Impact of Gender on Students' Classroom Engagement, Flow Experience and Learning Outcomes When Game-Based Answering Activities Are Integrated into the Curriculum

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Abstract: Many studies pointed out that when game-based answering activities are integrated into lecture teaching courses, students' classroom participation, flow experience, and learning effectiveness can be improved. However, some studies have also pointed out that gender differences could affect students' classroom participation, flow experience, and learning effectiveness when learning in physical classrooms or on the Internet. This study explores the impact of gender differences on students' classroom participation, flow experience, and learning effectiveness when the Kahoot game-based answering platform is integrated into lecture teaching courses. The subjects of the experiment were 31 students in the 12th grade of a senior high school in central Taiwan who were taking the "Arts and Life-applied Music" course. They are between 17 and 18 years old. Among them, there are 15 boys and 16 girls. The results showed that girls' classroom participation and flow experience were significantly better than boys'. However, in terms of learning outcomes (gain scores), girls are slightly better than boys, but not at a significant level. This study speculates that it may be because the theme of "Arts and Life-applied Music" is biased towards the field of music art, and girls are more interested in knowledge in this field. In addition, in the Kahoot game, because girls have better language skills, even if they use mobile phones to answer in class, the girls had a lot of speeches and discussions. During these processes, it is easier to strengthen the learning impression invisibly. On the other hand, boys tended to think in silence and reduced their interaction in language communication, and rushed to answer. This contrasts with the rational classroom atmosphere of boys and girls and boys tend to be more rational.

Keywords: Gender, game-based answering activities, classroom participation, flow experience, learning outcomes

1. Introduction

Although traditional lecture teaching is very efficient, it is often criticized for reducing students' classroom engagement and flow experience, which in turn affects learning outcomes. Many scholars have explored the factors that affect the classroom engagement of university students. The results showed that the factors that affect students' classroom engagement include teachers' motivation, encouragement or teasing among students, and interactions among students (Aziz & Kazi, 2019; Ghalley & Rai, 2019). Teachers asking questions to students in the classroom can increase interaction and thus increase engagement in the classroom. However, Mundelsee and Jurkowski's (2021) study indicated that students are often less willing to respond to teacher questions due to a lack of confidence, which in turn

affects classroom engagement. Therefore, it is important for students to be willing to participate actively when teachers ask questions in the classroom.

In addition to increasing student engagement in the classroom, immersing students in the instructional environment can have a significant impact on student learning outcomes. Clarke and Haworth's (1994) findings suggested that optimal mindfulness experiences are characterized by a high degree of cognitive engagement. Kiili, De Freitas, Arnab and Lainema (2012) found that well-designed game-based learning is effective in engaging students. The principles of good educational game design should include pedagogical elements that emphasize feedback and process principles.

Kahoot is a game-based scramble activity system suitable for integration into classroom lectures (Wang, Øfsdahl, & Mørch-Storstein, 2007, November). It is designed to provide highly interactive lecture robocall games using the classroom's existing presentation equipment and infrastructure (e.g., teacher's laptop, large screen, monopod projector, Internet connection, and students' cell phones). Dellos (2015) created quizzes on Kahoot with pictures and music to promote thinking for elementary school students. It enables students to use Kahoot to answer questions according totheir understanding without talking out loud in the classroom. This is beneficial to both teachers and students. This improves the disincentive for students to answer teacher questions individually as mentioned previously. Zhang and Yu (2021) analyzed 26 Kahoot-related journal articles to examine the impact of Kahoot on student learning outcomes, classroom interactions, and collaboration. The results showed that Kahoot can improve students' learning outcomes, interactions between students and teachers, and extracurricular collaborations among students in both traditional and flipped classroom learning environments if it is accompanied by good curriculum planning. From the above literature, Kahoot is a practical and effective tool for classroom interaction.

