

Impact of Two Types of Electronic Gamification Design (Badges / Leaderboard) On Three Learning Domains Among Medical-Surgical Nursing Students In Light of Covid-19 Pandemic

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Abstract

To investigate whether the Medical and surgical nursing courses offer gamification elements that contribute to the formation of clinical nursing competencies among undergraduate nursing students. Students were divided into two groups: Medical and Surgical Nursing. Specific presentations were created in the Learning Management System (LMS), an online program, for every module. Various game elements were implemented throughout the module. The game elements include the participation voluntarily with the inclusion of feedback immediately (can be positive or negative), providing a social connection. Students have the freedom of choice and the freedom to fail without any significant repercussions. Gamification adoption was believed to be an appealing and state-of-the-art approach, providing an alternative to the conventional practices, and having applicability in nursing education. In a quantitative analysis, it was observed that there was a significant improvement in the three learning domains after applying the gamification strategy.

Keywords: Educational Technology, Technology in Nursing Education; LMS; Teaching; Competency-Based Nursing Education; Gamification, COVID19.

Introduction:

Today we are faced with a society occupied in globalization and native technology, causing countless challenges in the university teaching staff. As a teaching-learning moralistic methodology, gamification gathers the characteristics that motivate and accomplish active and significant learning. Gamification is an innovative strategy used within the nursing career experience, which syndicates the learning based on games and the use of

digital applications (Solís de Ovando, Rodríguez & Hullin, 2018). Due to today's highly motivating and competitive nature, proper implementation of gamification can become an efficient learning tool. The present research aimed to study the elements of gamification that might appeal to medical students when utilizing an online learning system to acquire clinical skills. Focus group sessions were organized with the game developers, medical students, and game designers to develop an initial understanding of their preferences and

perceptions of gamification. It was concluded that gamification might increase motivation and engagement and must include both the social and competitive elements. (Rojas, Kapralos & Dubrowski, 2016).

Gamification Designs:

Badges:

The initial appearance of digital badges in online games was in 2002 with the Microsoft Xbox Live services (Antin & Churchill, 2011). Since that time, badges have been widely used in different contexts, such as Google news. In general, digital icons put the significance of digital badges that represent the personal achievement of game completion to prove individual gain of knowledge or skills and completion of the agreed course of study (Landers & Callan, 2011). Therefore badges within games are identified as digital badges (Abramovich, Schunn, & Higashi, 2013). or achievement (Jakobsson & Sotamaa, 2011).

A digital badge is known as "a representation of an accomplishment, interest or affiliation that is visual, available online, and contains metadata including links that help explain the context, meaning, process and result of an activity" as defined by Gibson, Ostashewski, Flintoff, Grant, and Knight (2013). Furthermore, digital badges are considered as a requirement to attain goals, make progression, and achieve results in the learning context (Gibson et al., 2013). Moreover, access to digital badges may enhance the learner's self-efficacy (Randall, Harrison, and West, 2013).

Granett & Button (2018), Shah (2021) Digital badges are deep-rooted in physical badges, like the ones recognized by Baden-

Powell with the cub scouts, somewhere different cub scouts could achieve different uniform badges by the accomplishment of a task or skill demonstration. Each badge would be shown on their clothes to help show-off their success among colleagues. Lately, integration of digital badges has taken place into mobile games and electronic fitness monitors such as Apple Watch™ and FitBit™, as well as achievement constructions built into gaming cabinets like Microsoft XBox™. Comparatively, the individual who is moved to earn what is now considered a basic digital image and relevant metadata is not explored yet, for the fact that demonstration of it can only be achieved in an online environment.

In education, the digital badges are well-thought-out by numerous people as a substitute tool for credentialing (micro). Nonetheless, authors argue that the digital badges have a motivational impact associated with the learner's nature who is motivated to learn new skills or information that is recognized as an informal way (Foli et al., 2016). Digital badges have a potential value in distinguishing learning when they are intentionally incorporated into a nursing university teaching topic. (White and Shellenbarger, 2018).

