

## Utilisation of gamification in higher education: a quick reference

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**ABSTRACT:** The educational landscape has undergone a prominent transformation in recent years, driven by technology and evolving pedagogical methods. Gamifying educational content, especially in engineering and computing, has become a common practice to enhance student engagement, motivation and academic performance. The impact of gamification has been thoroughly investigated in the literature. This article aims to highlight recent studies, provide insights on the subject matter and report their findings. This review serves as a quick reference point to the latest research conducted in this field as it explores gamification. Via this research, the authors hope to equip educators and decision-makers with the knowledge to navigate learning challenges and motivation issues to reshape how educators can inspire and empower university students.

**Keywords:** Gamification, distance learning, on-line education, educational technology

### INTRODUCTION

The transition from passive to interactive learning has been enormously aided by technology, offering a range of tools. One such tool is gamification, which has been viewed as a promising instrument for increasing student interaction and knowledge retention. Due to the Covid-19 pandemic and the resultant lockdowns, gamification has been utilised further to engage student participation in e-learning [1].

The urgency to understand and harness the potential of gamification has never been more significant as educators worldwide seek effective strategies to engage and motivate students. Several studies have examined the worthiness of gamification reporting various degrees of success. The aim of this article is to bring clarity to the matter and provide insights on impact of gamification. In this article, the authors provide an organised and accessible compilation of recent studies and their findings. Thus, they hope this work will equip educators and educational stakeholders with the knowledge needed to make informed decisions about executing gamification approaches.

The article is structured as follows: the next section presents the research methodology. After that a summary of recent literature, experiments and their findings is provided. The last section concludes the article and offers a perspective on the future of gamification in education.

### METHODOLOGY

This section describes the research methodology. In this research endeavour, the authors' primary goal was to conduct a comprehensive review of multiple papers to serve as a quick, accessible reference for the latest developments in the application of gamification within higher education. To achieve this, the authors employed a systematic approach to gather and incorporate relevant information from each selected research paper. In the review, they aimed to present a detailed summary highlighting the following elements:

- Participants: what were the demographic distribution and courses used in the experiment?
- Utilised tool: which gamification platform was used?
- Research questions, hypotheses or objectives: what did the researchers aim to achieve or examine in each study?
- Evaluation metrics: what were the metrics and tests used to report the findings?

- Findings: what did the researchers report and conclude upon completing their experiments?

Subsequently, as described in the next section, the authors compiled the gathered data and organised that in a structured manner, facilitating the presentation of the findings.

This systematic organisation provides educators, researchers and decision-makers with a comprehensive reference that offers valuable insights into the application and impact of gamification in higher education, and quick access to relevant information according to their interests and requirements.

## AGGREGATED FINDINGS

During the research, the authors meticulously surveyed recent papers that ventured into gamification, summarising their outcomes per the methodology articulated earlier. These findings have been thoughtfully organised into three distinct tables, categorised by the mode of instruction:

- Table 1, dedicated to traditional face-to-face environments, details experiments conducted in physical classrooms.
- Table 2 provides a nuanced overview of hybrid classes, where parts of the course are delivered on-line.
- Table 3 delves into research papers exploring the impact of gamification within on-line courses.

The collective insights gathered from these three tables paint a comprehensive picture of the potential and efficacy of gamification in education.

The findings generally reveal a notable trend - the beneficial impact of gamification on student engagement and academic performance, albeit to varying degrees across different instructional modes. Notably, some students expressed a preference for experiencing gamification in traditional *brick-and-mortar* classrooms compared to on-line learning environments [2][3].

Furthermore, one study reported that students appeared to derive more pronounced benefits from gamification when engaging in face-to-face classes [3]. Nevertheless, it is worth highlighting that, regardless of the instructional mode, students consistently exhibited enthusiasm for gamified activities and expressed support for their integration into the broader curriculum.

A significant proportion of the papers under review primarily relied on students' performance data and feedback to gauge the effectiveness of gamification strategies. However, an intriguing aspect emerged during this research: faculty members, when interviewed, expressed a keen interest in adopting gamification in their courses, provided they received the requisite training and support. This indicates a latent potential for the broader adoption of gamification among educators.