However, boys and girls in middle school begin to show significant differences in brain personality (Voyer & Voyer, 2014). Boys and girls have different brain and physiological development, and many educators believe that today's school systems: rigid classroom schedules, predominantly verbal classroom practices, less space and free time, and the need to work on multiple tasks at the same time prevent boys from being effective learners and potential troublemakers (Gurian, 2001). For example, the researcher observed that boys would often raise their hands during lecture time to leave the classroom and go to the restroom, which may be due to boys' lack of focus or comprehension of narrative knowledge. There have been many studies discussing the importance of gender differences in learning (Hyde, 2014). Failure to understand the importance of gender differences in academic development can be extremely risky (Green, 1993). If teachers are not attentive to the differences in learning between boys and girls, adjusting teaching methods and strategies for gender differences can result in compromising the effectiveness of well-designed instruction (Lesperance, Hofer, Retelsdorf, & Holzberger, 2022). Or, strategies and activities that are appropriate for girls may not also be appropriate to apply to teaching boys' classes (Cengiz Yakut, 2017).

To summarize, Kahoot is a game-based answering activity system that can increase students' classroom engagement, flow experience, and learning outcomes in traditional lectures. However, whether it has the same effect on male or female students has not been explored in the literature. Therefore, this study is a worthwhile research topic. The research questions of this study are specifically described as follows:

(1) Does gender have a significant impact on students' classroom engagement when game-based answering activities are integrated into the curriculum?
(2) Does gender have a significant impact on students' flow experience when game-based answering activities are integrated into the curriculum?
(3) Does gender have a significant impact on students' learning outcomes when game-based answering activities are integrated into the curriculum?

2. Literature Review

2.1 Impact of Game-Based Answering on Learning

2.1.1 Advantages of Game-based Answering

Aljezawi and Albashtawy (2015) compared the effects of question-and-answer game-based instruction and lecture-based instruction in a physical course on student performance, satisfaction, and knowledge retention. The study utilized a true experimental research method and involved a total of 66 students. The results showed that there was no significant difference in the performance scores of the instant test between the two teaching methods. However, in the immediate achievement post-test and the retention test, students in the question-and-answer format scored significantly higher than students in the lecture format. Satisfaction surveys showed that the answering format was preferred and recognized by students as a more satisfactory teaching method.

With the popularity of unlimited internet in classrooms, Kahoot is increasingly being used in physical courses for game-based answering activities. Licorish, Owen, Daniel and George (2018) explored the impact of Kahoot on students' classroom dynamics as well as their learning experience. The study conducted semi-structured interviews with 14 students. The results of the study showed that Kahoot enriched the quality of students' learning in the classroom and had the greatest impact on improvements in classroom engagement, motivation, and learning experience. Their findings also suggest that the use of educational games in the classroom may minimize disruption and thus improve the quality of teaching beyond the traditional classroom. Uzunboylu, Galimova, Kurbanov, Belyalova, Deberdeeva and Timofeeva (2020) also explored teachers' use of "Kahoot" as a teaching aid. The subjects of the study were 38 teachers, including 17 males and 21 females. In the study, semi-structured interviews were used as the data collection tool. The results of the study showed that the teachers perceived the advantages of Kahoot as helping to eliminate deficiencies in learning and increasing students' engagement, motivation, and activity in the classroom. Rajabpour (2021) explored the advantages and disadvantages of using Kahoot in the university classroom. Focus group interviews were used. Interviews were conducted with 13 faculty members working at the Center for Matriculation Studies at a university in Oman. Seven of them were male and six were female. The strengths of Kahoot as perceived by these teachers were: increased student participation, motivation, and activity in the classroom.

In summary, game-based answering activities, especially Kahoot, can indeed increase overall student engagement, motivation, activity, learning motivation, and learning experience in the classroom.

2.1.2 Limitations of Game-based Answering

Although game-based answering activities, especially Kahoot, have many advantages, there are some problems and limitations that exist within it in today's teaching and learning environments. Wang and Tahir (2020) conducted a literature review on the effects of using Kahoot, which included a total of 93 relevant studies. The impact of Kahoot on learning performance and classroom dynamics was examined from the perspectives of students and teachers. The main difficulties cited by students were unreliable Internet connection and time pressure to answer questions, while teachers cited difficulties in mastering the difficulty of questions and unreliable Internet connection. Rajabpour (2021) also suggested that using Kahoot in the classroom may have problems such as network congestion, the negative influence of students on ranking, and difficulty in maintaining freshness. In addition, Uzunboylu, Galimova, Kurbanov, Belyalova, Deberdeeva and Timofeeva (2020) also mentioned that Kahoot is an Internet-based game, so using the program may be problematic for students who have little knowledge of the Internet domain. Also, gender differences may have an impact on Internet learning activities. For example, Chen and Tsai (2007) explored gender differences in attitudes toward Internet learning among university students in Taiwan. The study collected responses from 1,866 Taiwanese university students (940 males and 926 females) between the ages of 18 and 23 through a web-based survey. While females may perceive the Internet as a technology that is more favorable for male use, the analysis showed that females had higher performance outcomes in e-learning than males. In addition, females

