Effect of Using Kahoot! As A Digital Game-Based Formative Assessment Tool in Enhancing Nursing Students' Knowledge and Learning Motivation

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Abstract

Background: Technological advancements had given rise to novel approaches in nursing education; one of these approaches is Kahoot!. This game-based platform offers a dynamic alternative to traditional assessments, fostering a dynamic and enjoyable learning environment. **Aim**: This study aims to determine the effect of using Kahoot! as a digital game-based formative assessment tool on nursing students' knowledge and learning motivation. **Setting:** Faculty of Nursing, Alexandria University, Egypt. **Research design**: A quasi-experimental research design. **Subjects:** A sample of 150 nursing students who were selected through a simple random sampling process. They were divided into two groups, each group consisting of 75 students. **Tools:** Three tools were used for data collection: "Nursing Students' Knowledge Test (NSKT)", "Nursing Students' Learning Motivation Questionnaire (NSLMQ)" and "Kahoot! Game-Based Learning Feedback Questionnaire (KGBLFQ)". **Results**: After applying Kahoot!, 93.3% among the study group significantly achieved satisfactory level of knowledge and 94.7% showed a high level of learning motivation compared to only 33.3% and 68.0% respectively among the control group. These differences between the study and control groups after applying Kahoot! were statistically significant as ($p_2 < 0.001$). Positive feedback about Kahoot! as a digital game-based formative assessment tool was given by 94.7% among the study group. **Conclusion**: Kahoot! as a digital game is a valuable formative assessment tool. It is significantly enhancing students' knowledge regarding the educational objectives and learning motivation. **Recommendations**: Nursing educators should link Kahoot! as a formative assessment tool to specific learning outcomes to enhance students' knowledge and motivation. Further research is needed to explore the long-term effect of Kahoot! on sustained retention of knowledge and learning motivation.

Introduction

In the twenty-first century, the technological innovations are moving more quickly than ever. Younger generations, especially nursing students, had frequent access to cutting-edge mobile technologies **(Lee et al., 2018)**. This digital landscape presents exciting opportunities for education, with educational games and Game-Based Student Response Systems (GSRS) proving highly effective in boosting students' engagement and learning experience **(Barrio et al., 2016)**.

Formative assessment plays a crucial role in streamlining the educational process by providing specific feedback that enhances students' learning **(Ozan, & Kincal, 2018)**. When students integrated into teaching and learning activities, formative assessment offers them timely, ongoing, and usable feedback. Traditionally, formative assessment has taken forms like paper-and-pencil tests or online quizzes **(Alzaid, & Alkarzae,2019; Ismail & Mohammad, 2017).** However, technological advancements had given rise to novel approaches, one of these approaches is Kahoot!.

Kahoot! is a free, real-time game-based learning platform and formative assessment application that allows teachers to create and

implement a variety of game-based interactive quizzes, surveys, and even conversational educational activities where students compete against each other (**Ismail & Mohammad, 2017**). This application led to widespread adoption in education, with over 70 million monthly active users during 2019 and a global reach exceeding 200 nations and 2.5 billion players (**Lunden, 2018; Vick, 2019**). It was first created in 2012 and published in 2013 as a result of the research project called Lecture Quiz, which was launched in 2006 at the Norwegian University of Science and Technology. The aim of this online platform is to boost students' learning experience and engagement by providing enjoyable learning activities through questionnaires or exams that educators can develop on the platform. Kahoot! could be used for a variety of assessments and projects, including formative assessments, research projects, and study presentations (**Aguiar-Castillo et al.; 2020**).

To use Kahoot! educators must first create a user account on the web platform, and from there, they could create exams with up to four response alternatives covering various topics, and can also add videos, images, and music to the exams to make the students more engaging (**Murawski et al., 2019; Plump & LaRosa, 2017; Wang & Tahir, 2020**). Students could access the platform with their smartphones or computers by using a code provided by the educators (**Bryant et al., 2018**). During the exam, students are encouraged to mark the option they believe to be accurate promptly, as success and promptness of response are rewarded. The three winning students could contribute to effective learning after the exam when the platform serves as a podium. Kahoot! automatically collects responses from all participating students in the educator's account, where they could be later reviewed in a Microsoft Excel sheet that the web platform makes available. This makes the process possible to assess how well students understood the materials and to get the best possible feedback on how the subjects should be developed (**Corell et al., 2018**).

Kahoot! is a serious game platform that had the potential to positively impact education by enhancing students' learning process, improving their performance and academic achievements as well (**Zhonggen, 2021**). Kahoot! had both educational and psychological implications for students' learning. Its ability to increase students'

engagement, enjoyment, and concentration had also a positive impact on students' attitudes, perceptions, and performance. It could also create a more dynamic classroom environment (**Wang & Tahir, 2020**). According to Mohamed et al. (2022), Kahoot! not only improves learning outcomes but also reduces students' anxiety, and creating a more conducive environment for success. Additionally, a literature review which done by McLaughlin and Yan (2017) highlights the psychological benefits of online formative assessments. Incorporating educational games as learning tools and utilizing online formative assessments had been linked to increased achievement scores and the cultivation of complex cognitive processes, such as self-regulation, which could positively affect students' cognitive, emotional, and motivational development.

