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The effectiveness of gamification on nursing practice for undergraduate students: A systematic review

[1]Hyun Kyoung Kim

[1]Associate Professor, Department of Nursing
Kongju National University, Gongju, Korea
hkk@kongju.ac.kr

Abstract

The purpose of this study was to examine the effectiveness of gamification in nursing practice for undergraduate students, as well as to explore the use of gamification in nursing education. This study is a systematic review of RCTs evaluating the effectiveness of gamification in nursing practice for undergraduate students. A total of 7 articles were identified in a search of PubMed, Cochrane Library, and Embase, and the additional databases were CINAHL (in English) and RISS (in Korean) between September 28, 2022 to October 5, 2022. Themes related to the environment and personal behaviors between 2002 and 2021 were extracted. The intervention themes were blood transfusion, postoperative pediatric nursing, postoperative hemorrhage and brain trauma nursing, basic and advanced life support, disaster nursing, and neonatal resuscitation. The primary outcomes were knowledge in five studies, satisfaction in one study, and competency in one study. The secondary outcomes were satisfaction in three studies, confidence in two studies, performance in two studies, skills in two studies, and self-efficacy, motivation, professional attitude, cognition, gameful experience, and affective response in one study each. Therefore, gamification interventions can be utilized in nursing practice education instead of traditional teaching methods such as lectures and face-to-face clinical practice.

Keywords: *Gamification, Education, Nursing Student, Nursing Practice, Systematic Review*

1. INTRODUCTION

Gamification is defined as a method using intrinsic motivation and game elements to induce participation and improve problem-solving skills in the areas of education, business, and healthcare [1]. Gamification elements include rules, competition, cooperation, a reward system, feedback, steps, scores, and aesthetics. The terms “game-based learning,” “serious game,” and “edutainment” have been used starting approximately 10 years ago [2]. Gamification using the internet was identified as a feasible characteristic of distance learning, which emerged in the healthcare field with advances in computer technology [3]. Moreover, the coronavirus disease 2019 (COVID-19) pandemic restricted face-to-face education, and attention was directed toward the use of gamification in educational alternatives to learning in a physical classroom [4].

Several systematic reviews have been conducted on gamification education for the health professions, as well as a scoping review [5] and integrated review [6]. However, no systematic review of gamification in practice-oriented nursing education has been published. Therefore, this systematic review was conducted to

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Corresponding Author: hkk@kongju.ac.kr
Tel: +82-41-850-0308, Fax: +82-41-850-0700
Assistant professor, Dept. of nursing, Kongju National Univ., Korea

investigate gamification in nursing practice education for undergraduate students. Rigorous randomized controlled trials (RCTs) provide higher levels of evidence for nursing researchers and educators.

The purpose of this study was to examine the effectiveness of gamification in nursing practice for undergraduate students, as well as to explore the use of gamification in nursing education. This study can provide insights into how to improve the quality of nursing practice education using gamification and provide practical data on gamification regarding themes and methods for future educational interventions. The specific goals of this study were 1) to describe the topics and participants, 2) to identify gamification intervention methods, and 3) to examine the effectiveness of gamification for nursing practice.

2. MATERIALS AND METHODS

This study is a systematic review of RCTs evaluating the effectiveness of gamification in nursing practice for undergraduate students. The systematic review was performed in accordance with the PRISMA (Preferred Reporting Items of Systemic Reviews and Meta-Analysis) reporting guidelines [7].

2.1 Data source

The researcher identified articles using a systematic literature review method in the core electronic databases and extracted topics, participants, intervention methods, and outcomes. The three core databases were PubMed, Cochrane Library, and Embase, and the additional databases were CINAHL (in English) and RISS (in Korean). A hand-search of the references of identified articles was also conducted. The extracted data contained the first author, publication year, nation, study design, characteristics of participants, number of participants, setting, intervention name, intervention theme, intervention period, the use of gamification, primary/secondary outcomes, results, and statistical significance.

The participant, intervention, comparison, outcome, setting, time, and study design (PICOST-SD) framework was used to develop a search strategy that was implemented from September 28, 2022 to October 5, 2022. The researcher employed an advanced search using MeSH term, EMTREE, and CINAHL Complete, including professional words, similar words, synonyms from the thesaurus, and natural words. The period of the literature was designated as extending up to the search date, the language was English or Korean, and eligible articles were RCTs whose full texts could be retrieved from a peer-reviewed journal. The search terms used database-specific combinations of “nursing,” “education,” and gamification-related terms such as “gamification,” “game-based education,” “metaverse,” and “avatars.”

2.2 Study selection

The inclusion criteria were studies describing (1) the use of gamification as an educational intervention, (2) involving nursing students in an undergraduate program, and (3) interventions for a nursing practicum. The exclusion criteria were (1) books, proceedings, conference papers, editorials, government reports, letters, pilot studies, protocol studies, and dissertations; (2) studies that did not present complete results; and (3) review articles, meta-analyses, qualitative research, descriptive studies, cohort studies, and quasi-experimental studies. The research questions within the PICOST-SD framework were as follows [8].