held more positive attitudes toward the usefulness and diversity of e-learning content than males.

2.2 Impact of Gender Differences on Learning

In the past, many scholars have mentioned that gender differences have an impact on students' learning.

Lesperance, Hofer, Retelsdorf and Holzberger (2022) explored gender differences in learning motivation. The study synthesized 71 stressors from 20 preliminary studies. The results of the analysis indicated that male and female students would differ in motivation, interest, self-confidence, stereotypes, and affective factors and that making adjustments in teaching styles based on these factors would have a positive impact on both male and female students. In addition, Hyde (2014) also explored gender similarities and differences. The study summarized past research on gender similarity and difference theories. The results of the analysis showed that females and males performed similarly in mathematics; males outperformed females in timing tests and spatial performance; females were more neurotic and gentler than males in temperament; males were more irritable in emotional experience, while females were more prone to sadness, fear, and happiness; females were more prone to guilt and shame when expectations were placed on them, whereas males were more confident. From the above two studies, we can see that there are differences in the characteristics of different genders, and the teaching methods used by teachers will also produce differences in the effectiveness of teaching, so the teaching methods can be adjusted by the above analysis. In addition, Voyer and Voyer (2014) explored gender differences in academic achievement. The study included an assessment of gender differences in student achievement at the elementary, middle, high school, or college level (undergraduate and graduate). A final analysis was conducted on 502 measures drawn from a sample of 369 respondents. The results of the study indicate that there is a stable female advantage in school achievement. Notably, females had the greatest advantage in language courses and the least advantage in math courses. However, while girls outperform boys, there are hidden problems. For example, high-achieving girls who clearly outperform boys often have the same level of confidence as boys with lower scores, i.e., they appear to be less confident despite their good grades (Kent, Sharma, Malliaris, Jukic, & Varma, 2023).

Gender differences may be manifested differently in different domains, and Green (1993) conducted a study on music, gender, and education. The study was conducted on 78 music teachers in the United Kingdom. The results of the study showed that girls were perceived to be more emotionally close, open, communicative, hardworking, driven, reliable, and persistent than boys, while boys had more talent for imagination, ability to manipulate technique, and innovative or challenging forms of music. Yakut (2017) also explored gender stereotypes related to athletic training and practice factors. The study was conducted on 36 young adults, 20 males and 16 females with an average age of 23 years. The results of the study showed that males had a greater advantage in performing visual exercises, whereas females showed a more deliberate exercise strategy and seemed to emphasize accuracy more than males.

However, unlike gender differences in academic performance, there is no significant difference in the number of students' classroom discourse Raviv and Aflalo (2023) investigated gender differences in students' classroom discourse in physics. The study was conducted on two unisex high school classes, boys' and girls' classes, aged 16 to 17 years. The results of the study showed that the average number of all classroom discourse parameters was similar in both classes. From the teachers' perspective, if there were differences between the two classes, they were related to students' personality and classroom environment rather than students' gender.

Sigit, Suryanda, Suprianti and Ichsan (2019) to study the effect of gender on learning outcomes of biodiversity among high school students. The study was conducted on a simple random sample of 114 students (57 males and 57 females). The results of the study showed that there was a significant difference between the average learning outcomes of male and female students. Female students had higher academic achievement than male students.

