

## *Exploring the Landscape of Gamification in Higher Education: A Systematic Mapping Study*

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### **Abstract**

The concept of gamification is attracting significant attention and implementation in several industries. However, its use in higher education is still in its early phases. The use of game design aspects in non-game situations, sometimes called gamification, has emerged as a prominent trend in boosting learning experiences. This systematic mapping study investigates the utilisation of gamification in non-game contexts, specifically within higher education. By analysing peer-reviewed articles published between 2018 and 2022, the study explores various aspects, including the application of gamification, the variables under investigation, the game design elements employed, and the platforms utilised for implementation. This study focuses on the examination of the academic implications of incorporating game design components. It aims to identify and analyse this field's current patterns and future directions. The findings indicate that gamification is widely seen within Computer Science/Information Technology and Business domains. Majorly analysed variables include motivation, academic performance, and engagement. The research also highlights the increased use of gamification in online courses throughout the pandemic, emphasising its potential to enhance remote education experiences. Notably, platforms like Kahoot! have regularly shown favourable results in this area. This study comprehensively examines the current state and possibilities of gamification in higher education environments.

Keywords: Gamification, Higher Education, Systematic Mapping

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## **Introduction**

In the past decade, the concept of gamification has emerged as a compelling approach across numerous domains (Hamari, Koivisto, & Sarsa, 2014). In the realm of education, gamification has become recognized as a technique that is used by institutions and educators to enhance learners' engagement, and motivation, and promote learning outcomes (Manzano-León et al., 2021). The increasing interest in using gamified approaches in education highlights its potential to revolutionize traditional pedagogical methods. This paper aims to explore the implementation of gamification within the dynamic landscape of higher education by embarking on an exploration of the existing body of research on the usage of gamification.

## **Definition of Gamification**

Gamification has evolved as a potent approach in a variety of situations to affect human behaviour throughout the past decade. However, it is still a relatively contemporary idea (Hosseini, Humlung, Fagerstrøm, & Haddara, 2022). Initially appearing in the digital media industry in 2008, gamification has been rapidly incorporated into marketing, management, health and wellness, ecology initiatives, and education (Deterding, Dixon, Khaled, & Nacke, 2011). Even before 2008, the concept of gamification had existed for significantly longer than it was noticed. Moreover, it had been used in several instances as Kim et al. (2018) concluded: as an early attempt to increase client loyalty in a company, the Sperry & Hutchinson (S&H) stamp was a good example in business. In 1981, American Airlines (AA) implemented gamification into its operations to attract new clients and retain existing ones. Holiday Inn launched a comparable loyalty programme across the States after AA in 1983. Kim et al. (2018) also listed examples for educational purposes, such as The Oregon Trail and Lemonade Stand were created in the 1970s, Master Type, Rocky's Boots, SimCity, and so on in the 1980s.

In 1996, Richard Bartle (1996) developed a taxonomy based on investigating people who play multi-user dungeons (MUDs) and observing their social patterns. Bartle categorized participants into four groups based on their inclinations for acting or interacting and their interest in these games: socializers, explorers, achievers, and killers.

In 2002, game designer Nick Pelling was responsible for creating a game-like interface for ATMs and vending machines. He invented the Term "gamification" and labelled it as a "deliberately nasty word" since it was used to describe "using game-like accelerated user interface design to make electronic transactions both enjoyable and fast" (Burke, 2014). Since then, the term has taken on a broader meaning and is used primarily to motivate and engage people in a particular environment (Perryer, Celestine, Scott-Ladd, & Leighton, 2016).

In 2009, a gamified map application Foursquare was launched. The appearance of Foursquare was ground-breaking. It allowed players to collect badges by checking in one area, exploring new areas, or being a mayor of multiple places (Burke, 2014).

Although the term was invented much earlier than being widely accepted, it has been defined from many perspectives by researchers and academics throughout the years. According to Zichermann and Cunningham (2011), gamification is "the process of game-thinking and game mechanics to engage users and solve problems." While Kappa (2012) focused more on the design perspective and described gamification as "using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning and solve

problems." However, the multiple definitions of gamification all centre on the same principle, defined by Deterding et al. (2011) as the use of game design elements in non-game contexts. More specifically, gamification refers to the following:

- the use (rather than the extension) of
- design (rather than game-based technology or other game related practices)
- elements (rather than full-fledged games)
- characteristic for games (rather than play or playfulness)
- in non-game contexts (regardless of specific usage intentions, contexts, or media of implementation).