The badges' use is a characteristic gamification method and has been propagated as magnification (Butler, 2014; Hakulinen, Auvinen, & Korhonen, 2013). The badges are a visual exhibition of the progress of users, specifying the competency level achieved, providing instant feedback, and constituting a single method of extrinsic rewards (Boticki, Baksa, Seow, & Looi,

2015; Hakulinen et al., 2013; Hanus & Fox, 2015; Turan, Avinc, Kara, & Goktas, 2016). Progress symbols can have an enormous impact on a person's behavior, with a noteworthy example being the use of badges in military organizations (Butler, 2014). It has been documented by multiple studies that badges raise motivation and have a considerable impact on engagement, action, and learning enthusiasm (Anderson, Huttenlocher, Kleinberg, & Leskovec, 2014; Gibson, Ostashewski, Flintoff, Grant, & Knight, 2015; Ruipérez-Valiente, Muñoz-Merino, & Kloos, 2016; Santos et al., 2013).

Leaderboards:

Rank evaluation presentations in the form of leaderboards are prevalent among the different digital media applications (Seaborn & Fels, 2015). They are most commonly used within the internet-based games since their determination, long-term accumulation, and skill levels characterization is applicable for more than a single session of play (Wang & Sun, 2011). Since the initial days of arcade cabinets, the leaderboards have been used among the marketable games for raising the ability for replay. Such as the Action Role Playing Games (ARPG's) like Path of Exile (2013) and Diablo III (2012) using the leaderboards that were season-based. Due to their popularity, the leaderboards are exciting for gamification. This perception has been defined as "the intentional use of game elements for a gameful experience of non-game tasks and contexts" (Seaborn & Fels, 2015, p. 17). Because of this, there has been a frequent inclusion of leaderboards in the quizzes like the usability-quiz or a quiz for learners who have hearing impairments. For this,

leaderboards are frequently included in quizzes such as a usability-quiz or a quiz for learners with hearing impairments (Glova, Asuncion, Martin, Manzan, & Pagtaconan, 2014; Hemke, Meyer, Hühne, Schneider, & Wohlgemuth, 2014).

Leaderboards are prevalent in the project management applications or within the tools during software development for stand-in user input (Halan, Rossen, Cendan & Lok, 2010; Kudos Badges, 2015). Viewing examples such as these, it comes as no surprise that leaderboards appear to be advantageous for educational institutional materials creators. Even though the research lacks the analysis of individual outcomes of the learners in their interaction with leaderboards. Even if the presence of leaderboards is there in the experiential evaluations, they are mostly available as part of a more fantastic strategy for gamification or are incorporated in combination with achievements and additional competitive mechanisms limiting the analysis immensely (Bajko, Hodson, Seaborn, Livingstone, & Fels, 2015; Landers & Landers, 2015). Experimental studies focus on gamification foundations and are often deficient in preliminary statistical analysis to produce comparable effects (Seaborn & Fels, 2015). Even when the collection of values is attained, other learning aspects are more often targeted by the researchers (Butler, 2013).

Categorization and encompassing numerous aspects, like the number of right answers, the time spent, or the goals attained, can be achieved via leaderboards. Leaderboards can also be employed to evaluate and categorize answers for the

given tasks (like Beta, Foldit). The essential data is easy to attain frequently as it is already the game's part. Therefore, the consequent list is comparatively easier to fit in the concept of education as there are no interferences with the gameplay. Nonetheless, various other facets of educational gaming are influenced by the leaderboards. The leaderboard's greater difficulty also increases the observed value of the results attained, ultimately increasing the memorability (Wang & Sun, 2011).

When the leaderboards are presented at the game's end, they naturally raise the motivation for replay and increase the time-on-task (Landers & Landers, 2015). Further, then the motivational effects, there is a more significant influence of leaderboards on the progress awareness and the educational video games' goals by the progress illustration and actions incitement (Seaborn, Pennefather, & Fels, 2013). If there is a lack in the early phases' assignation of a game or class by the students, they fall back in a leaderboard and ultimately start moving. Thus, the leaderboards offer goals or stimuli helping complete the learning tasks (Domínguez et al., 2013; Barata, Gama, Jorge, & Gonçalves, 2013). They might also be useful when the players cannot beat the complete game, and they can attempt to break their records themselves, subsequently perceiving achievement even via the learning course's initial stages (Wang & Sun, 2011). In summary, the long-term goals are offered by the leaderboards, as well as the short-term objectives.