Motivation is a crucial factor in student's successful learning processes. It determines the level of student's engagement and direction in the learning activities. It categorized into two types: intrinsic motivation, which arises from within the individual, and extrinsic motivation, which comes from external stimuli. Learning motivation refers to the driving force that activates the learner, ensuring continuity and progress towards learning objectives (**Nayir, 2017; Rojabi et al., 2022**). Advantages of learning motivation include overcoming challenges, directing learning activities towards specific goals, and selecting effective learning strategies. Regarding the fluctuating quality of students' academic achievement from year to year, it is imperative to develop strategies to motivate learners and improve their learning outcomes. Without proper motivation, learning may not occur, and the curriculum's objective may not be achieved (**Filgona et al., 2020**).

On the other hand, a persistent challenge in traditional educational systems is the issue of low learning motivation, which could significantly hinder the students' academic progress (**Sanaie et al., 2019**). There are various ways to increase learning motivation, such as providing value, gifts, announcing achievements, praising students, fostering an enjoyable learning environment, and building interest. Studies had shown that Kahoot! could be used for increasing both intrinsic and extrinsic motivation, serving as a useful assessment tool, and maintaining students' attention throughout the lesson (**Cameron & Bizo,**

2019; Ismail & Mohammed, 2017; Tan et al., 2018). Özaras-Öz and Ordu (2021) who discovered that Kahoot! is particularly useful for enhancing knowledge and skills among nursing students as well supporting the educational processes and activities.

Significance of the study:

During COVID-19 pandemic, along with recurrent wars and natural disasters all had impacted the educational programs, including nursing education. To adapt to the situation, various learning modalities such as blended learning and online learning had been used to effectively educate nursing students. This shift to distance learning increased the need for distance assessment tools, highlighting the importance of preparing nursing students for future crises. Kahoot! is a digital game-based formative assessment tool that aims to enhance learning outcomes by encouraging curricular interaction between students and instructors in various courses. From psychological perspective, this tool is designed to foster positive emotions, such as curiosity, enthusiasm, and joy, while also helping to reduce stress levels and create a more relaxed learning environment (**Mohamed et al., 2022; Wang & Tahir, 2020**). However, there is a debate among researchers regarding the value and significance of game-based learning systems like Kahoot!. Some view game designs as frivolous and lacking in seriousness, while others believe that they could be beneficial for learning. This study aims to contribute to the ongoing dialogue by investigating the efficacy of Kahoot! in a demanding field like nursing education where the significance of game-based learning systems like Kahoot! remains understudied.

Specifically, this study was conducted within the Faculty of Nursing at Alexandria University, where undergraduate students face a significant challenge: formulating effective educational objectives and teaching units for their patients. Although they take a mandatory "Educational Strategies in Nursing" course, in which many students find this task complex and struggle to comprehend and articulate the unit of educational objectives. Recognizing this gap in knowledge about educational objectives, the researchers plan to incorporate Kahoot!, a game-based formative assessment tool, into the 'educational objectives' unit of the course. By making learning engaging and interactive, Kahoot! may have the potential to bridge this knowledge gap and equip students with the motivation to learn and the confidence to effectively formulate educational objectives for their future patients.

This study aims to:

Determine the effect of using Kahoot! as a digital game-based formative assessment tool in enhancing nursing students' knowledge and learning motivation.

Research hypotheses:
1. Nursing students who are evaluated by Kahoot! as a digital game-based formative assessment tool exhibit higher levels of knowledge in educational objectives than those who are not.
2. Nursing students who are evaluated by Kahoot! as a digital game-based formative assessment tool exhibit higher levels of learning motivation than those who are not.
3. Nursing students who are evaluated by Kahoot! as a digital game-based formative assessment tool provide a positive feedback about it.

Materials and Method

I. Materials
Research design:

A quasi-experimental research design was used in this study.

Setting:

The study was conducted at the Faculty of Nursing, Alexandria University in Egypt, which affiliated to the Ministry of Higher Education. The faculty utilizes a credit hour system for its undergraduate and graduate programs. In order to obtain a baccalaureate degree in nursing sciences, an undergraduate student is required to complete four academic levels and study various curricula that are distributed across eight semesters. It is important to note that each academic year consists of two terms, with the first term covering the first, third, fifth, and seventh semesters, and the second term covering the second, fourth, sixth, and eighth semesters.

Subjects:

The subjects of this study comprised 150 undergraduate nursing students who were recruited

using simple random sampling method to represent 700 nursing students from different academic levels enrolled in "Educational Strategies in Nursing" mandatory course during the first academic semester of the academic year 2022-2023. In order to determine the required sample size, the G Power software was utilized with an effect size = 0.3, alpha error = 5%, study power = 80%, number of groups was two and number of repetitions was two. The software determined a sample of 150 students. These students were randomly assigned to two groups, study, and control, with each group consisting of 75 students. Matching between the both groups was considered as much as possible regarding student' sex, current academic level and last obtained Grade Point Average (GPA).