Deterding et al. (2011) categorized game design elements into different levels of abstraction. Five levels from concrete: 1) Interface design patterns, 2) game design patterns or game mechanics, design principles, heuristics or 'lenses', 3) conceptual models of game design units, 4) game design methods, and 5) design processes.

### **Game Design Elements**

As previously mentioned, Deterding et al. (2011) divided game design elements into five categories, but not everyone agreed. Dicheva et al. (2015) took the game design element "badges" as an example, stating that it has been used as a game interface design pattern in Deterding's categorization, a game mechanic (Zichermann & Cunningham, 2011), and a game component (Werbach & Hunter, 2012), and a game dynamic (Iosup & Epema, 2014), and a motivational affordance (Hamari, Koivisto, & Sarsa, 2014). Dicheva et al. (2015) classified "badges" into gamification design principles instead of simply using game design principles to distinguish gamification and game.

In general, game design elements are defined into multiple levels of abstraction. There are several widely accepted game design element classifications. Zichermann and Cunningham (2011) categorized game design elements into mechanics, dynamics, and aesthetics (MDA). Werbach & Hunter (2012) classified them into Dynamics, Mechanics, and Components (DMC), which correspond to the first two components of Zichermann and Cunningham's framework and gamification design principles by Dicheva et al. (2015).

### **Gamification in Education**

Gamification aids learning (Kim, Song, Lockee, & Burton, 2018). In education, gamification has increased prompting further research on this topic (Furdu, Tomozei, & Kose, 2017). Kim et al. (2018) defined gamification as "A set of activities and processes", "To solve problems related to learning in education", and "By using or applying the game mechanics". Gamification is becoming more popular in academia (Alhammad & Moreno, 2018).

Borges et al. (2014) conducted a systematic mapping in education to generate an overview and identified computer-supported collaborative learning initiatives that employ gamification. The authors found that higher education uses gamification the most. They also summarised primary studies by research objective and identified that most of the studies were aimed at students. They also categorised other objectives, including improving learning, mastering skills, behavioural change, socialization, and challenging. In the end, they discovered that there is a dearth of methods that integrate gamification with computer-supported collaborative learning.

Caponetto et al. (2014) examined 119 papers published from 2011 to 2014. Over half of these papers were in primary school and higher education. A cloud-generated diagram showed motivation and engagement were the most frequently used words from the paper abstracts. The authors also noted considerable ambiguity surrounding the terms gamification and game-based learning. Most papers consistently use the term gamification as the “use of game mechanics in non-gaming contexts” (Deterding et al., 2011). Lastly, gamification has been used in a wide range of subjects such as science, maths, foreign languages, health and software engineering, and transversal attitudes and behaviours such as peer collaboration, creativity, and self-guided learning.

Dicheva et al. (2015) mapped educational contexts where gamification and game elements have been used. First, visual status, social engagement, freedom of choice, freedom to fail, and rapid feedback are the most common educational gamification design elements. Points, badges, and leaderboards are the most popular game mechanisms. Further, computer science and information technology is the most dominant area/subject that uses gamification. Among four other categories, including courses without online gamification support, MOOCS or online courses, E-learning sites, and gamification support platforms, blended learning courses are the most used for higher education. Dicheva et al. (2015) divided gamification into four categories: 1) manual implementation on student performance, implementation as a plug-in or extension for a learning management system or online learning environment, 3) third-party software, or 4) standalone application. They reported that a plug-in or extension is mostly used.

In the most recent year, several review papers from different aspects were published. Hamari et al. (2018) examined 128 studies to identify how it was implemented, the expected outcomes, and the results. Social-oriented, immersion-oriented affordances are seldom applied in education. The most common psychological outcomes are the user experiences and perceptions of the system and features, while the most common behavioural outcomes are grades, participation in a system, and speed of conducting tasks and assignments. Finally, they advised adopting gamification with greater social and immersion-oriented affordances in an educational context.

