, competitions) was in improving your understanding of course material?
12	How would you compare your understanding of course material between Kahoot! quizzes without prizes and with the potential to win prizes?
13	Do you think the competitive element of Kahoot! quizzes helped you learn the course material better?
14	How would you rate your stress or anxiety due to the competitive aspect of Kahoot!?
15	How would you compare your stress or anxiety between non-gamified (traditional) and gamified lectures?
16	How would you rate your overall experience with Kahoot! quizzes when no prizes were offered?
17	How would you rate your overall experience with Kahoot! quizzes when prizes were offered?
18	How would you compare your overall experience between Kahoot! quizzes with no prizes and those with prizes?
19	How likely would you recommend the use of gamification in future iterations of this course?
20	Would you prefer fewer or more competitive activities like Kahoot! quizzes in future courses?
21	What aspects of the gamified experience did you find most beneficial? Please explain why.

Table 10: Survey Questions for ECE 210

2 Survey for ECE 329/ECE 477

Q#	Survey Question
1	How engaged did you feel (e.g., paying attention, participating) during lectures without gamification?
2	How engaged did you feel during lectures with gamification?
3	How would you compare your level of engagement between lectures with and without gamification?
4	How motivated were you to participate during the non-gamified (traditional) lectures?
5	How motivated were you to participate during the gamified lectures?
6	How would you compare your level of motivation between lectures with and without gamification?
7	How easy was it for you to stay focused during non-gamified (traditional) lectures?
8	How easy was it for you to stay focused during gamified lectures?
9	How would you compare your ability to focus between non-gamified (traditional) and gamified lectures?
10	Rank the following options in order of preference: non-gamified lectures, gamified lectures without prizes, gamified lectures with prizes.
11	How helpful do you think gamification (e.g., quizzes, competitions) was in improving your understanding of course material?
12	How would you compare your understanding of course material between non-gamified (traditional) and gamified methods?
13	Do you think the competitive element of Kahoot! quizzes helped you learn the course material better?
14	How would you rate your stress or anxiety due to the competitive aspect of Kahoot! quizzes?
15	How would you compare your stress or anxiety between non-gamified (traditional) and gamified lectures?
16	How would you rate your overall learning experience during non-gamified (traditional) lectures?
17	How would you rate your overall learning experience during gamified lectures?
18	How would you compare your overall learning experience between non-gamified (traditional) and gamified lectures?
19	How likely would you recommend the use of gamification in future iterations of this course?
20	Would you prefer fewer or more competitive activities like Kahoot! quizzes in future courses?
21	What aspects of the gamified experience did you find most beneficial? Please explain why.

Table 11: Survey Questions for ECE 329/ECE 477

3 Survey for ECE 330/ECE 333

Q#	Survey Question
1	How engaged did you feel (e.g., paying attention, participating) during Mentimeter activities in class?
2	How engaged do you think you will feel during Kahoot! quizzes with the potential to win prizes?
3	How would you compare your level of engagement between using Mentimeter and Kahoot!?
4	How motivated were you to participate in Mentimeter activities during class?
5	How motivated do you feel about participating in Kahoot! quizzes when prizes are offered?
6	How would you compare your level of motivation between using Mentimeter and Kahoot!?
7	How easy was it for you to stay focused during lectures with Mentimeter?
8	How easy was it for you to stay focused during lectures with Kahoot!?
9	How would you compare your ability to focus between lectures with Mentimeter and Kahoot!?
10	Rank the following options in order of preference: non-gamified lectures, Mentimeter, Kahoot!.
11	How helpful do you think Mentimeter was in improving your understanding of course material?
12	How helpful do you think Kahoot! was in improving your understanding of course material?
13	How helpful do you think the competitive aspect of Kahoot! will be in keeping you motivated when prizes are involved?
14	How would you rate your stress or anxiety due to the competitive aspect of Kahoot! quizzes?
15	Do you think the competitive element of Kahoot! quizzes helped you learn the course material better?
16	How would you rate your overall experience with Mentimeter?
17	How would you rate your overall experience with Kahoot! quizzes when prizes are offered?
18	How would you compare your overall experience between using Mentimeter and Kahoot!?
19	How likely would you recommend the use of Mentimeter or Kahoot! in the future iterations of this course?
20	Would you prefer using gamification like Mentimeter or Kahoot! in future courses?
21	What aspects of the gamified experience (using Mentimeter and Kahoot!) did you find most beneficial? Please explain why.

Table 12: Survey Questions for ECE 330/ECE 333