Tools:

The following three tools were used for data collection:

Tool I: Nursing Students' Knowledge Test (NSKT):

This test was developed by the researchers after reviewing of related literature (**Stunden& Jefferies, 2018; Xu, 2016**). It was used to measure the knowledge level of nursing students regarding the 'educational objectives' unit of the "Educational Strategies in Nursing" course. The NSKT consists of 25 questions about importance, types, domains, elements, and characteristics of the educational objectives. The test includes two parts; part one consists of 20 multiple-choice questions, while part two consists of 5 true-false questions about educational objectives unit.

The total score of the test ranges from 0 to 25. The scoring system of the test is as follows:

- A score <60% indicates unsatisfactory knowledge level.
- A score ranging from 60% to <75% indicates a fair knowledge level.
- A score of ≥75% indicates satisfactory knowledge level.

Tool II: Nursing Students' Learning Motivation Questionnaire (NSLMQ):

This questionnaire was developed by the researchers to measure nursing students' learning motivation. It is based on the ARCS (Attention, Relevance, Confidence, and Satisfaction) model of motivation developed by Keller (1987). The questionnaire consists of 10 statements, each rated on a 4-point Likert scale, ranging from strongly disagree (1) to strongly agree (4).

The total score of the NSLMQ ranges from 10 to 40, with higher score reflects higher level of learning motivation. The scoring system of the questionnaire is as follows:

- A score from 10 to 19 indicates a low level of learning motivation.
- A score from 20 to 29 indicates a moderate level of learning motivation.
- A score from 30 to 40 indicates a high level of learning motivation.

Tool III: Kahoot! Game-Based Learning Feedback Questionnaire (KGBLFQ):

The researchers designed this questionnaire to evaluate nursing students' feedback on Kahoot! as a digital game-based formative assessment tool. The KGBLFQ is based on a survey questionnaire developed by Tan et al., (2018), which assesses students' perceptions of Kahoot! as a tool for knowledge and learning motivation reinforcement.

The KGBLFQ includes 20 statements grouped into three subscales: *fun and positive emotions*, e.g., feelings of joy, enthusiasm, curiosity and being relaxed (6 statements); *engagement*, e.g., involvement and attention (4 statements); and *utility for learning and motivation*, e.g., understanding and retaining new knowledge, and interest and motivation to learn (10 statements). All statements are rated on a 4-point Likert scale, ranging from strongly disagree (1) to strongly agree (4). The total score of the KGBLFQ ranges from 20 to 80, with higher score reflects more positive feedback about Kahoot! as a formative assessment tool. The scoring system of the questionnaire is as follows:

- A score of <50% indicates negative feedback about Kahoot! as a formative assessment tool.
- A score of ≥50% indicates positive feedback about Kahoot! as a formative assessment tool.

In addition, a nursing student's personal and academic data sheet that includes student's age, sex, current academic level, and last obtained Grade Point Average (GPA), is attached to the previously mentioned tools.
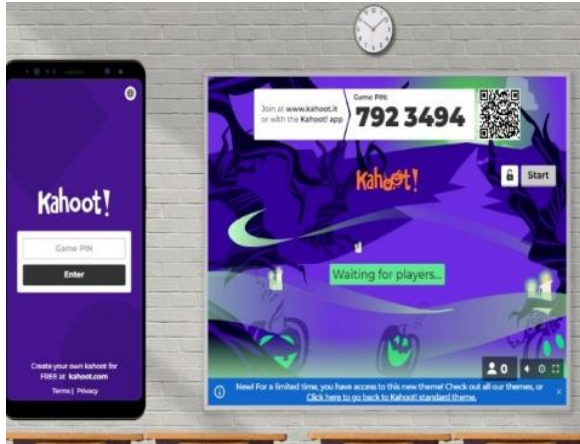
II. Method

The study was conducted through the following three phases:

I. Preparation phase:

1. An Approval from The Research Ethics Committee (REC), Faculty of Nursing, Alexandria University, was obtained before conducting the research (IRB00013620) (Serial Number 2022-9-52).

2. An official permission to conduct the research was obtained from the Dean of the Faculty of Nursing, Alexandria University.

3. Tools I, II and III were developed by the researchers after a thorough review of the related literature.

4. The developed tools were tested for their content validity by five experts in the fields of Nursing Education, Psychiatric and Mental Health Nursing. They proved to be valid.

5. A pilot study was carried out on 10% of undergraduate nursing students (15 students) in previously mentioned setting to assess the feasibility, clarity, and applicability of the tools, as well to estimate time needed to fill in the study tools. These students were excluded from the study subjects to avoid contamination of the study sample. Furthermore, these students were excluded from study population to avoid re-choosing them in random sample selection of the study sample.

6. Tools I, tool II and tool III were tested for their reliability using Cronbach's Alpha test. The tools were reliable, and their coefficient values were 0.91, 0.94 and 0.98 respectively.

7. The study tools were transformed into electronic questionnaires using the Microsoft form, to facilitate the online sharing and ensure the confidentiality of data.