Manzano-León et al. (2021) revealed that university education increased across education levels in 14 quantitative experimental research. Academic achievement, engagement, and motivation was highly investigated. They also found that most studies report positive results of using gamification. Saleem et al.(2022) focused on online education, addressing the purposes of using gamification, challenges for both students and teachers and elements that enhance students’ motivation and engagement. Gamification in online education aims to increase specific skills, discover goals that promote learning, engage students, maximise learning, and encourage attitude change. Gamification can be useful for teachers acquiring knowledge and enhancing vital skills such as decision-making, cooperation, and communication, and an additional technique to make the learning process entertaining, interactive, and useful. Additionally, Saleem et al. indicated challenges such as technology infrastructure, Internet service, and the willingness to use this tool.

Most gamification research examined how gamification positively influenced academic promotion (Fuster-Guillo et al., 2019; Ng & Lo, 2022; Sailer & Sailer, 2021; van Roy, Deterding, & Zaman, 2019), motivation and engagement (Ghawail & Yahia, 2022; Ortega-Arranz et al., 2019; Rincon-Flores & Santos-Guevara, 2021; Song, Shi, Wang, & Xu, 2018). Since digital technology has become more affordable and prevalent, it is easier to employ

gamification (Zainuddin, Chu, Shujahat, & Perera, 2020). Few scholars focused on technology adoption or combined technology acceptance to examine students' motivation. Ab Rahman et al. (2018) identified the correlations between gamification technology, students' attitudes toward using gamification, and students' engagement based on a modified TAM in IT subjects. Chen and Zhao (2022) integrated the self-determination theory and TAM to identify the impact of motivation on gamification technology acceptance in foreign language education.

## **Design of the Systematic Mapping**

A systematic mapping design is employed in this study. A systematic mapping study is comparable to a systematic review, with the exception that it categorises the sort of research reports and results that have been published and frequently provides a visual summary of its findings, the map (Petersen, Feldt, Mujtaba, & Mattsson, 2008). The essential process steps of carrying out a systematic mapping study (Petersen, Feldt, Mujtaba, & Mattsson, 2008), including a definition of research questions, conducting a search, screening of papers, keywording of an abstract, and data extraction and mapping are followed.

## **Research Questions**

This study attempts to provide an overview of existing research on gamification in higher education. The main objective is specified by five research questions:

- RQ1: What subject areas are gamification implemented in higher education?
- RQ2: Which variables have received the most attention in the realm of higher education gamification studies?
- RQ3: What game design elements have been applied in the higher educational context?
- RQ4: What platforms/tools are used to implement gamification in higher education?
- RQ5: What are the results reported in the studies?

## **Searching Criterion**

The search in this study was limited to 1) experimental studies that discuss explicitly the use of game elements in higher education. Theoretical or reflective papers were excluded; 2) published in peer-reviewed journals, and full articles are accessible; 3) Published in English between 2018 to 2022; 4) Studies that focus on game-based learning, serious games, simulation, virtual reality, smart learning, or distance learning without game elements were excluded. Non-accessible articles, books or book chapters, review articles, conceptual papers. Editorials and conference proceedings were excluded.

Two major electronic databases Web of Science and Science of Direct were used to search a combination of the following keywords: Gamification AND ("higher education" OR university OR "tertiary education" OR college). Initially, 1231 primary papers from Web of Science, and 698 from Science of Direct were retrieved. Only 7 duplicates were removed after exporting all searched records to the RefWorks platform. Based on the abstracts, all publications that did not meet the inclusion criteria were removed. A second round of filtering was based on full text, although some studies were conducted in higher education, the publications are not explicitly related to students' learning, such as career development, awareness of sustainability, and library searching skills., etc were excluded. A total of 54 full-text articles that met the criteria were thoroughly examined.

## Findings

### RQ1 Subject Areas

RQ1 addresses the subject domain where gamification is applied in higher education. As Figure 1. illustrates, most studies among 54 selected articles applied gamification in Computer Science/Information Technology (CS/IT) and Business/Marketing/Management in higher education. Followed by Education, Medical/Health/Nurse, and Language learning. The rest 6 articles applied gamification in multiple disciplines, instead of focusing on any specific subject.