Another example is Noroozi, Banihashem, Taghizadeh Kerman, Parvaneh Akhteh Khaneh, Babayi, Ashrafi and Biemans (2022) explored gender differences in argumentative essay writing and peer review performance and absorptive capacity in a higher education context. The study utilized a pre-test and post-test design for the experiment. A total of 101 students majoring in the field of environmental science were enrolled in the experiment. These students were asked to individually write a dissertation, participate in a peer review exercise, and revise their original dissertation based on the peer reviews received. The results of the study showed that female students performed better than male students in terms of topic stance in writing the paper. There were also gender differences in peer review performance, with females providing better reasoning, more constructive reviews, and higher quality peer reviews for issues identified during peer review compared to males. However, in another study, the results were opposite to the previous two results. Hashemi, Si Na, Noori and Orfan (2022) explored the gender acceptance of ICT use in English language learning. The study used a quantitative research method. The population of the study was 152 students (94 males and 58 females) from Takhar University in Afghanistan. The results of the study showed that most of the male respondents believed the use of ICT tools and applications could help them to improve their English language skills. On the other hand, female respondents agreed that the use of ICT could help improve reading comprehension, but their acceptance level was generally lower compared to that of male respondents.

Summarizing the above, regarding the impact of gender on learning, there is no certain result that male and female students have different strengths and weaknesses in different subjects or situations. Therefore, the effect of gender on Kahoot's learning pattern is a research topic worth exploring and is the focus of this study.

3. Method

3.1 Research Architecture

The research architecture is shown in Figure 1. The independent variable is gender. The dependent variables are classroom engagement, flow experience, and learning effectiveness. The control variables are teacher, teaching content, grade level of participants, and prior education.

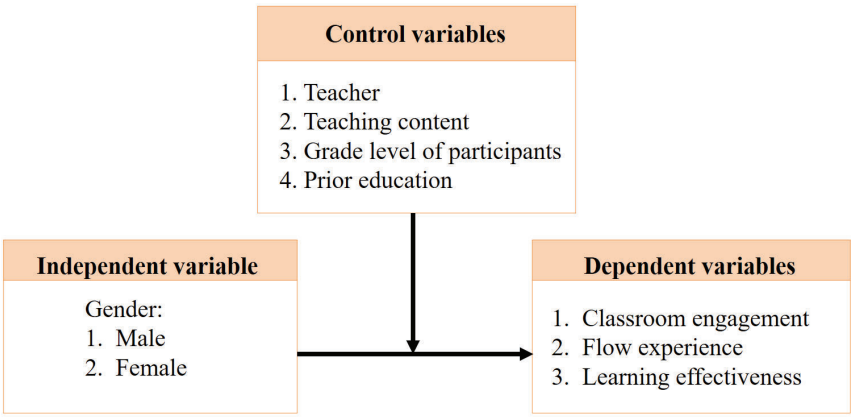

Figure 1. Research Architecture

3.2 Subjects

The subjects of this study were 31 students in the 12th grade of a high school in central Taiwan who were enrolled in the "Arts and Life-applied Music" course. Their ages ranged from 17 to 18 years old. There were 15 male students and 16 female students.

3.3 Research Tools

The research tools used in this study included the Kahoot game-based answering platform, the pre- and post-tests of the "Arts and Life-applied Music", the classroom participation questionnaire, and the flow experience questionnaire. The pre- and post-tests were provided by the instructor and consisted of 20 multiple-choice questions each with a similar level of difficulty. The questions were all about the basic core knowledge of the content of "Arts and Life-applied Music". The classroom engagement questionnaire is based on a questionnaire designed by Elmaadaway (2017). The questionnaire was modified from the one proposed by Jamaludin and Osman (2014) and was divided into three components: behavioral engagement (10 questions), cognitive engagement (7 questions), and emotional engagement (8 questions), with a total of 25 questions. The Heart Flow Experience Questionnaire was modified by Pearce, Ainley and Howard (2005) and consisted of 8 questions. The questionnaires were reviewed and modified by two experts in the field of digital learning with more than 10 years of experience in the field for expert validity.

3.4 Procedure

The experimental procedure of this study is shown in Figure 2. The teacher first gave the students a 15-minute pre-test to find out the students' prior knowledge of the "Arts and Life-applied Music" program. Then, the teacher gave a lecture, which was accompanied by an instructional video and a textbook to explain the subject matter of Arts and Life-applied Music. Each 15-minute lecture was interspersed with a 5-minute Kahoot game, with a total of three rounds of Kahoot games, as shown in Figure 3. Afterward, a 10-minute post-questionnaire on classroom participation was filled out. Finally, a 15-minute post-test will be administered.