Gamification in Nursing Education:

In the corporate industry, gamification is being employed as an

engagement method for employees to achieve the organization's objectives and incentivize the clients to use their products. Recently, in elementary education and the well-recognized universities and colleges, gamification has become a powerful instructional strategy. Health care is still in the initial phases of implementing gamification in their education model, though that might be related to the deficit in knowledge in the concept of gamification and its application in the health care setting (Brull & Finlayson, 2016).

Gamification offers nursing students a great environment where they can exercise clinical reasoning and make decisions in a representative and secure way. The use of gamification as part of nursing education increases fulfillment, creative thinking, and control, among other features, with little to no harmful properties throughout the experience, which substantially impacts decision-making (García-Viola & Garrido-Molina et al. 2019).

Work progression in health care and Nursing has been affected by the Information and Communication Technologies (ICTs), moving towards the need for the former Health professionals' preparation for their utilization in the various professional practice scenarios. Therefore, the most prevalent concern of the present is professionals' qualifications to ensure their clinical skills and background are concordant with the health care's newer standards, especially on the ICT insertion related refrains. The National Curricular Guidelines (DCNs) for the undergraduate Nursing training points out from clinical skills and capabilities perspective in relation

to communication that the nurses are in command of being proficient in these ICTs. Therefore, the different aspects like the knowledge progress, attitudes, and skills regarding the information technology use in the professional practice require composing the nursing competencies' list (Castro & Gonçalves, 2018).

The researchers have shown Re-emergence of the serious games as an innovative strategy for teaching-ma to improve student learning outcomes. "Serious games" are described as games powered by educational goals, not entertainment. Serious games' use as a component of the nursing education's learning-teaching experience fits into the active learning's strategy and philosophy. The "digital" nursing student needs engagement, stimulation, realism, and entertainment, not more readings and Powerpoint supplements in the classroom to support learning (Day-Black, Merrill, Konzelman, Williams & Hart, 2015).

Evidence of moderate-to-large magnitude effect was reported in a systematic review by Gentry et al. (2019) from five studies via evaluation of individually delivered mediations for the objectively measured knowledge compared to traditional learning. Evidence of the effect of small-to-large magnitude from ten studies was also studied to improve skills compared to conventional learning. Gamification or serious gaming happen to be no less than convincing as controls, and as observed from multiple studies, it is highly effective for improving skills, satisfaction, and knowledge. Nonetheless, the evidence available is generally of low quality, and a

requirement for thorough theory-driven research is present.

Struggling to maintain educational excellence in the online era has brought upon the redesign of various nursing practitioners' courses. Even though there have been multiple online learning approaches, case presentation can reflect the diverse cultural and social situation for challenging the learner. The case-based gamification and discussion strategies are efficient in attracting students to a challenging environment. The students positively reacted to the case-based presentation with the elements of the game. This approach has been designed for challenging and adding worthiness to the experience of learning (Mackavey & Cron, 2019).

In health care education, gamification is used in the clinical context and has shown promising improvement in the health care staff's performance in their everyday routine. The present study focuses on medication sorting task performed manually in the hospitals. The medication sorting task is extensively prone to errors and requires daily performance. However, medication errors are critical and can lead to severe complications. A real-world approach for gamification of the medication sorting task was presented in the current study, in the patient's routine pill organizer. The game player must sort the right medication in the right dispenser and is punished or rewarded in real-time. At the game's end, scores are rewarded, and the user can register in the leaderboard (Bukowski, Kühn, Zhao, Bettermann, & Jonas, 2016).

Roche, et al., (2018). implemented "Kaizen," a software-based knowledge competition, among the first-year class of undergraduate nursing students, to determine the effects of gamification on student education. Researchers found a statistically noteworthy increase in the odds of a correct response (odds ratio, 1.8; 95% confidence interval, 1.0-3.4) for around 1 question repeated in round 2, suggesting retention of knowledge. They also found statistically significant differences in final examination performance among different play styles. To maximize the benefits of gamification, researchers must use the resulting data to power educational analytics and inform nurse educators how to enhance student engagement, knowledge retention, and academic performance.