1) Participants: nursing baccalaureate students
2) Interventions: a nursing practical educational intervention using gamification (game-based education, gaming simulation, or virtual game).
3) Comparison: traditional education, only using a mannequin simulation, lecture, clinical education, or no intervention.

4) Outcome: students' competencies, knowledge, attitude, skill, or psychological factors.
5) Setting: face-to-face game, internet-based game, web-based game, virtual situation, or mobile application.
6) Time: any time point during a nursing educational program.
7) Study design: randomized controlled trial of a gamification intervention.

2.3 Included studies

The total number of articles was 1997 in CINAHL (60), Cochrane Library (1), Embase (212), PubMed (1627), and RISS (97). After reading the titles, 36 articles remained from CINAHL (0), Cochrane Library (1), Embase (19), PubMed (16), and RISS (0). The hand search added 8 articles, and 7 duplicated articles were removed. After reading the abstract and full text, 30 articles were removed according to the exclusion criteria. Seven articles were finally included.

2.4 Quality appraisal

The Cochrane Risk of Bias (RoB) 2.0, which is suitable for individually randomized, parallel-group trials, was used for the quality appraisal of seven articles [9]. The RoB 2.0 assessment has six domains of risk of bias as follows: (1) bias arising from the identification or recruitment of participants into clusters, (2) bias due to deviation from the intended intervention, (3) bias due to missing outcome data, (4) bias in the measurement of the outcome, (5) bias in the selection of the reported results, and (6) overall risk of bias. The researcher evaluated the bias as low, some concerns, or high in each domain. The risk-of-bias VISualization (robvis) web application [10] was used to present the result of the quality appraisal as traffic lights and weighted bar plots of the distribution of risk-of-bias judgements (Figure 1).

Figure 1. Quality appraisal via RoB 2.0 assessment

2.5 Data extraction and synthesis

The seven selected articles were coded and summarized using an Excel form. The following data were coded: study design, the characteristics of participants, the number of participants, setting, intervention name, intervention format, intervention period, used gamification, primary/secondary outcomes, results using mean and standard deviation, and statistical significance using the t- test and p-value.

3. RESULTS

3.1 Characteristics of the topics and participants

Three studies were published between 2017 and 2022 [11-17]. The nations of the studies were Canada,

China, France, Taiwan, Spain, Singapore, and Turkey. All the studies were 1:1-allocation RCTs with a parallel design. The participants were sophomore nursing students in four studies, junior nursing students in one study, basic life support program enrolled nursing students in one study, and students who had completed fundamental nursing practice I in one study. The total number of participants ranged from 16 to 146, and the numbers of participants in the experimental and control groups were 8 and 73, respectively. The settings were virtual reality in two studies, simulation based games in two studies, a mobile application game in one study, a face-to-face card game in one study, and a web-based simulation application in one study (Table 1).

Table 1. Characteristics of the selected studies

Number	First author	Publication year	Country	Study design	Participants	Exp. group	Con. group	Setting
1	Tan	2017	Singapore	1:1 RCTs	Sophomore	57	46	Virtual hospital
2	Verkuyl	2017	Canada	1:1 RCTs	Sophomore	8	8	Virtual simulation
3	Blanie	2020	France	1:1 RCTs	Sophomore	73	73	Simulation game
4	Puertas	2021	Spain	1:1 RCTs	Basic life support subject enrolled	92	92	Mobile application
5	Liu	2021	Taiwan	1:1 RCTs	Fundamental nursing practice completed	45	47	Face-to-face card game
6	Ma	2021	China	1:1 RCTs	Sophomore	51	53	Computer-based simulation
7	Sarvan	2022	Turkey	1:1 RCTs	Junior	45	45	Simulation game

RCTs=randomized controlled trialS

3.2 Characteristics of the gamification intervention methods

The intervention names were as follows: “serious game for safe administration,” “virtual gaming simulation (VGS),” “simulation by gaming (SG),” “Guess it (SVUAL),” “clinical situation-based teaching,” “disaster themed game,” and “serious game simulation (SGS).” The intervention themes were blood transfusion, postoperative pediatric nursing, postoperative hemorrhage and brain trauma nursing, basic and advanced life support, disaster nursing, and neonatal resuscitation. The intervention periods were 50 minutes in one study, 90 minutes in one study, and 2 hours in five studies. The control group interventions were face-to-face lectures in two studies in one study, traditional teaching in two studies, theoretical training in one study, and simulation in one study. The follow-up timing ranged from only immediately after the intervention in six studies to just after the intervention and 2 weeks later and 1 month later in each study (Table 2).