8. A representative sample from undergraduate students registered in the "Educational Strategies in Nursing" mandatory course during the first academic semester of the academic year 2022-2023 from 1st of October to 14th of November. The study subjects were recruited through applying the simple random sampling method. This was done before teaching the educational strategies unit in the course.

9. The recruited students were assigned randomly into two equal groups: study and control, 75 students each.

10. Prior to collecting data, the researchers met the randomly recruited students in their classrooms on group basis. They explained the purpose of the study and ensured the students that their responses would remain anonymous and confidential. Each student who agreed to participate in the study is asked to provide informed written consent on the Microsoft Team.

11. Before teaching the educational strategies unit in the "Educational Strategies in Nursing" course, the researchers developed a Microsoft Team including two channels one for the study group and the other for the control group.

12. Students' personal and academic data were collected, and a pretest of students' knowledge about educational objectives, and learning motivation was done using tools I and II. This was done for both study and control groups using Microsoft Forms, where each group received a unique link in its Microsoft Team channel. All questions were mandatory, allowing only one response per question. Completing the questionnaire served as confirmation of informed consent and agreement to participate in the study.

13. **Preparation of Kahoot! as a game-based formative assessment tool:**

    The researchers had created three Kahoot! game-based quizzes, using the upgraded version. These quizzes contain 25 questions, (20 multiple-choice questions, 5 true or false questions). The questions are based on the content covered in the educational objectives' unit. To enhance student engagement, the researchers set a time limit for each Kahoot! question and provided appropriate pictures and music. Each Kahoot! quiz had a unique PIN code, QR code, and link, which had been provided to the students for responding to the Kahoot! game-based questions (Picture 1).

(Picture 1)

(Picture 2)

II. Implementation phase:

1) Study group:

a. The study group was given instructions on how to use Kahoot! a game-based learning application and was given the option to either download the app on their mobile devices or use it online (https://kahoot.com/home/mobile-app/).

b. Through using their cell phones or tablets, students answered questions that were projected on the screen, accompanied by stimulating music and colorful animated pictures to keep them engaged in the activity.

c. Students had the option to write their true names or a nickname, and their responses were ranked according to their speed and number of correct answers, with total points assigned.

d. The educational objective unit was explained on three weeks, every week a two-hour lecture after each lecture one of the Kahoot! quizzes was conducted.

e. Each question had a timer of twenty seconds, which created a mild competition between students during the Kahoot! game.

f. At the end of each Kahoot! game, students' responses were presented (Picture 2), simple gifts were given, and the top three winners presents on podium to enhance their learning motivation and sharing this podium on the Microsoft teams (Picture 3).

(Picture 3)

2) Control group:
Students in the control group were evaluated using paper-based exams without any interference from the researchers.

III. Evaluation phase:

- At the end of educational objectives unit, students' levels of knowledge about educational objectives, and learning motivation were measured using tools I and II (post-test). This was done for both study and control groups using Microsoft Forms, where each group received a unique link in its Microsoft Team channel.

- Students of the study group received a special link to provide feedback on their experience using Kahoot! as a digital game-based formative assessment tool. This was done using tool III.

Ethical considerations:

1. Student's informed consent was obtained after explanation of research purpose.
2. Subjects were informed that their participation in the study is voluntary, and they have the right to withdraw at any time.
3. Confidentiality of students' data was assured.
4. Anonymity of subjects was ascertained.

Statistical analysis:
Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. The level of significance of the obtained results was p-value equal to or less than 0.05 and 0.01.

The following statistical tests were used:

1. **Chi-square test:** For categorical variables, to compare between different groups.
2. **Monte Carlo test:** Correction for chi-square when more than 20% of the cells have expected count less than 5.
3. **Student t-test:** For normally distributed quantitative variables, to compare between two studied groups.
4. **Mann-Whitney test (U test):** For abnormally distributed quantitative variables, to compare between two sample means that come from the same population.
5. **Wilcoxon signed ranks test (Z test):** For abnormally distributed quantitative variables, to compare between two periods.
6. **Spearman coefficient:** To correlate between two distributed abnormally quantitative variables.
7. **Cronbach's Alpha:** Reliability statistics were assessed using Cronbach's Alpha test.

Results

Table (1) presented the personal and academic characteristics of the study and control groups. It was found that 64.0% and 61.3% of the students in study and control groups respectively were less than 20 years old. It was observed that about two thirds of students in both groups were females (65.3% and 65.3% respectively). In relation to the students' last obtained GPA, the most obtained GPA among the study group were B- to B+ (45.3%), while C- to C+ were the most obtained GPA among the control group (36.0%). As regards the academic level, it was found that the majority of the students in both groups were at their second level (82.7% and 92.0% respectively). No statistically significant differences were found between the study and control groups in relation to

all personal and academic characteristics, indicating that the two groups were matched.