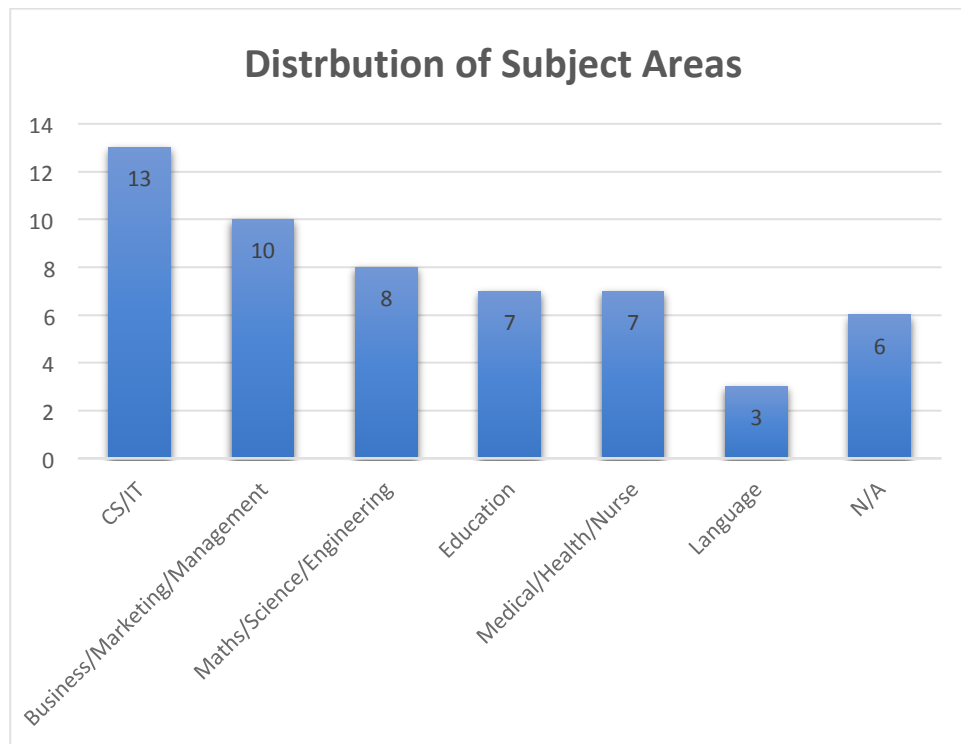


Figure 1: Distribution of Subject Areas

### RQ2 Analysed Variables

RQ2 aims to identify the variables that have been frequently analysed in higher education. Motivation, academic performance/grades, engagement, class attendance/participation, and learning outcomes are five variables that have attracted the most attention among the selected studies. Figure 2. shows the distribution of studies by the analysed variables. Apart from these top 5 variables, satisfaction, attitude toward learning, and technology acceptance also have been analysed in these studies.

