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Investigating the Impact of Online Gamification on Nursing Students' Knowledge of Lung Diseases, Lung Sounds, and Self-Efficacy

Fatemeh Najafi [1], Mosayeb Mozafari [1], Masoumeh Shohani [1], Maryam Pakseresht [1], Fakhredin Taghinezhad [1], Reza Pakzad [2], Amirreza Bazhdan [3], Alireza Vasiee [1]✉

[1] Department of Nursing, Faculty of Nursing and Midwifery, Ilam University of Medical Sciences, Ilam, Iran
[2] Department of Epidemiology, Faculty of Health, Ilam University of Medical Sciences, Ilam, Iran
[3] Student Research Committee, Department of Nursing, Faculty of Nursing and Midwifery, Ilam University of Medical Sciences, Ilam, Iran

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✉ ***Correspondence to:***
Alireza Vasiee
Department of Nursing, Faculty of Nursing and Midwifery, Ilam University of Medical Sciences, Ilam, Iran

Email:
rezawest10@gmail.com

A B S T R A C T

Introduction: Diagnosing and performing timely treatment for lung diseases is crucial for saving patients' lives. This study aims to investigate the effect of online gamification on nursing students' learning of lung diseases, lung sounds, and self-efficacy.

Material & Methods: This semi-experimental study involved 68 sixth-semester nursing students, selected through convenient sampling and randomly allocated to control and intervention groups using dice throws. Over three weekly sessions, the intervention group received training on lung diseases and lung sounds via the Storyline platform and gamification through Kahoot, while the control group received the same content through lectures by the same instructor. Questionnaires assessing demographics, learning outcomes, and self-efficacy were administered before and two weeks after the intervention. Data were analyzed using Chi-square, independent t-tests, paired t-tests, and Kolmogorov-Smirnov tests in SPSS v.16, with a significance level of 0.05.

Results: The participants had a mean age of 22.73 ± 1.29 years, and 63% were male. There were no significant differences between the two groups in learning assessment and self-efficacy before the intervention (P=0.193 and P=0.167, respectively). After the intervention, the intervention group showed a statistically significant improvement in learning assessment scores (P=0.031, 16.55±2.57) compared to the control group (P=0.086, 9.11±1.01). Similarly, self-efficacy scores in the intervention group (P=0.023, 65.29±3.97) were significantly higher than in the control group (P=0.084, 48.18±5.36).

Conclusion: Online gamification significantly improves the learning of lung diseases, lung sounds, and self-efficacy in nursing students.

Keywords: Gamification, Lung diseases, Self-Efficacy, Nursing

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Introduction

Pulmonary illnesses are prevalent among people and pose a significant risk to their lives (1). The complications of these disorders vary depending on the location and severity of the illness, and they can result in either brief or long-lasting difficulties (2). Hence, it is imperative to promptly initiate the identification and diagnosis of pulmonary diseases (3). Based on the study findings, lung diseases rank as the third leading cause of mortality globally. In Iran, they are the fourth leading cause of death, behind heart disorders, various forms of malignancies, and trauma (4).

Nurses on the front line of patient care require extensive knowledge and abilities in diagnosing pulmonary diseases to effectively prevent the emergence of life-threatening consequences associated with these conditions. This is crucial for adequate and comprehensive training (5). The ability to distinguish and evaluate typical lung sounds from atypical ones in respiratory emergencies is of paramount significance. Given that the nurse is typically the first to detect the presence of abnormal lung sounds, it is crucial for them to differentiate between normal and abnormal lung sounds. This skill is a significant responsibility and an essential part of their training (6).

Over the past decade, there has been a significant revolution in the methods and approaches used to teach medical courses worldwide. To ensure that students acquire a wide range of knowledge and engage in enjoyable and thought-provoking discussions within diverse educational settings, it is essential to note that specific classrooms still adhere to traditional teaching methods. Consequently, these learners assume a passive role, merely receiving information instead of actively participating in dynamic and stimulating learning experiences (7). The conventional lecture approach, being the predominant mode of education, has resulted in insufficient time being allocated for students to engage in intellectual discourse and delve into the subject matter. As a result, students find themselves in a passive state, merely attending classes without active participation (8).

Utilizing innovative educational approaches like online education and gamification enhances learners' cognitive capacity, prompting them to employ critical thinking and logical faculties to analyze and solve problems (9). The utilization of the online education platform during the coronavirus pandemic demonstrates the efficacy of this approach in delivering educational information and training to nursing students, as evidenced by its success (10, 11). Gamification is the utilization of game attributes and benefits in real-life settings to enhance learning and the acquisition of knowledge (12). These strategies are effective for cultivating advanced cognitive abilities and actively engaging learners in the process of acquiring knowledge (13).