Table (2) showed that the study and control groups' level of knowledge regarding the educational objectives as measured by Nursing Students' Knowledge Test (NSKT) before and after applying Kahoot! It was found that before applying Kahoot! most of nursing students in both groups had unsatisfactory knowledge level about educational objectives (85.3% and 82.7% respectively). No significant difference existed between both groups before Kahoot! As (p_1=0.656). However, after using Kahoot! the study group experienced a significant improvement, with the majority of students (93.3%) achieving satisfactory level of knowledge compared to only 33.3% in the control group who received traditional instructions. This difference between the study and control groups after applying Kahoot! is statistically significant as (χ^2=66.316, p_2<0.001).

Before the interventions, total mean scores of knowledges were 10.39±3.27 among the study group and 11.24±3.35 among the control groups, with no significant difference found between groups as (U=2324.500, p_1=0.065). After applying Kahoot!, it can be noticed that the total mean score of knowledge among the study group significantly increased to 21.80±2.35. After using traditional methods, the total mean score of knowledge among the control group slightly increased to 15.69±5.14. However, a statistically significant difference between the two groups was observed as (U=977.000, p_2<0.001).

The average and mean percent scores of knowledges among the study group increased from (0.42±0.13 and 41.55±13.08 respectively) before Kahoot! to (0.87±0.09 and 87.20±9.42 respectively) after Kahoot! application, indicating a great improvement among the study group's level of knowledge. While for the control group, average and mean percent scores of knowledges increased from (0.45±0.13 and 44.96±13.39 respectively) in the pre assessment to (0.63±0.21 and 62.77±20.55 respectively) after using the traditional methods, which indicating a slight improvement among control group's level of knowledge.

Within the study group, mean percent score of knowledge about educational objectives increased from 41.55±13.08 before Kahoot!

Application to 87.20±9.42 after Kahoot! The improvement was statistically significant as (Z=7.525, p<0.001). The control group also showed a statistically significant improvement with (Z=5.248, p<0.001), where the mean percent score of knowledge increased from 44.96±13.39 in the pre assessment to 62.77±20.55 after Appling the traditional instructions. However, the improvement was significantly greater among Kahoot! group.

Table (3) showed that the study and control groups' level of learning motivation as measured by Nursing Students' Learning Motivation Questionnaire (NSLMQ) before and after applying Kahoot!. It was noted that before applying Kahoot! both groups had high level of learning motivation (62.7% and 61.3% respectively), with no significant difference existed between groups (χ^2=0.854, MCp_1=0.648). After Kahoot! 94.7% of the study group experienced high level of learning motivation compared to only 68.0% among the control group who received the traditional methods. The difference between the study and control groups after applying Kahoot! is statistically significant as (χ^2=66.316, $eMCp_2$<0.001).

The total mean scores of learning motivation among the study and control groups before interventions were 29.24±6.0 and 29.53±3.52 respectively, with no significant difference found between groups as (U=2796.50, p_1=0.952). After Kahoot!, the total mean score of learning motivation among the study group significantly increased to 32.13±4.18. The total mean score of learning motivation among the control group almost did not change after receiving the traditional instructions (29.56±3.58). A statistically significant difference between the study and control groups was noted as (U=1671.500, p_2<0.001).

The average and mean percent scores of learning motivation among the study group increased from 2.92 ± 0.60 and 64.13 ± 19.99 respectively before to 3.21 ± 0.42 and 73.78 ± 13.94 respectively after Kahoot!, indicating a great improvement among study group's level of learning motivation. The average and mean percent scores of learning motivation among the control group were 2.95 ± 0.35 and 65.11 ± 11.72 respectively before and almost did not change after

receiving the traditional instructions (2.96 ± 0.36 and 65.20 ± 11.95 respectively).

Within the study group, mean percent score of learning motivation from 64.13 ± 19.99 before to 73.78 ± 13.94 after Kahoot!. The improvement was statistically significant as (Z=3.698, p<0.001). On the other hand, the control group showed no statistically significant change in the level of learning motivation as (Z=0.269, p=0.788).

Table (4) exhibited that the correlation matrix between the total mean scores of knowledge and learning motivation among the study and control groups before and after applying Kahoot!. Before applying any intervention, no significant correlation was found between knowledge and learning motivation among both groups as (p=0.063 and p=0.678, respectively).

After using Kahoot! a positive and statistically significant correlation was observed between knowledge and learning motivation among the study group as (p=0.011). This suggests that increased knowledge could lead to an improvement in learning motivation, and vice versa. A positive and statistically significant correlation also appeared between knowledge and

learning motivation among the control group as (p=0.045), which indicating a similar correlation between knowledge and motivation, yet; slightly weaker than in the Kahoot! group.

Table (5) revealed that the feedback of the study group about Kahoot! as game-based learning and assessment tool. It was found that the majority of nursing students among the study group had an overall positive feedback about Kahoot! (94.7%); as a useful tool for fun and experiencing positive emotions (97.3%), engagement (96.0%) and utility for learning and motivation (94.7%).

The mean scores for feedback across all subscales were positive. "Fun and experiencing positive emotions" subscale scored the highest with a mean of 19.21±2.93, "engagement" subscale scored a mean of 12.60±2.08, whereas "utility for learning and motivation" subscale scored a mean of 31.88±5.09. These high subscales mean scores indicated a strong overall positive experience with Kahoot! (63.69 ± 9.62).