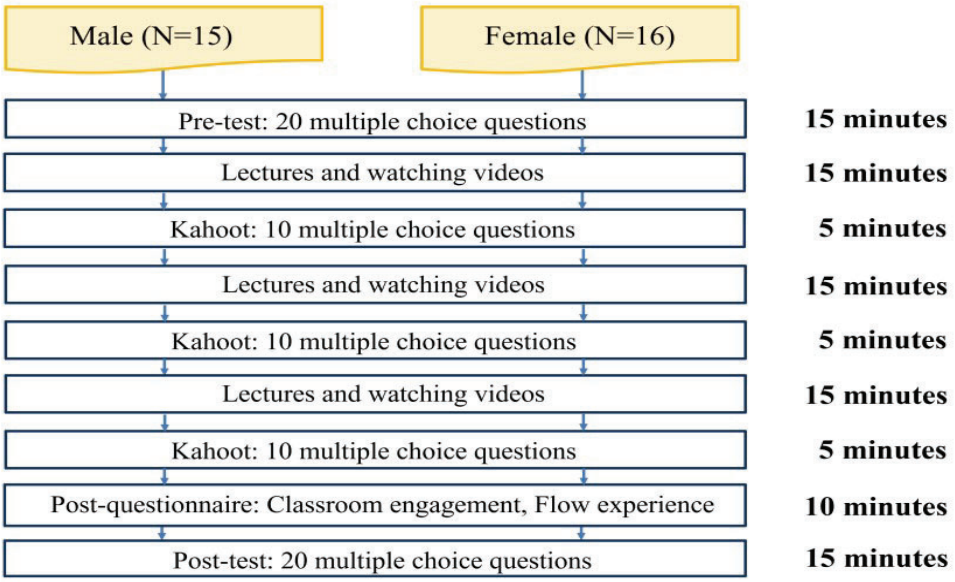

Figure 2. Procedure Chart

Figure 3. Kahoot Game in Classroom

3.5 *Data Analysis*

In this study, the reliability of the questionnaires was analyzed, and then a paired-sample t-test was used to determine whether there was a significant improvement in the learning outcomes of the overall student population. Next, an independent sample t-test was conducted to determine whether there was a significant difference between male and female students in terms of classroom engagement (including behavioral participation, cognitive participation, and affective participation), flow experience, and gain scores.

4. Results

4.1 Reliability Analysis

The reliability of the questionnaires in this study ranged from 0.921 to 0.955, which were all greater than 0.9, indicating that the results of the questionnaires in this study were very reliable.

4.2 Paired Sample t-test

The results of t-test of the paired samples of the pre- and post-tests are shown in Table 1. The mean of the post-tests is higher than that of the pre-tests, which means that using Kahoot for teaching activities has a significant effect on students' performance (t=-20.476, p<0.001). From the results of the analysis, using Kahoot for teaching can increase male and female students' classroom interaction, learning motivation and confidence, and also make students more immersed in classroom teaching, which can effectively improve students' academic performance.

Table 1. *The Results of Paired Sample t-test*

Group	Sample size	Average value	Standard deviation	*t*-value
Pre-test	31	42.90	12.300	-20.476***
Post-test	31	88.06	14.299	

***p<0.001

4.3 Independent Sample t-test

The t-test results of the independent samples of male and female students are shown in Table 2. The mean values of all constructs of the test were higher for female students than for male students, with significant differences in behavioral involvement (t=-2.666, p<0.05), cognitive involvement (t=-3.263, p<0.01), affective involvement (t=-2.979, p<0.01), and flow experience (t=-2.621, p<0.05). In other words, when Kahoot was applied to classroom teaching, female students' classroom engagement and flow experience were significantly higher than male students.