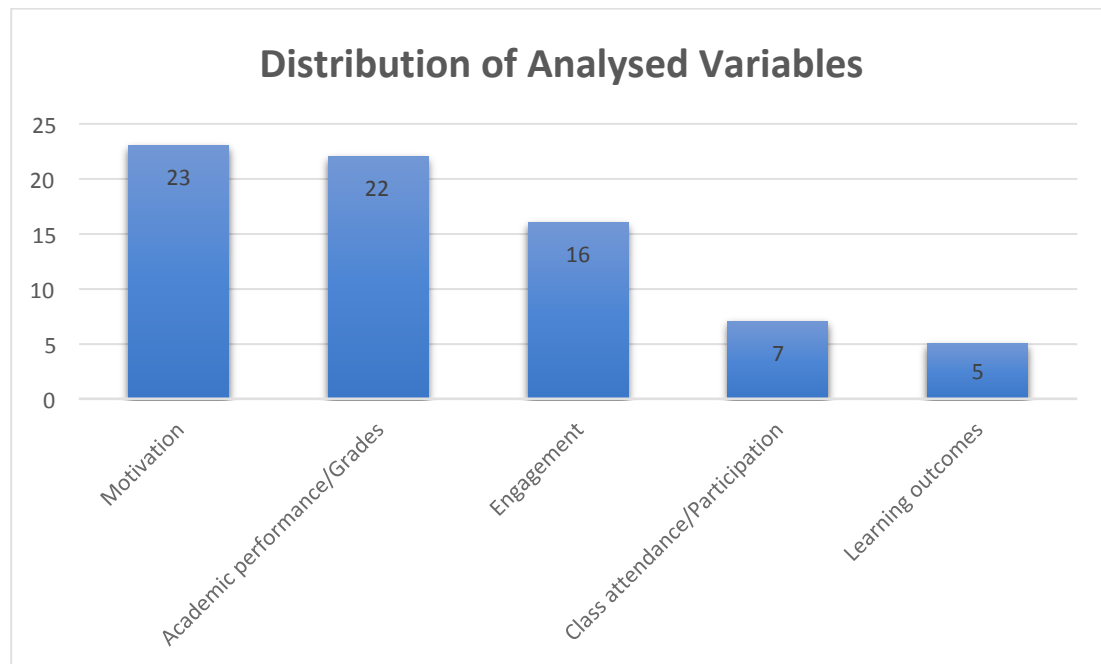


Figure 2: Distribution of Analysed Variables

### RQ3 Game Design Elements

Although game design elements were distinguished by Deterding et al. (2011) into interface design patterns, game design patterns or game mechanics, design principles, heuristics or 'lenses', conceptual models of game design units, game design methods, and design processes, game design elements are not grouped in a way that everyone agrees on. Dicheva et al. (2015) took the game design element "badges" as an example and indicated that it has been used as a game interface design pattern in Deterding's categorization, a game mechanic (Zichermann & Cunningham, 2011), and a game component in (Werbach & Hunter, 2012), and a game dynamic in (Iosup & Epema, 2014), a motivational affordance in (Hamari, Koivisto, & Sarsa, 2014). Dicheva et al. (2015) classified "badges" into gamification design principles instead of simply using game design principles to distinguish gamification and games.

In general, game design elements are defined and categorized into several levels of abstraction. There are several widely accepted game design element classifications. For example, they are categorized into mechanics, dynamics, and aesthetics (MDA) by Zichermann and Cunningham (2011), classified into DMC (Dynamics, Mechanics, and Components) by Werbach & Hunter (2012), and grouped into game mechanics which correspond to the first two components of Zichermann and Cunningham's framework, and gamification design principles by Dicheva et al. (2015). In this research, Werbach & Hunter's DMC framework is selected to identify game design elements in the higher education context. All design elements covered by the DMC framework are recorded in this research. Fig 3. shows the distribution by dynamics, mechanics, and components. As a result, challenges, competition, and feedback are the top three mechanics that have been applied in higher education, and points, leaderboards, badges are the most popular components used in various subjects.