Learning through a sequence of therapeutic interventions, including gamification, incorporates various aspects: individual elements (such as accountability and perception), mechanical elements (such as prompt feedback and regular progress tracking), and emotional elements (such as motivation and self-efficacy) (14). Self-efficacy significantly influences learning outcomes (15). Self-efficacy, a major component of Bandura's socio-cognitive theory, pertains to individuals' perceptions of their own capabilities to perform tasks and acquire knowledge. Based on this perception, individuals assess their behavior with the aim of learning. Research demonstrates the significance of self-efficacy in achieving academic success. The results of these studies show a favorable correlation between self-efficacy and academic advancement in universities among individuals aged 16-18 (16-18).

Innovative educational approaches can be used in a conducive setting that caters to the learner's preferences and stimulates their interest in applying or acquiring knowledge (19). Research findings indicate that gamification is a highly effective

approach for reinforcing prior knowledge and facilitating the acquisition of new understanding. Furthermore, gamification enhances knowledge retention, as simulation games have been shown to prolong the duration for which acquired knowledge remains in memory (20). Given the significance of learning and retention in the professional development of nurses, it is advisable to enhance these aspects by implementing innovative instructional techniques and assessing the results of learning (21). Therefore, the present study was undertaken to examine the impact of online gamification on the acquisition of knowledge about lung diseases, lung sounds, and self-efficacy among nursing students.

Materials and methods

Setting and Sample

This study was semi-experimental research conducted from November 4th to December 5th, 2023, at the School of Nursing and Midwifery of Ilam, Iran. The study participants were selected from nursing students in their 6th semester using a convenience sampling method, with inclusion criteria including a desire to participate in the study, ownership of a personal smart mobile device, full-time availability for the study, and a score of less than 12 in the Learning Assessment Test (LAT). Exclusion criteria included being absent for more than one meeting, transferring to another college, having work experience as a paramedic or student worker, previous completion or failure of an emergency nursing in crisis course unit, participation in heart and respiratory disease workshops within the past three months, and incomplete questionnaire responses. Informed written consent was obtained from all participants at the start of the study. Ethical considerations included obtaining an ethics code (IR.MEDILAM.REC.1402.158), honesty in library collection and data report, written informed consent from all samples according to the Declaration of Helsinki's announcement, and interventional human principles.

Sample Size, Randomization and Blinding

Using a convenience sampling approach, 68 participants were randomly allocated to control (34 participants) and intervention groups (34 participants) by dice throwing. The first person in the class list, ordered alphabetically, threw the dice. If the dice number was odd, the participant entered the intervention group; if even, the participant entered the control group. Subsequent participants were assigned to groups using the same algorithm, without further dice throwing. This assignment continued until the last person on the alphabetical class list was assigned. Afterward, the final sample list was exported, and the research team had no access to manipulate the allocation.

Measuring tools, Validity and Reliability

1. Demographic tool questionnaire

Demographic variables entailed age, sexuality and last semester's average.

2. Learning Assessment Test (LAT)

The instrument used for assessing learning content was developed by the research team and consisted of 20 questions with different options in two series. The first series contained twenty questions, and the second series featured twenty different questions compared to the first series. The difference in the obtained points between these two tests served as the learning score, with one point awarded for each correct answer and zero points for incorrect or unanswered questions. The scoring range ranged from 0 to 20, with a higher score indicating greater competency in learning.

To assess content validity index (CVI) and content validity ratio (CVR) using the Baltz and Wassel approach, ten faculty members were involved. Following validity assessments, the CVR, CVI, and internal consistency (Cronbach's coefficient) for the

first series were 0.89, 0.79, and 0.81, respectively. For the second series, the corresponding values were 0.84, 0.82, and 0.93, respectively.

3. Self-Efficacy Questionnaire (SEQ)

The questionnaire used for assessing educational self-efficacy was designed by Sherer et al. and comprises 17 items. It employs a Likert scale ranging from completely disagree (1) to completely agree (5) for scoring, with a score range of 17 to 85. Higher scores indicate a better educational self-efficacy situation.

In the original version of this tool, the content validity index (CVI) value is 0.82, and the content validity ratio (CVR) value is 0.88. In the Iranian version of the tool, which was validated on 98 medical students, the CVI and CVR were reported as 0.92 and 0.80, respectively. The internal consistency, measured by Cronbach's coefficient, was reported as 0.86 (22).