Table 1: Assessing gamification impact in conventional (face-to-face) classrooms.

Authors	Sample details	Gamification tool	Objective/hypothesis/research question	Assessment metric	Findings/results
(Ibanez et al, 2014) [4]	22 participants (5 female and 17 male) undertaking an operating systems course	Q-learning platform	The researchers hypothesised that their gamified platform:  H1. Will encourage students to work beyond the course's requirements. H2. Will enable students to adapt their learning strategy once they achieve the course's learning requirements. H3. Will allow students to gain knowledge of programming.	Shapiro-Wilk test  Nonparametric Wilcoxon signed-rank test	Q-learning kept students interested in the learning activity and they continued to work even after achieving the learning goal.
(Barrio et al, 2016) [5]	131 participants (54 female and 77 male) from different universities enrolled in different courses	Integrated interactive gamification classroom (IGC) tool and student response systems (SRS)	The researchers evaluated four hypotheses related to whether the use of a gamified student response system would result in:  H1. Higher motivation. H2. Higher attention. H3. Higher engagement. H4. Higher learning performance.	MANOVA test  Nonparametric Kruskal-Wallis test  Nonparametric Tukey's HSD	H1 confirmed. H2 confirmed. H3 not confirmed. H4 confirmed.

(Fotaris et al, 2016) [6]	106 participants (19 female and 87 male) undertaking a fundamentals of software development course	Kahoot! Who Wants to be a Millionaire? Codecademy's on-line interactive platform	The study aimed to assess the role of gamification by answering the following research questions: RQ1. Did these three gamification tools make students more engaged in learning programming? RQ2. Did these three gamification tools allow students to acquire a more profound understanding of programming?	Average Variance SD Median	The results showed that multi-dimensional gamified learning has successfully achieved a positive impact on students' engagement and programming understanding in a Python programming course.
(Licorish et al, 2018) [7]	14 participants (4 female and 10 male) undertaking an information systems strategy and governance course	Kahoot!	The researchers wanted to investigate four questions related to Kahoot!'s influence. More specifically, they wanted to know: RQ1. Does it impact classroom dynamics? RQ2. Does it affect students' engagement? RQ3. Does it motivate students' learning? RQ4. Does it enrich students' learning experiences?	Qualitative approach	The results confirmed that Kahoot! has a positive impact on classroom dynamics, students' engagement, motivation and learning experiences.
(Shehata et al, 2019) [8]	44 participants (20 female and 24 male) undertaking an introductory financial accounting course	Nearpod	The researchers asked the two questions below to determine the role of Nearpod: RQ1. Did Nearpod improve students' learning experience? RQ2. How did that learning experience compare to the one gained from paper-based quizzes?	Wilcoxon signed-rank test SD Mean	Results suggested that Nearpod's use positively impacted students' interest and learning. Also, students reported that Nearpod quizzes are more pleasing and less stressful. The participants also appreciated the instant feedback.
(Iwamoto et al, 2017) [9]	49 undergraduate students (33 female, 16 male) undertaking a psychology course	Kahoot!	The researchers asked students four questions to assess the role and extent to which Kahoot! helped them in their examinations' preparation	Mean (interval and ratio level data)	Test scores did improve significantly with Kahoot! ( $p = 0.008$ ). The students invariably voiced the importance of active reviewing, visual learning and applying teaching material to real-life experiences.
(Chaiyo and Nokham, 2017) [10]	121 students	Kahoot!, Quizizz and Google Forms	The study aimed to assess the role of Kahoot!, Google Forms, and Quizizz via the research questions below: RQ1. What is the impact of gamification on students' concentration? RQ2. What is the impact of gamification on students' engagement? RQ3. What is the impact of	Nonparametric Kruskal-Wallis test	Compared with Google Forms, Kahoot! and Quizizz provide several benefits in the classroom. Students believe Kahoot! and Quizizz supported their learning and increasing their concentration,

			gamification on students' enjoyment? RQ4. What is the impact of gamification on students' perceived learning? RQ5. What is the impact of gamification on students' motivation? RQ6. What is the impact of gamification on students' satisfaction?		engagement, enjoyment and motivation.
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Table 2: Assessing gamification impact in hybrid classes.