In today's life, social media offer new employed ways. People are progressively expanding interactions from face-to-face meetings to online communication, networking, searching, creating and sharing information, and taking care of patients/citizens via tweeting care, Facebook care, blogging care, and vlogging care, documentary care, gamification-care, infographic care, for instance. This chapter discusses social media utilization in the healthcare domain, including nursing education, training, and research. When in the present healthcare era, social media is used effectively and purposefully, it can give all of us a more fantastic choice in how we live, how we pay attention of our health, and how we learn and shape our professional competencies produce evidence-based, qualified data. Nurses need continuous education and proper tools to

make the most of social media's benefits, not forgetting privacy and ethical issues. This use of social media in professional nursing produces the need for new competencies (Kouri, Rissanen, Weber & Park, 2017).

Nursing administrators must provide cost-effective and efficient ways of orientation training. Traditional approaches, including classroom lectures, can be costly with low retention of the information. Gamification engages the user, provides a level of satisfaction and uses critical thinking skills. The gamification orientation group had the maximum mean scores post orientation compared with the didactic and online module groups. Findings demonstrate gamification as an effective way to teach when compared with more traditional methods. Staff enjoy this type of learning and engaged more knowledge when using gaming elements (Brull et al., 2017).

Purpose:

To assess the Impact of Design on two types of electronic Gamification (Badges / Leaderboard) on three learning domains: knowledge (Cognitive learning domain), clinical performance (psychomotor learning domain), and attitude (affective learning domain) among Nursing students in light of Covid-19.

Methods:

Phases of the research:

The current research consisted of six phases as follows:

- (Phase1) Define learning objectives,
- (Phase2) Developing teaching content,
- (Phase3) Selecting learning interface and developing learning strategies,
- (Phase4) Development of Educational plan,

(Phase5) Developing research tools and establish its validity and reliability, and (Phase6) conducting the research.

Phase 1: Defining learning objectives:

The investigators conducted a needs analysis of the target learners by assessing nursing students' learning needs, learning characteristics, and access to technology to determine the learning goals.

The educational plan's main goal was to enhance nursing students' understanding of selected topics in Medical and Surgical Nursing upon the three main learning domains cognitive, psychomotor, and affective domains.

The approved syllabus of medical surgical nursing² of the Cairo University faculty was the framework for developing learning objectives. Further objectives were established by assessing the nursing students' learning needs, conducting pretest of their knowledge, and focus group discussion on evaluating their attitude and learning needs.

Phase 2: Developing teaching content:

After identifying and developing learning objectives, the design of the course units' content, learning strategies, evaluation methods, and teaching methods were done according to the well-established objectives. The curriculum consisted of four-course units for the two groups as follows;

Medical Nursing:providing comprehensive nursing care of(a) Patients with renal disorders undergoing Hemodialysis, (b) Patients with Multiple sclerosis, (c) Cancer patients are undergoing Chemotherapy/Radiotherapy and (d) Patients with blood disorders.

Surgical Nursing:providing comprehensive nursing care of(a) Patients undergoing orthopedic surgery, (b) Patients are undergoing urinary tract surgery, (c) Intraoperative nursing, and (d) Patients with integumentary disorders and burn.

Phase 3: Select learning interface and learning strategies:

The investigators discussed the selected electronic (LMS) with the Faculty management. "Schoology" was selected to be used with the students. The interface included video, audio, images, and text.

Previously the common teaching strategy was the development of PowerPoint-based presentations that are shown in the class. In our study, the interactive online content in the current research was easily accessible from the home computer of smartphones.

Phase 4: Development of Educational plan:

The investigators adopted the ADDIE model as a theoretical framework for this study. Dick et al. (2004) emphasized that Instructional design requires using a system to analyze problems and identify learning objectives to establish a strategic plan to solve teaching problems, test solutions, evaluate the results, and revise the program. Although the literature offers several systematic instructional design models, the ADDIE model is probably the most commonly used. Gustafson and Branch (2011) observed that the systematic ADDIE model has six features:

1. Curriculum instructional design and learning activities are learner-centered.
2. Instructional design is a goal-oriented process.

3. The learner can exhibit concrete and meaningful actions and solve practical problems.

4. There are specific learning outcome indicators, and the assessment approach shows both reliability and validity.

5. The teaching content is based on the development of empirical data.

6. The curriculum instructional design requires teamwork. However, the ADDIE model has been criticized as limited and static (Allen & Sites, 2012). The ADDIE model's fivefold framework covers all of the steps of the instructional design process (Dick, Carey, & Carey, 2011; Gustafson & Branch, 2011).