Intervention

After obtaining the ethics code and completing the random allocation, inclusion and exclusion criteria, the study commenced. Demographic information, the Learning Assessment Test (LAT), and the Self-Efficacy Questionnaire (SEQ) were filled out by participants using an online sheet.

In the intervention group, three training sessions were scheduled, each lasting two hours. These sessions took place weekly on Saturdays and utilized the Storyline platform. The content focused on lung diseases and sounds, selected in alignment with the emergency nursing in crisis course unit. Training covered topics such as normal and abnormal lung sounds, causes, diagnostic methods, treatments, and nursing interventions.

During the last half-hour of each session, a gamification element was introduced using the Kahoot mobile phone app. This involved diagnosing various types of lung sounds and engaging in related nursing activities through online puzzle competitions, brainstorming, clinical scenarios, short answer questions, and true/false questions. In this gamified approach, students progressed to higher levels by correctly answering steps within the Kahoot software. Each step increased in difficulty compared to the previous one. At the end of each session, the six students with the highest scores were announced as winners.

The samples comprising the control group received identical content to that taught to the intervention group, delivered through traditional lectures and PowerPoint presentations by the same instructor. These sessions occurred face-to-face three times a week (on Tuesdays each week), with each session lasting two hours.

At the conclusion of the study, two weeks after the intervention's end, participants were asked to refill the Learning Assessment Test (LAT) and Self-Efficacy Questionnaire (SEQ) without prior notice.