All feedback subscales had positive mean percent scores. "Fun and experiencing positive emotions" subscale was ranked the first with the highest mean percent of 19.21±2.93, followed by "utility for learning and motivation" subscale at 31.88±5.09, and "engagement" subscale at 12.60±2.08. The total mean percent score of students' feedback about Kahoot! was 72.82±16.0

Table (1): Distribution of nursing students among the study and control groups according to their personal and academic characteristics

Personal and academic characteristics	Study group (N =75)		Control group (N =75)		Test of Significance	P
	No.	%	No.	%		
Age (years).						
<20	48	64.0	46	61.3	χ^2=0.114	0.866
≥20	27	36.0	29	38.7		
Min. – Max.	*18.0 – 27.0*		*18.0 – 21.0*		*t=1.927*	*0.057*
Mean ± SD.	*19.76 ± 1.51*		*19.40 ± 0.57*			
Sex						
Male	26	34.7	26	34.7	χ^2=0.000	1.000
Female	49	65.3	49	65.3		
Academic level						
First	9	12.0	3	4.0	χ^2=4.301	[MC]p=0.180
Second	62	82.7	69	92.0		
Third	3	4.0	3	4.0		
Fourth	1	1.3	0	0.0		
Last obtained GPA						
A- – A	17	22.7	24	32.0	χ^2=3.096	0.213
B- – B+	34	45.3	24	32.0		
C- – C+	24	32.0	27	36.0		

SD: Standard Deviation χ^2: Chi square test   t: Student t-test   MC: Monte Carlo test
p: p value for comparing between the studied groups.

Table (2): Distribution of the study and control groups according to students' level of knowledge of educational objectives before and after applying Kahoot!

Level of knowledge	Study group (N =75)				Control group (N =75)				Test of Significance (p₁)	Test of Significance (p₂)
	Before		After		Before		After			
	No.	%	No.	%	No.	%	No.	%		
Unsatisfactory (<60%)	64	85.3	0	0.0	62	82.7	45	60.0	χ^2=0.198 (p₁=0.656)	χ^2=66.316** (p₂<0.001)
Fair (60% – <75%)	11	14.7	5	6.7	13	17.3	5	6.7		
Satisfactory (≥75%)	0	0.0	70	93.3	0	0.0	25	33.3		
Total score (0 – 25)									U=2324.500 (p₁=0.065)	U=977.000** (p₂<0.001)
Median (Min.–Max.)	10.0 (6.0–18.0)		22.0 (17.0–25.0)		11.0 (5.0–18.0)		14.0 (6.0–25.0)			
Mean ± SD.	10.39 ± 3.27		21.80 ± 2.35		11.24 ± 3.35		15.69 ± 5.14			
Average score									---	---
Median (Min.–Max.)	0.40 (0.24–0.72)		0.88 (0.68–1.0)		0.44 (0.20–0.72)		0.56 (0.24–1.0)			
Mean ± SD.	0.42 ± 0.13		0.87 ± 0.09		0.45 ± 0.13		0.63 ±0.21			
% score									---	---
Median (Min.–Max.)	40.0 (24.0–72.0)		88.0(68.0–100.0)		44.0 (20.0–72.0)		56.0(24.0–100.0)			
Mean ± SD.	41.55 ± 13.08		87.20 ± 9.42		44.96 ± 13.39		62.77 ± 20.55			
Test of Significance	Z=7.525	** (p<0.001)			Z=5.248** (p<0.001)				---	---

SD: Standard Deviation χ^2: Chi square test   U: Mann Whitney test   Z: Wilcoxon signed ranks test
p₁: p value for comparing between the study and control before Kahoot!
p₂: p value for comparing between the study and control groups after Kahoot!
*p: p value for comparing between before and after in each group   **: Statistically significant at p ≤ 0.001*

Table (3): Distribution of the study and control groups according to students' level of learning motivation before and after applying Kahoot!

Level of learning motivation	Study group (N =75)				Control group (N =75)				Test of Significance (p₁)	Test of Significance (p₂)
	Before		After		Before		After			
	No.	%	No.	%	No.	%	No.	%		
Low (10–19)	4	5.3	0	0.0	2	2.7	2	2.7	χ^2=0.854 (MCp₁=0.648)	χ^2=66.316** (MCp₂<0.001)
Moderate (20–29)	24	32.0	4	5.3	27	36.0	22	29.3		
High (30–40)	47	62.7	71	94.7	46	61.3	51	68.0		
Total score (10 – 40)									U= 2796.50 (p₁=0.952)	U=1671.500** (p₂<0.001)
Median (Min.–Max.)	30.0(10.0–40.0)		31.0(20.0–40.0)		30.0(19.0– 38.0)		30.0(18.0–38.0)			
Mean ± SD.	29.24 ± 6.0		32.13 ± 4.18		29.53 ± 3.52		29.56 ± 3.58			
Average score									---	---
Median (Min.–Max.)	3.0(1.0–4.0)		3.10 (2.0–4.0)		3.0 (1.90–3.80)		3.0(1.80–3.80)			
Mean ± SD.	2.92 ± 0.60		3.21 ± 0.42		2.95 ± 0.35		2.96 ± 0.36			
% score									---	---
Median (Min.–Max.)	66.67(0.0-100.0)		70.0(33.33-100.0)		66.67(30.0–93.33)		66.67(26.67–93.3)			
Mean ± SD.	64.13 ± 19.99		73.78 ± 13.94		65.11 ± 11.72		65.20 ± 11.95			
Test of Significance	Z=3.698	** (p<0.001)			Z=0.269	(p=0.788)			---	---