Table 2. *The Results of Independent Samples t-test*

Facet	Group	N	Average	SD	*t*-value
Behavioral Engagement	Male	15	3.720	0.679	-2.666*
	Female	16	4.363	0.662	
Cognitive Engagement	Male	15	3.505	0.691	-3.263**
	Female	16	4.304	0.672	
Emotional Engagement	Male	15	3.758	0.709	-2.979**
	Female	16	4.492	0.662	

Flow Experience	Male	15	3.950	0.789	-2.621*
	Female	16	4.641	0.677	
Gain Score	Male	15	42.00	12.780	-1.410
	Female	16	48.13	11.383	

*p<0.05 **p<0.01

5. Discussion

5.1 Classroom Engagement

The results of this study showed that girls were significantly more engaged than boys when using Kahoot in the classroom. However, this result is contrary to the findings of Aguillon, Siegmund, Petipas, Drake, Cotner and Ballen (2020). The study examined the impact of gender differences on students' classroom engagement. The study was conducted with 244 and 265 undergraduates enrolled in a two-semester introductory biology course at a large research university, with a gender ratio of 55.9% and 57.1%, respectively. It was found that males in most classes' engagement more than expected, especially after the group discussions in both semesters, with a significantly higher proportion of males than females responding voluntarily. This difference may be due to different subjects and different teaching activities. For example, in math and science related classes, males will have higher participation while in language related classes, females will have higher participation (Hyde, 2014). Males are likely to be more engaged than females when using physical teaching methods, while the opposite may be true when using online teaching methods (Chen & Tsai, 2007). Various factors interact with each other to influence student engagement and understanding the impact of gender differences in learning can help to make appropriate adjustments in teaching.

5.2 Flow Experience

The results of this study showed that female students had significantly higher flow experiences than male students when using Kahoot in the classroom. This result is like the findings of Hsieh, Lin, and Hou (2016). The study investigated the relationship between mental stream experiences and academic performance of primary school students. Gender and grade differences were also investigated. A total of 34 elementary school students participated in the study. The results of the study showed that students with higher levels of mindfulness tended to have higher levels of learning performance. Gender differences showed that female students in this study had higher performance scores in the mini-educational game and had a better mind-flow experience.

5.3 Learning Outcomes

In this study, because of the small sample size and the unequal distribution of pre-test scores, the learning outcome of this study is the students' gain score, which is the post-test minus the pre-test scores. The results showed that when Kahoot was used in the classroom, the gain scores (learning outcomes) of female students were slightly higher than male students, but not to a significant level. This result is close to that of Johnson (2011) and Nguyen, Hou, Richey and McLaren (2022). In Johnson's (2011) study, the performance of gender differences in digital learning was examined. The subjects of the study were 303 males and 252 females. The results of the study showed that females had slightly better learning outcomes than males when compared to males. In Nguyen, Hou, Richey and McLaren's (2022) study, differences in learning outcomes between male and female students were examined in a Math Learning Game. The study was conducted with 624 students in grades 5 and 6 at the elementary school level. The results of the study showed that the improvement scores of female students were significantly higher than those of male students. In other words, Math Learning Game is more valuable to female students.

6. Conclusions and Recommendations

6.1 Conclusions

In this study, the male students were not as engaged as the female students in terms of participation, flow experience, and gain scores. This study hypothesizes that it is possible that the subject matter of the Arts and Life-applied Music textbook is oriented towards the music art, and that the female students are more interested in this area of knowledge. In addition, for the answering game, because girls have better verbal ability, even if they use cell phones to press the button to answer the question, the girls' group will have a lot of speeches and discussions, and it is easier to strengthen the impression of learning in these processes. On the other hand, male students tend to be silent and thinking more than talking, reducing the language exchange and interaction during the answering, which makes the classroom atmosphere of male students much different from that of female students in terms of rationality.

6.2 Recommendations

In order to adjust how to improve boys' participation and test scores, we can consider adding graphical symbols or mind maps in classroom lectures or answering games to enhance the logical view instead of purely textual narration. In addition, male students may be more sensitive to body movement than female students, and a long classroom lecture is not likely to attract the attention of high school-aged male students for a long period of time. Therefore, in addition to the Kahoot answering, the addition of hands-on activities or the need to move seats to change the grouping of seats may increase the sense of freshness in the classroom and increase male students' participation.

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