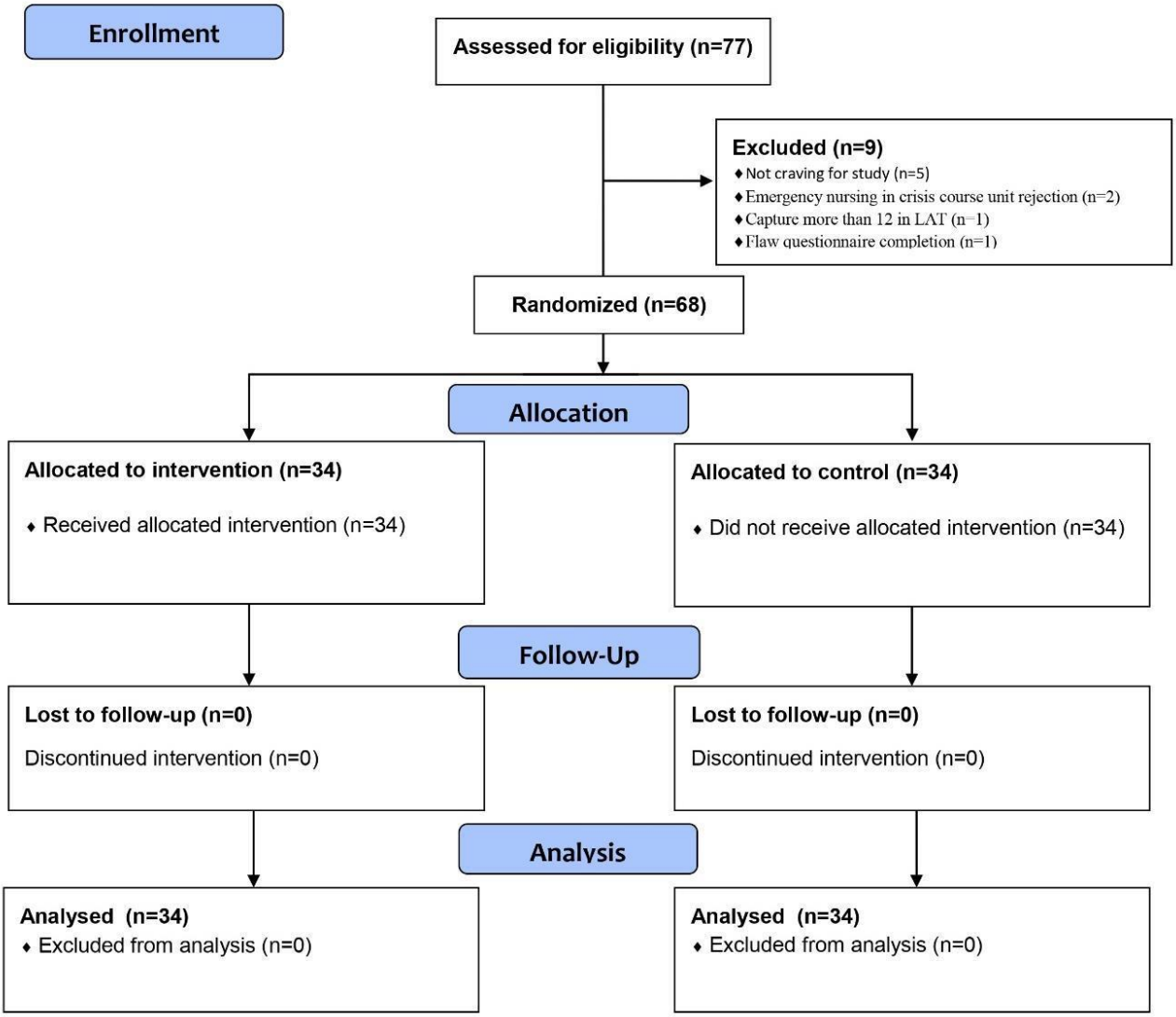

Figure 1. The process of allocating and implementing the study protocol for control and intervention groups.

Statistical and Data analysis

Statistical tests conducted in this study included chi-square (to observe demographic variables among groups), independent t-tests (for comparing score differences between groups), paired t-tests (to investigate differences in scores before and after the intervention), and Kolmogorov-Smirnov tests (to assess normal distribution of data). The significance level was set at 0.05. Data analysis was performed using SPSS version 16 software.

Results

To assess the normal distribution of quantitative data, the Kolmogorov-Smirnov test was employed, yielding a result indicating normal distribution (P=0.526). The mean and standard deviation of the participants' ages were 22.73 ± 1.29. The majority of participants were male, had a moderate average in their last semester, and resided in personal houses.

Using the chi-square test, analysis between the variables of sexuality (P=0.492), last semester's average (P=0.703), and residency status (P=0.881) revealed no significant differences between the control and intervention groups (Table 1).

Table 1. Distribution of Demographic Variables Across Groups.

Variable		Control (34)	Intervention (34)	P Value (chi-Square)
Sexuality	Men	19 (% 55)	24 (% 70)	0.492
	Women	15 (% 45)	10 (% 30)	
Last Semester's Average	12 – 14.50 (Low)	26 (% 76)	20 (% 64)	0.703
	14.51 – 17.00 (Moderate)	7 (% 21)	12 (% 34)	
	17.01- 20.00 (Perfect)	1 (% 3)	2 (% 6)	

The mean scores of the learning assessment in the control and intervention groups did not significantly differ before the intervention (P=0.193). However, after the intervention, this difference became significant (P=0.012). Similarly, the mean scores of Self-Efficacy in the control and intervention groups did not show a significant difference before the intervention (P=0.167), but after the intervention, this distinction was significant (P=0.006).

Independent t-tests revealed significant differences in the average scores of the learning assessment (P=0.004) and Self-Efficacy (P=0.019) between the two groups (Table 2).

Furthermore, paired t-tests indicated no statistically significant difference between the mean scores of the learning assessment before and after the intervention in the control group (P=0.086). However, this difference was significant in the intervention group (P=0.031). Similarly, there was no significant difference in the average Self-Efficacy scores before and after the intervention in the control group (P=0.091), but there was a significant difference in the intervention group (P=0.023) (Table 2).

Table 2. Matching Mean Scores of Learning Assessment and Self-Efficacy Before and After Intervention in Both Groups.

Variable		Group		P Value*
		Control	Intervention	
		M ± SD	M ± SD	
Learning Assessment	Before	8.74±1.61	9.11±1.01	P= 0.193
	After	6.88±0.73	16.55±2.57	P= 0.012
Mean Difference		-1.86	7.44	P=0.004
P Value #		P=0.086	P=0.031	--
Self-Efficacy	Before	51.27±4.76	48.18±5.36	P=0.167
	After	43.82±4.01	65.29±3.97	P=0.006
Mean Difference		-7.45	17.11	P=0.019
P Value #		P=0.091	P=0.023	--
*: Independent t **#:** Paired t				

Discussion

The aim of this study was to investigate the impact of online gamification on learning lung diseases, lung sounds, and self-efficacy among nursing students. The findings revealed a statistically significant difference in average learning scores and self-efficacy between the control and intervention groups after the intervention. This suggests that online gamification has effectively enhanced learning outcomes in students.