In the analysis stage, the learning needs of the target learners are considered. The design stage considers how the target learners learn. In the development stage, teaching materials are constructed. The next stage involves implementing the teaching, constructing the teaching environment, and placing teaching materials in the teaching environment. The final stage is the evaluation of outcomes and performance.

Analysis:

In the analysis phase, the instructional problem is clarified, the instructional goals and objectives are established, and the learning environment and learner's existing knowledge and skills are identified.

- The audience are second-year students at the Faculty of Nursing Cairo University, Males and females, age 17-21 yrs.old.
- Behavioral outcome aimed at is better clinical performance as well as higher-grade achievements.

- Course delivery through Schoology online and periodical on-ground meeting following all health precautions for COVID19.

Design: In the design phase, learning objectives were identified, assessment instruments were selected, exercises, content, subject matter analysis, lesson planning, and media selection were made.

Development: In that phase creation of course content, time frame, and communication tools were done.

Implementation: During the students' implementation phase, preparation of the students was done by training them on new tools (use of software). Application of online Education was made.

Evaluation: Evaluation was in two forms, formative evaluation through assignments and quizzes. In addition to summative evaluation through OSCE.

Phase 5: Developing Research tools and arbitration:

The investigators recruited the following tools to measure the three main learning domains; cognitive, psychomotor, and affective domains:

- Quizzes to measure students' knowledge (revised by medical surgical nursing professors) to measure the cognitive domain.
- Approved clinical skills checklist (authorized by Faculty of Nursing, Cairo University) to measure the psychomotor domain.
- Students' reflection questionnaire (revised and approved by a panel of education experts) measures the affective attitude domain.

A panel of experts of Faculty of Nursing Academic Staff members and panel of education experts approved the previous tools.

Phase 6: conducting the research:

This phase was divided into two stages; in both stages "schoolology" interface and gamification strategy were used by using badges and leaderboard to one of the groups to examine the difference between the two groups.

Stage One month before the COVID19 shutdown, students were monitored in clinical practice at selected departments at Cairo university hospitals. The interaction was done online, badges and leaderboards were used, and emphasis was on the ground during an actual clinical practice meeting inside the hospital. This stage was four weeks.

Stage two, after suspension of on-ground study due to COVID19 pandemic, the investigators held interactive online meetings. They used problem-based scenarios that represent actual patients and follow-up of students' achievements, using "Schoolology" badges and leaderboard.

Final Evaluation: Final evaluation of the three learning domains was done by calculating students' mean scores of knowledge, skills, and attitude.

Table 1: Frequency and percentage distribution of personal characteristics among the studied patients (n = 60).

Item	No.	%	— SD ± X
Age			
17 < 20 years	48	80	18 ± 1.6
20 < 22 year	12	20	
Gender			
Male	27	45	
Female	33	55	

Results:

Table (1) illustrates that; regarding studied patients' age, 80 % of them were within the age ranged between 17 – less than 20 years with a mean of 18 ± 1.6, and 55 % of them were females.

Table 2: initial mean score and standard deviation of students' knowledge, skills, and attitude

		Number	Mean	Std. Deviation
Knowledge	Badges	30	26.0333	2.20475
	Leaderboard	30	24.8333	1.05318
Skills (clinical performance)	Badges	30	35.1000	1.39827
	Leaderboard	30	34.2333	1.61210
Attitude	Badges	30	11.3667	1.21721
	Leaderboard	30	12.0667	1.36289

Table 3: The final mean score, standard deviation, and t-test value of students' knowledge, skills, and attitude

		Number	Mean	Std. Deviation	t	sig
Knowledge	Badges	30	50.6000	7.46763	6.2	.000
	Leaderboard	30	70.4000	15.63727		
Skills (clinical performance)	Badges	30	68.3667	19.37201	8.3	.000
	Leaderboard	30	104.4333	13.81824		
Attitude	Badges	30	23.3667	3.16754	12.7	.000
	Leaderboard	30	32.7000	2.46563		

Table 4: Correlation of Gamification strategy and students' knowledge, skills, and attitude

Item	t-test	P-value
Knowledge before	0.009	Not sig
Knowledge after	0.000	Sig
Skills before	0.03	Not sig
Skills after	0.000	Sig
Attitude before	0.040	Not sig
Attitude after	0.000	sig