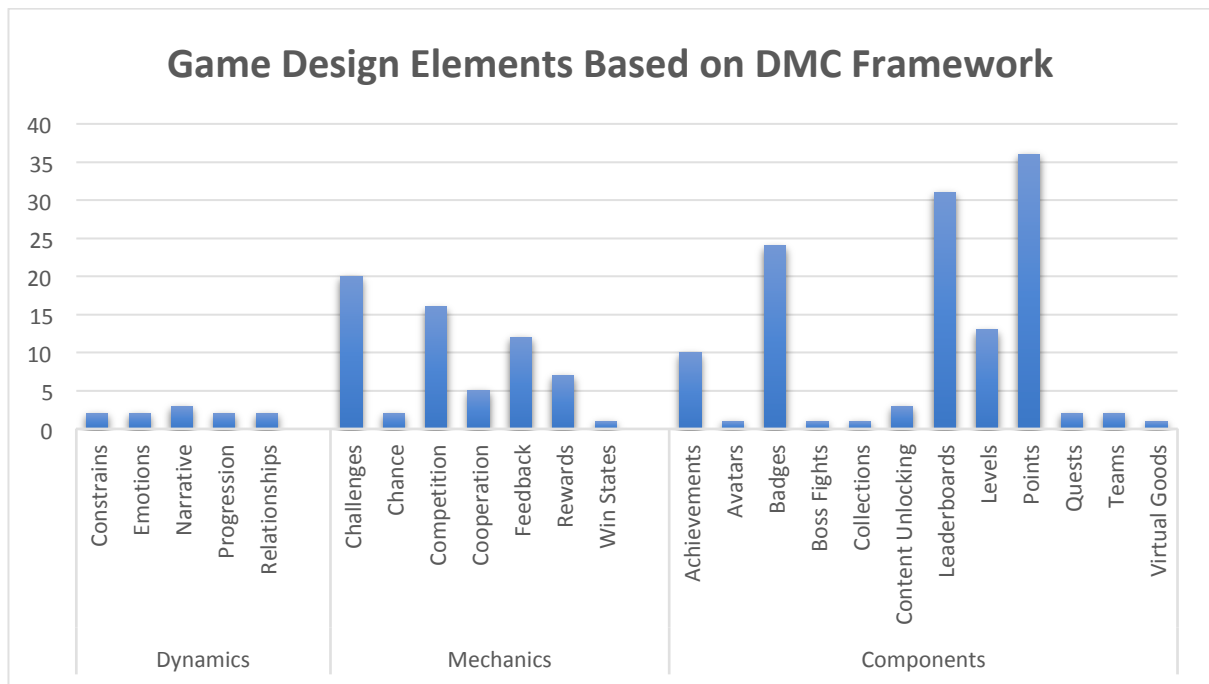


Figure 3: Game Design Elements

#### RQ4 Type of Implementation

This research question seeks to identify the platforms or tools created or utilised to employ gamification in higher education. The study of the selected papers resulted in four categories: An existing third-party gamification support platform including software, mobile application, and website application was used. In this category, 28 papers utilised an existing gamification platform. The most prevalent platform report in this study is Kahoot! 14 papers among them used Kahoot! which was employed either as an only gamification platform or integrated with other gamification platforms. For example, Leon & Pena used Mentimeter, Socrative, and Kahoot! to design and present subject content, assessment, and learning complexity in a dynamic, entertaining, and active way (2022). Apart from Kahoot!, other existing gamification platforms were reported. Examples include Classcraft (Ferriz-Valero, Osterlie, Martinez, & Garcia-Jaen, 2020), Horses for Courses (Legaki, Xi, Hamari, Karpouzis, & Assimakopoulos, 2020), Ace Your Self-Study (Baars, Khare, & Ridderstap, 2022), BioVL (Caño de las Heras et al., 2021), Khan Academy and Codecademy (van Roy, Deterding, & Zaman, 2019), Heureka (Sobrino-Duque et al., 2022), Q-Learning-G (Ibanez, Di-Serio, & Delgado-Kloos, 2014), QueryCompetition (Morales-Trujillo & Garcia-Mireles, 2021), G-SIDRA (Lopez-Jimenez et al., 2022), Rain Class and FIF Speaking (Chen, Zhang, & Yin, 2022).

A new gamification platform was developed. This comprises research that created a brand-new independent platform, either a mobile application or an online application that incorporates game design principles and gamification elements. BeHere (Pinter, Cisar, Balogh, & Manojlovic, 2020), ePS (Ngan, Tang, Chan, Chen, & Tang, 2018), and 2TSW (Polito & Temperini, 2021).

A gamification plug-in/extension to an existing online education system or a non-gamified platform was used in the university. For example, X points (Jusas, Barisas, & Janciukas, 2022) and Level UP (Bai, Hew, Gonda, Huang, & Liang, 2022) were plugged into the online learning system. Badgr tool was implemented on Massive Open Online Courses (MOOC)



(Ortega-Arranz et al., 2019), and the Question Board Platform was plugged into an online learning portal (Bouchrika, Harrati, Wanick, & Wills, 2021). Moodle is the most widely used online learning education system and gamification applications were added to it (Ahmed & Asiksoy, 2021; Bovermann, Weidlich, & Bastiaens, 2018; Garcia-Iruela & Hijo-Neira, 2020; Garcia-Iruela, Fonseca, Hijo-Neira, & Chambel, 2020; Ng & Lo, 2022; Tsay, Kofinas, & Luo, 2018).

No special gamification platform was used. This category includes research that employs gamification without using a gamification platform or extending a non-gamified tool. For example, a picture, stamp, or other evidence was sent through the What's App Group Chat when participation or assistance in institutional events and teamwork challenges were confirmed (Diaz-Ramirez, 2020).

Figure. 4 illustrates the distribution of the studies by the type of implementation. More than half of the papers use existing gamification platforms in higher education, and plug-in or extension to existing online education/non-gamified platforms is also commonly utilised.