SD: Standard Deviation $\chi 2$: Chi square test   MC: Monte Carlo test   U: Mann Whitney test
Z: Wilcoxon signed ranks test   p₁: p value for comparing between the study and control before Kahoot!
p₂: p value for comparing between the study and control groups after Kahoot!
p: p value for comparing between before and after Kahoot! in each group
***: Statistically significant at p ≤ 0.001*

Table (4): Correlation matrix between the total mean scores of knowledge and learning motivation among the study and control groups before and after applying Kahoot!

Learning motivation	Knowledge			
	Study group (N =75)		Control group (N =75)	
	r_s	P	r_s	p
Before Kahoot!	0.216	0.063	0.049	0.678
After Kahoot!	0.291	0.011*	0.233	0.045*

rs: Spearman coefficient   *: Statistically significant at p ≤ 0.05

Table (5): Distribution of students among the study group according to their feedback about Kahoot! as measured by KGBLFQ

KGBLFQ subscales	Positive feedback (≥50%)		Negative feedback (<50%)		Total mean score	Average mean score	Mean % score	Rank according to mean % score
	No.	%	No.	%	Mean ± SD.	Mean ± SD.	Mean ± SD.	
Fun and positive emotions (6 – 24)	73	97.3	2	2.7	19.21 ± 2.93	3.20 ± 0.49	73.41 ± 16.29	1st.
Engagement (4 – 16)	72	96.0	3	4.0	12.60 ± 2.08	3.15 ± 0.52	71.67 ± 17.33	3rd.
Utility for learning and motivation (10 – 40)	71	94.7	4	5.3	31.88 ± 5.09	3.19 ± 0.51	72.93 ± 16.96	2nd.
Total score of KGBLFQ (20 – 80)	*71*	*94.7*	*4*	*5.3*	*63.69 ± 9.62*	*3.18 ± 0.48*	*72.82 ± 16.04*	

SD: Standard Deviation

Discussion

The rapid advancement of technology necessitates continuous adaptation in nursing education. Integrating "information technology" into curricula empowers students to acquire the necessary skills and knowledge while fostering engaging learning experiences (**Singh & Masango, 2020**). Nursing educators typically use formative assessment to help students overcome anxieties associated with traditional testing. The digital game-based assessment, exemplified by Kahoot!, offers a considerable promise for achieving this goal (**Ismail & Mohammad, 2017**). Accordingly, the present study hypothesized that nursing students who are evaluated by Kahoot! as a digital game-based formative assessment tool exhibit higher levels of knowledge about educational objectives and learning motivation than those who are not.

These hypotheses were proved by the results of the current study as the majority of students in the study group achieved significantly satisfactory level of knowledge about educational objectives after using Kahoot!. While this digital assessment tool was effective in enhancing knowledge, the control group's progress indicated that the traditional methods could also be effective. However, there was a significant difference regarding knowledge improvement between the study and control groups after implementation of Kahoot!, favoring the study group. This finding is congruent with the finding of a study done by Mohamed et al., (2022) who reported higher overall learning achievement among nursing students among the Kahoot! group compared to a non-game-based group. Furthermore, in a study done by Kalleny, (2020) who concluded that Kahoot! is a successful application to be used as a game-based formative assessment in lab sessions for medical students. Conversely, this result differs from Aras and Çiftçi (2021), who found no significant relation between question-answer reinforcement and Kahoot! method.

These obvious improvements among the study group's levels of knowledge after applying Kahoot! could be attributed to the inherent game-based nature of the application. Its cheerful design, engaging music, and immediate feedback through celebrating right answers and displaying correct responses corrective explanations for wrong answers likely contribute to improved knowledge retention. This game-based environment likely enhances student's attention and engagement, leading to deeper understanding and knowledge consolidation. Furthermore, Kahoot! promotes active learning through participation and interaction. Students engage in answering questions, formulating responses, and analyzing their peers' answers, leading to a more active and meaningful learning experience than passive listening.