Significant level ≤ 0.5

Table 5: The Alfa results which show effectiveness using gamification strategies

	Eta	Eta Squared
Knowledge	.635	.403
Skills	.737	.543
Attitude	.858	.737

Table 6: represents the ANOVA test of both groups measuring knowledge, skills, and attitude

			Sum of Squares	Df	Mean Square
Knowledge after gamification use * group	Between Groups	(Combined)	5880.600	1	5880.600
	Within Groups		8708.400	58	150.145
	Total		14589.000	59	
Clinical performance (skills) after gamification use * group	Between Groups	(Combined)	19512.067	1	19512.067
	Within Groups		16420.333	58	283.109
	Total		35932.400	59	
Attitude after gamification use * group	Between Groups	(Combined)	1306.667	1	1306.667
	Within Groups		467.267	58	8.056
	Total		1773.933	59	

Table 7: Mean score and standard deviation of students' knowledge, skills, and attitude after gamification strategy: badges and leaderboard.

group		Knowledge after gamification use	Clinical performance (skills) after gamification use	Attitude after gamification use
badges	Mean	50.6000	68.3667	23.3667
	N	30	30	30
	Std. Deviation	7.46763	19.37201	3.16754
leaderboard	Mean	70.4000	104.4333	32.7000
	N	30	30	30
	Std. Deviation	15.63727	13.81824	2.46563
Total	Mean	60.5000	86.4000	28.0333
	N	60	60	60
	Std. Deviation	15.72486	24.67841	5.48331

Discussion:

The current study found that using gamification strategies has improved nursing students' performance upon the three learning domains: Knowledge, attitude, and practice. These results match the results of the study by Caton & Greenhill (2014), who examined the use of gamification approach for increasing attendance and engagement among undergraduates; they recruited 62 students as a control group, in which they were taught the course by the same teacher who used the same assignment, and assessment methods and a trial group of 74 students, without using the gamification framework in the following year. The gamification framework used rewards and penalties to recognize and motivate detached students promptly. The penalty system utilized yellow cards as a warning to students not participating in group-project activities and used red cards that deducted 25 points of their project grades were used for recurrent violations. Rewards for classes such as top programming, a game of the year, and most pleasing design were presented at the finish of the semester. Comparing the grades between the groups presented that the trial group had a higher student performance ratio. The educator also noticed that the trial group exhibited more interest in the class and shaped superior final projects compared to the control group.

The current study's constraints were mainly the social and psychological pressure due to the COVID-19 pandemic and suspension of regular on-ground classes in the university. Holmes and Gee (2016) reviewed potential constraints to

implementing gamification in a higher educational setting and presented a framework to address the concerns with gamification by providing a heuristic tool to categorize the use of games into frames. The framework was developed by analyzing literature on game-based teaching and learning (GBTL), and different applications of games in higher education were identified. The frames were classified based on the application method and the type of tools used to integrate games into the classroom. The applications can be broadly categorized into four frames: action, structuring, bridging, and design. The frames can be used to analyze and develop GBTL solutions. The importance of implementing games contextually to demonstrate gamification as an honest and practical approach to teaching and learning was also outlined.

The current study results found a great impact of gamification strategies using badges and leaderboards among university students in the selected (LMS) environment. These results are congruent with Chang and Wei's (2016) study on the use of awards and penalties throughout the semester was effective in motivating disengaged students. It was observed that serious games could be effectively evaluated through knowledge tests, self-reporting, and in-game performance. An iterative design process using continuous feedback of target participants and frequent testing can be used to design serious games for knowledge transfer. It is essential to consider the context of the application when using educational games.

Conclusion:

Education has been significantly affected by the COVID19 pandemic and the worldwide pressure to move toward online-based education. Educators face a significant challenge to motivate their students and meet their needs to achieve educational goals. The current research emphasizes the use of gamification, badges, and leaderboard as educational tools to help motivate students and increase their clinical performance. Investigators encourage the use of gamified learning in higher education. Successful implementation of gamification encourages the conduction of further research on applying gamification on a wide scale. The study identified gamification benefits, such as improving student engagement, motivation, skills, self-confidence, attitude, and overall academic performance. Improved student attitudes, knowledge, and performance were the most significant advantage of using gamification. Those results emphasize the application of gamification in higher education using badges and leaderboard as essential game elements that are appropriate for use in higher education.

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