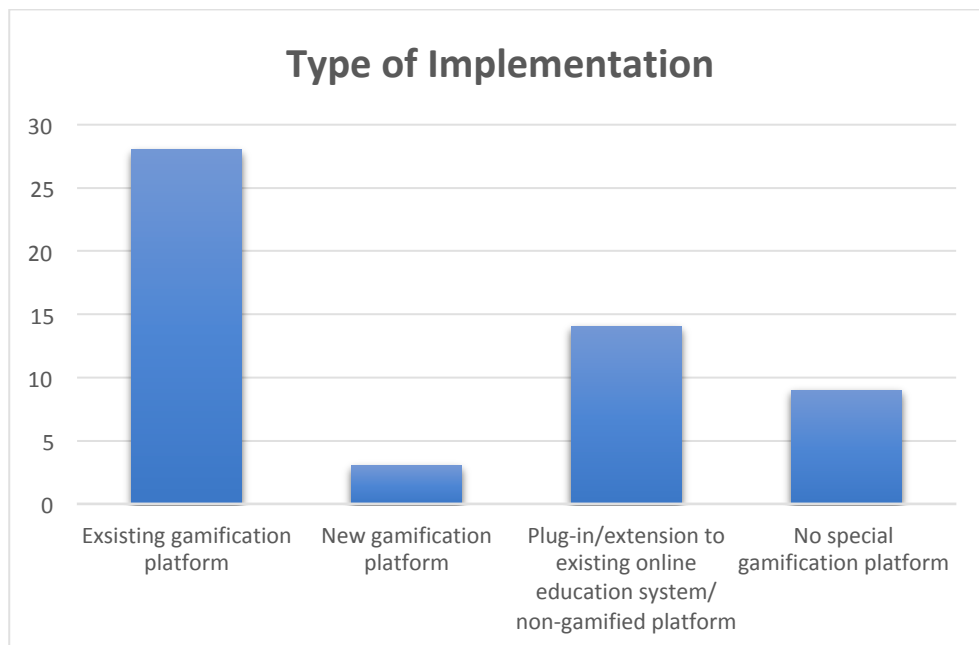


Figure 4: Type of Implementation

## RQ5 Reported Results

Figure. 5 displays the distribution of the selected papers based on the type of reported results, which are classified into four categories: positive, negative, no significant difference, and mixed results.

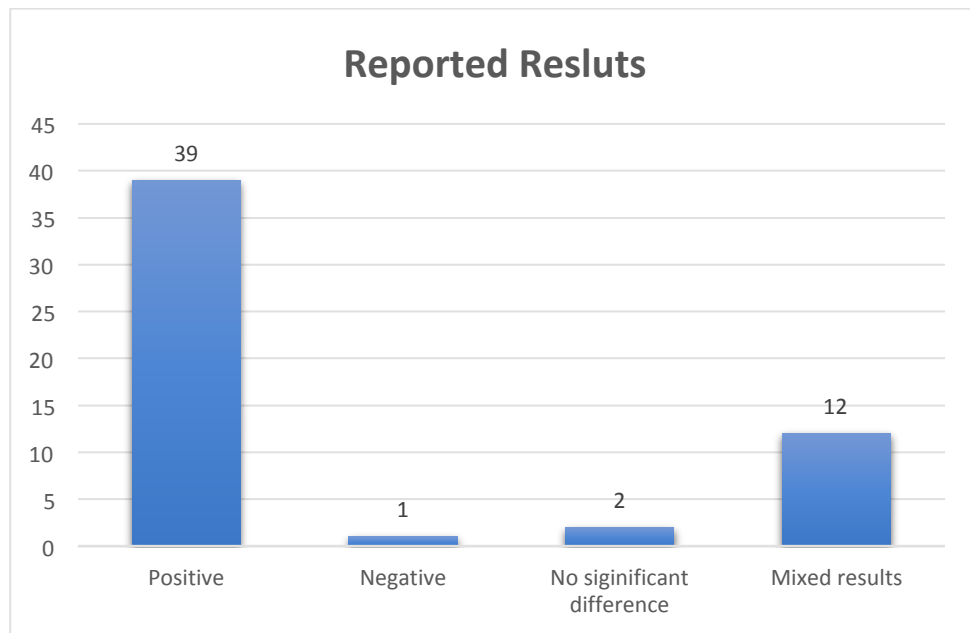


Figure 5: Reported Results

## Discussion and Conclusions

This systematic review examined 54 articles from 17 countries. The findings identified gamification applied subject areas in the context of higher education, and focused on analysed variables, gamification design elements, the implementation, and reported positive and negative aspects of gamification.

In this study, it was found that gamification most applied study area in higher education in Computer Science/Information Technology. Although gamification has been more commonly adapted to various disciplines in the higher education sector, CS/IT has become the most dominant study area that applies gamification. Dicheva et al. (2015) explained the reason was that many teachers lack the necessary skills and time to create, develop, and/or maintain a sufficient supportive technological infrastructure, the early application of gamification to learning occurred mostly in CS/IT fields. And this seems not been significantly changed based on the results found in this study. Although learning management systems (LMS) such as Blackboard, and Moodle and Virtual classroom technologies for synchronous teaching platforms such as Blackboard Collaborate, Teams, and Zoom have been widely used in higher education as technological support in recent years, the adoption of applying gamification in other disciplines is still limited.