Another explanation to the improved levels of knowledge among the study group could be related to the psychological effects of Kahoot! and their potential impact on knowledge acquisition. Beyond its engaging gameplay and competitive elements, Kahoot! utilizes certain psychological principles to enhance knowledge retention. First, the game-based format is stimulating, and attracting student attention as well diverting them from distractions. This focused attention creates a prime learning atmosphere for information absorption and processing. Second, Kahoot!'s real-time feedback with cheerful sounds and visual cues celebrating correct answers and highlighting wrong ones reinforces learning immediately and consolidating information in memory. Within this respect, the finding of a study done by Licorish et al., (2018) who suggested that the implementation of Kahoot! in the classroom could potentially reduce distractions and enhance the quality of teaching and learning. They also concluded that Kahoot! is an effective educational technology which could provide students with timely feedback beyond what is typically offered in traditional classroom settings. Third, the fun and engaging nature of Kahoot! creates a positive emotional association with learning. This reduces anxiety which associated with the traditional testing, allowing students to approach the material with a more relaxed and open mind, conducive to knowledge acquisition. Additionally, the sense of accomplishment and peer recognition earned through Satisfactory performance of Kahoot! games which foster the feelings of competence and confidence. Such positive emotional state could indirectly improve cognitive function and knowledge retention. This explanation is supported by the results of the current study where the majority of the study group perceived Kahoot! as a useful tool for fun and experiencing positive emotions.

While in a study conducted done by Filgona, et al., (2020) who emphasized the importance of motivation as a psychological construct and a teaching technique that could effectively enhance learning in the classroom. In the same direction, the current study focused on the effect of using Kahoot! on learning motivation among students. The results revealed that the majority of students among the study group experienced high level of learning motivation after using Kahoot! Additionally, a statistically significant difference regarding learning motivation between the Kahoot! and control groups was found. This finding contrasted with the finding of a study done by Aras and Çiftçi (2021) who observed that there was no significant relation between motivation and Kahoot! use. On the other hand, this result is in congruent with other studies which emphasized the positive impact of Kahoot!' as an interactive and competitiveness application on motivational engagement and classroom dynamics across a variety of educational settings (**Coveney et al., 2022; Licorish, & Lötter, 2022**). The significant improvement among the study group's level of learning motivation may be attributed to the Kahoot!'s competitive nature. This competitive nature of Kahoot! also fosters social interactions where students learn from each other and strive to improve their performance.

Moreover, extrinsic motivation programs have been widely used in educational settings to influence behavior towards specific learning goals. Reinforcement programs had been implemented in schools to assess their effectiveness in motivating students towards desired behavior. These programs involve providing extrinsic rewards, such as grades and praise from teachers. As a result, students' behavior could be greatly improved (**Petrasek et al., 2022; Rahimi et al., 2021**). It seems that Kahoot follows a similar approach. For instance, as a game-based application Kahoot! displays first quick and correct answers, ranks students by speed and grade, and celebrates the top three performers. Such features may reinforce students' engagement and foster their motivating learning experience through the experienced feelings of accomplishment and enjoyment. Additionally, Kahoot! offers a stimulating learning environment that includes immediate feedback, playful design, and celebrates correct answers. This creates a positive emotional association and reinforces positive behavior, which stimulates students' intrinsic motivation to learn and encourages them to seek more knowledge. In the same context, the findings of the present study highlight the positive and significant correlation between knowledge and learning motivation among the study and control groups. This suggests that an increase in

knowledge could lead to an improvement in learning motivation, and conversely, an increase in learning motivation could lead to knowledge improvement.

Finally, it is likely that the above mentioned explanations (the combined effect of Kahoot!'s competitive nature, immediate feedback, positive emotional state and fun factor) were contributing factors to the study group's positive view of Kahoot!. Specifically, the majority of students reported positive feedback about strengthens of Kahoot!, as an assessment tool for having fun and experiencing positive emotions, promoting engagement and being useful for learning and motivation. This finding aligns with the finding of a study done by Susanti (2018) who found Kahoot! is a stimulating and enjoyable quiz rather than a traditional assessment. Similarly, Licorish et al., (2018) who highlighted an increase of the students' interactivity, engagement, and participation during Kahoot! sessions, fostering a deeper connection with the course learning material. The students liked the use of it in class and stated that they enjoyed the course because of the Kahoot!.

Conclusion

It can be concluded that Kahoot! is a valuable digital game-based formative assessment tool. This tool had been shown to be significantly enhance nursing students' knowledge of educational objectives and learning motivation compared to traditional methods. The students' feedback about Kahoot! as a formative assessment tool was positive. Moreover, this digital game-based tool had the potential to foster a stronger connection between knowledge and learning motivation, where increased knowledge fuels stronger learning motivation and vice versa.

Recommendations

Based on the findings of the current study, the following recommendations are suggested:

- Nursing educators should link Kahoot! as a formative assessment tool to specific learning outcomes to enhance students' knowledge, motivation, and satisfaction.
- Nursing educators need to apply Kahoot! after students has acquired some knowledge, as this creates the most excitement and involvement in the classroom. Careful planning of lessons is necessary to achieve this value.
- More studies are essential to explore the long-term effect of Kahoot! on sustained retention of knowledge, learning motivation,

learning outcomes and student engagement compared to traditional methods.
- Further research is needed to gain a deeper exploration of Kahoot!' psychological effects on knowledge acquisition, learning motivation and other learning conditions.
- Other studies are needed to investigate the mechanisms underlying the connection between knowledge and learning motivation, particularly within the context of Kahoot!
- Further research is required to study the applicability of Kahoot! to other subject areas and educational settings.

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