Table 2. Interventions of the selected studies

Number	Author	Intervention	Themes	Period	Follow up	Treatments for Con. group
1	Tan	Virtual reality	Blood transfusion	30 minutes	Immediate & 2 weeks	None
2	Verkuyl	Virtual gaming simulation	Child post-operative care	2 hours	Immediate	Laboratory simulation
3	Blanie	Simulation by gaming	Hemorrhage and brain trauma	2 hours	Immediate & 4 weeks	Text teaching via power point presentation
4	Puertas	Guess it app	Life support	2 hours	Immediate & 3 weeks	Traditional teaching
5	Liu	Clinical situation-based teaching	Medication terminology	50 minutes	Immediate	None
6	Ma	Brave the wind and wave game	Disaster nursing	110 minutes	Immediate	Simulation
7	Sarvan	Integrating serious game simulation	Neonatal resuscitation	2 hours	Immediate	Theoretical training

3.3 Effectiveness of the gamification for nursing practice

The primary outcomes were knowledge in five studies, satisfaction in one study, and competency in one study. The secondary outcomes were satisfaction in three studies, confidence in two studies, performance in two studies, skills in two studies, and self-efficacy, motivation, professional attitude, cognition, gameful experience, and affective response in one study each. All studies showed that the interventions were effective for knowledge ($p < .05$, $p = .045$, $p < .001$) and partly effective for satisfaction ($p < .05$, $p < .001$) and confidence ($p < .001$, $p = .001$). They were partly effective for performance ($p = .105$, $p < .001$) and effective for skills ($p = .008$, $p = .041$). Effectiveness was also found for self-efficacy (not reported), motivation (not reported), professional attitude (not reported), cognition ($p = .004$), gameful experience (not reported), and affective response ($p = .010$) (Table 3).

Table 3. Effectiveness of the gamification

Number	First author	Primary outcome	Secondary outcome	t or z	p-value
1	Tan	Knowledge		-11.46	<.001
			Confidence	-9.04	<.001
			Performance	1.64	.105
			Perception	none	none
2	Verkuyl	Skill		-2.10	.040
			Knowledge	-2.12	.045
			Satisfaction	none	Not significant
3	Blanie	Concordance		None	.43
			Clinical reasoning	None	Not significant
			Satisfaction	None	.001
			Motivation	None	.004
			Professional transfer	None	.003
4	Puertas	Knowledge		-3.96	<.05
			Gameful experience	-1.89	.049
5	Liu	Satisfaction		7.36	<.001
			Self-confidence	7.34	<.001
			Performance	6.66	<.001
6	Ma	Competence		3.11	.002
			Cognition	2.98	.004
			Skill	2.68	.008
			Affective response	2.61	.010
7	Sarvan	Knowledge		None	.036
			Skill	None	.011
			Satisfaction	None	.407
			Self-confidence	None	.098

4. DISCUSSION

This study investigated seven RCTs regarding nursing practice education using gamification. The interventions were effective for knowledge, self-efficacy, motivation, professional attitude, cognition, gameful experience, and affective response, and partially effective for satisfaction and performance. The overall effectiveness of the interventions for nursing knowledge acquisition was consistent and high.

The trials were performed from 2017 onwards and covered various nursing educational themes. Gamification was attractive because of the characteristics of deep and epistemic learning in contrast to traditional learning [18]. Gamification has benefits in engagement, motivation, and the promotion of creative, critical thinking [19]. The attractive learning elements lead to an immersive experience to practice nursing skills. The goals of nursing practicum education are to foster and develop professional nursing competency to solve health problems through the course of clinical and laboratory practice curricula [4]. Innovative learning methods, such as virtual reality, the metaverse, and simulations have increasingly been adopted in the nursing

education areas.

This study showed the effects of gamification on nursing practice in the specific domains of health problems: postoperative hemorrhage [12], brain trauma [13], blood transfusion [11], medication [15], disaster nursing [16], life support [14], and neonatal resuscitation [17]. The themes were limited to surgical, emergency, and life support nursing, and the clients were neonates, children, or adults. Hence, these interventions should be expanded to a broader range of clients, including women and the elderly, and should include other themes, such as maternal, community, psychological, and administrative nursing management. This study suggests the possibility of developing a nursing intervention using gamification elements to enhance users' engagement, pleasure, and motivation, as well as the effects of an educational program for undergraduate students.

The strength of this study is that it confirms the possibility of gamification education's utility in the context of innovations in distance learning. In this study, six out of seven studies were distance games conducted through the internet, except for one face-to-face card game. One of the reasons for this was that the COVID-19 pandemic accelerated distance education. There are several limitations of this study, such as the small sample and inclusion of only English-language studies, although a systematic literature search strategy was used. Additionally, the quality of RCTs using RoB 2.0 revealed bias in the areas of allocation of participants into clusters, deviation from the intended intervention, missing outcome data, measurement bias, and selection of the reported results.

5. CONCLUSION

This study found that gamification in nursing practice education was effective for the acquisition of knowledge, satisfaction, confidence, practice performance, nursing skills, self-efficacy, motivation, professional attitudes, cognition, positive experience, and affective response among nursing students. Therefore, gamification interventions can be utilized in nursing practice education instead of traditional teaching methods such as lectures and face-to-face clinical practice.

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