These results are consistent with a study conducted by Inangil et al., which explored the effects of gamification on learning and diagnosing diabetes and associated symptoms among medical students (23). Similarly, the use of gamification in that study led to improved precision and efficiency in diabetes

diagnosis, indicating enhanced learning outcomes. Another study by Antit et al. compared gamification with reverse learning in teaching ECG interpretation to medical students. The findings favored gamification over reverse learning, highlighting its efficacy in enhancing students' competency in ECG interpretation (24).

In contrast, a study by Ghezelghash et al. compared different teaching methods, including lecture-based instruction, problem-solving activities, and computer-assisted self-learning, for interpreting electrocardiograms (ECGs) among nursing students. Interestingly, their results showed that computer-assisted self-learning exhibited the least effectiveness compared to other methods, contradicting the findings of our study (25). This discrepancy could be attributed to various factors such as the nature and duration of the intervention, content design, admission criteria, and methodological differences in sample measurement.

Several factors may contribute to the decrease in scores of outcome variables observed in the control group. These include differences between the lecture method and the gamification method, the volume of materials presented, participants' level of cooperation, and the difficulty level of questionnaires post-intervention.

El-Beheiry et al.'s study, comparing traditional teaching methods with gamification on learning surgical skills in medical students, observed a decrease in learning scores in the control group, consistent with our findings (26). In their study, the control group relied on note-taking and memorization of presented images, while the intervention group engaged in surgical procedures using simulators, training videos, and hands-on participation in surgical procedures. Both studies share the commonality of employing traditional teaching methods in the control group and utilizing two-step tests to measure learning differences.

Similarly, Van Nuland et al.'s study aimed to compare the effects of gamification and traditional teaching methods (lecture and slide presentation) on learning and educational participation of medical students in an anatomy course. Their results indicated a decrease in learning scores and educational participation in the control group by the end of the intervention, mirroring our findings (27).

In their study, the control group learned educational content solely through slides without the use of interactive educational materials. In contrast, the intervention group engaged in activities such as puzzles, individual competitions, and question-and-answer games, resulting in higher levels of learning and educational participation compared to the control group. Both studies observed a decrease in learning scores and educational participation in the control group due to the absence of intervention.

Academic motivation and self-efficacy are essential components in solidifying learning outcomes and enhancing the quality of education. These aspects are influenced by therapeutic learning measures, including gamification (15). Tan et al.'s study, which investigated the effect of gamification on learning about blood product administration and their side effects among nursing students, demonstrated increased learning and motivation in students, consistent with the findings of the current research (25).

In their research, gamification was conducted on the Kahoot platform alongside clinical scenarios as an intervention, and questionnaires were completed by participants immediately after the intervention. The shared characteristic between these studies is the impact of gamification on enhancing learning and measuring components that influence learning, such as motivation and self-efficacy.

Haghgou et al.'s study, comparing the lecture method with the web-based question-and-answer method on the motivation and consolidation of learning ECG interpretation in nursing students,

demonstrated that the web-based question-and-answer method increases motivation to learn and consolidation, aligning with the findings of the current research (28). Their study emphasized motivation as an effective factor in consolidating acquired knowledge and evaluated levels of knowledge consolidation as weak, moderate, and excellent. Both studies share the commonality of observing the positive effect of the intervention on enhancing learning and related factors such as motivation and self-efficacy in medical students.

Conclusion

Utilizing online simulation games as a novel instructional approach in nursing students has been found to enhance both learning outcomes and self-efficacy. The findings of the present study suggest that engaging in online gamification significantly improves learning rates, understanding of lung diseases and associated sounds, and self-efficacy.

While this study has identified certain limitations, including its restricted duration, sample size, and specific demographics, it also boasts several notable strengths. These include the utilization of innovative platforms such as Storyline and Kahoot, the development of clinical scenarios for managing patient situations, the classification of lung disorders and associated sounds, and the establishment of a competitive learning environment for enhanced learning. Given the study's findings, it is recommended that future research explore diverse teaching techniques and up-to-date online platforms, while also employing larger sample sizes to further investigate other theoretical units employed in clinical education.

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Conflict of interest

The authors declare no conflict of interest.

Authors' contributions

AV, FN: Conceptualization, AV, FT, MS: Methodology, MM, AV: Validation, RP: Formal Analysis, AB, FN, MS: Investigation, FN, MS: Resources, FT, RP, MP: Data Curation, AV, MM: Writing– Original Draft Preparation, AV, FN: Writing– Review & Editing, AB, FN: Visualization, MM, FN: Supervision, AV: Project Administration.

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