Authors	Sample details	Gamification tool	Objective/hypothesis /research question	Assessment metric	Findings/results
(Hakami, 2020) [11]	74 participants (all female)	Nearpod	RQ1. Does Nearpod's use encourage female students' interaction in a bring-your-own-device learning environment?	Cronbach's alpha coefficient SD Mean	The study's results showed that using Nearpod in that classroom environment has stimulated active learning. Additionally, students were pleased with Nearpod in all courses, especially those delivered via the video-conference learning system.
(Machajewski, 2017) [12]	501 students undertaking an introduction to computing course	Kahoot!, Google Traveler, MyGame, Game Bolt-on, and others	Gamification techniques support short- and long-term student engagement.	Rubrics used to assess students work Qualitative and quantitative feedback shared with faculty	Engaging students during lectures through technology and gamification can be a short-term method of engagement. However, long-term methods of experience points (XP) tracking and trading facilitate player journeys and enhance the player experience.

Table 3: Assessing gamification impact in on-line classes.

Authors	Sample details	Gamification tool	Objective/hypothesis/research question	Assessment metric	Findings/results
(Strmečki et al, 2015) [13]	55 participants (24 female and 31 male) undertaking a computer graphics course	Implementing game elements in the Moodle platform	Hypothesis: On average, the post-test achievement for the group that utilised gamification will be more significant than that achieved by the control group that did not.	Independent <i>t</i> -test SD	The study results align with the hypothesis as they showed a notable difference in favour of the group that utilised gamification.
(Sailer and Homner, 2019) [14]	419 participants (204 female and 215 male)	Implementing order-picking game environment	When compared to the control environment:  H1. Gaming environment offers a higher level of competence. H2. Gaming environment offers a higher level of decision freedom. H3. Gaming environment presents participants with a higher level of task meaningfulness. H4. Gaming environment offers participants a higher level of social fulfilment.	Scheffe post-hoc test SD Mean	H1 confirmed. H2 not confirmed. H3 not confirmed. H4 confirmed.

(Quadir et al, 2018) [15]	26 students undertaking an e-learning theory and practice course	Kahoot!	Several statements related to Kahoot!, its usability and role as an IRS including:  Students are satisfied with using Kahoot! as a learning/ instructing assisted tool. Students found Kahoot! fun.	Regression analysis	Students were mostly satisfied with the instant feedback and usability aspects compared to engagement.
(Lobet et al, 2020) [16]	346 first-year Bachelor students undertaking a biology course	QuoVidi (treasure hunt and photo quiz)	A gamified learning activity motivates students and allows them to learn over time rather than memorising a list of words.	Arithmetic mean  Qualitative approach	Students achieved 87% accuracy in the treasure hunt and 62.3% in the quiz. However, 91% of the survey respondents liked the activity and believe they learned from it.
(Lelli et al, 2020) [2]	Two computer science courses (fundamentals of programming and software engineering)	ClassCraft	Due to the pandemic, gamification was applied in emergency remote teaching to engage and motivate students on-line.	Arithmetic mean  Qualitative approach	Gamification was an effective way to engage students during the pandemic.

## CONCLUSIONS

The educational sector's technological advancements propelled gamification into the forefront as educators utilised its potential to engage, motivate and empower students in *brick-and-mortar* and on-line classrooms. This article reviewed the effectiveness of gamification in higher education.

In general, researchers have reported a positive impact of gamification in improving one aspect or another of the educational process. Thus, implementing gamification in various courses may ultimately enhance the quality of graduates and better prepare them for the job market.

While gamification's impact was more tangible in traditional classes, distance learning students were also willing to take part in a gamified activity. Thus, it is recommended to embed it within a variety of higher education courses. Indeed, gamification has demonstrated its worthiness in enhancing student interaction, knowledge retention and active participation.

The studies reviewed have uncovered a spectrum of success stories, showcasing the versatility of gamification across various educational settings. From the virtual classrooms of engineering and computing to the broader range of subjects and disciplines, gamification has proven to be a valuable ally in the pursuit of effective learning.

Finally, gamification increases student engagement. However, applying a variety of gamified tools in different formats may have a better effect in maintaining student engagement and interest.

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## BIOGRAPHIES



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