This study also concludes that motivation, academic performance, and engagement are the most analysed variables, followed by class attendance, learning outcomes, satisfaction, attitude toward learning, and other cognitive variables. Most selected articles reported that motivation, as the most studied variable, can be promoted by applying gamification. Only Ferriz-Valero et al. (2020) found that students' intrinsic motivation does not change in their studies. It's interesting to notice that the majority of these studies made use of leaderboards, points/scores, or/and badges, which is why extrinsic motivation was fostered, with students executing tasks to get the points, scores, or/and badges.

Furthermore, engagement as another key component of successful learning in education is studied and discussed with motivation on most occasions. Students who reported high

motivation by badges at the end of the course demonstrated higher levels of engagement than those who were not motivated by badges (Ortega-Arranz et al., 2019). Meanwhile, the results are not always consistent when motivation is studied with another frequently analysed variable, academic performance. Both motivation and academic performance are improved in the study (Fuster-Guillo et al., 2019; Morales-Trujillo & Garcia-Mireles, 2021). However, intrinsic motivation does not change when academic performance is benefited (Ferriz-Valero, Osterlie, Martinez, & Garcia-Jaen, 2020). In addition, the group less involved in the gamification received better academic results, although motivation was improved in the subject (Hernandez-Fernandez, Olmedo-Torre, & Pena, 2020). It is reasonable to assume that when students have an assessment that they deem important surrounded by a pleasant atmosphere, they will be more motivated to complete the assessment. It would also be worthwhile to examine the impact of gamification on the modification of undesirable student behaviours, such as classroom disruption and absenteeism.

Interestingly, 14 papers used Kahoot! as an online gamification platform in higher education, and all reported results are positive. Ismal et al. (2019) used Kahoot! as a formative assessment tool in medical education and identify that Kahoot! is an attractive learning tool, a source of motivation, and learning guidance in the study. Likewise, Felszeghy et al. (2019) employed Kahoot! in histology teaching and reported that students are more enjoyable studying in a more relaxed atmosphere for discussions and are less reluctant to learn the lessons. At the same time, Kahoot! enables students to obtain just-in-time feedback and engage with instructors and peers. Apart from students' motivation, Campillo-Ferrer et al. (2020) also identified the impact on the acquisition of social and civic competencies. Kahoot! enable students to absorb knowledge in a novel manner and create a set of social and civic competence-related skills and talents. Kahoot! as an online gamification platform helps students to improve academic performance in business management subjects (Martinez-Jimenez, Pedrosa-Ortega, Liceran-Gutierrez, Ruiz-Jimenez, & Garcia-Marti, 2021; Ortiz-Martinez, Santos-Jaen, & Palacios-Manzano, 2022) and computer engineering degrees (Fuster-Guillo et al., 2019). As the empirical studies approved, Kahoot! as an application of gamification platform in the context of higher education has generated an environment for students learning to enhance various aspects, such as motivation, participation, engagement, formative assessment results, classroom dynamics, and peer interaction.

It is noticeable that all studies used online support even those studies which did not use a special gamification platform. Based on the review results, during the pandemic, gamification elements have been more frequently applied in online courses or online and face-to-face mixed courses. Students had to attend online classes and spent 6-8 hours per day on online learning in the past several years during the pandemic. Apart from the above-mentioned benefits of applying gamification, it also helps students reduce online fatigue and stress during the pandemic (Ropero-Padilla et al., 2021). To some extent, Covid-19 has not only drastically changed human life, but also significantly changed education patterns (Yang & Lee, 2021). It has compelled universities to be more innovative, adaptable, and agile in the teaching transition to online or blended learning (Ropero-Padilla et al., 2021).

Finally, it is crucial to note that gamification in the context of higher education needs to be implemented properly. Instructors need to consider the correct ways to integrate gamification into the learning process (Wirani, Nabarian, & Romadhon, 2022). It must be content-related or well-planned (Felszeghy et al., 2019; Ismal et al., 2019). Good preparation can avoid causing confusion and stress for both instructors and students. For example, instructors need

to know the conditions of the facilities and infrastructure when gamification is applied, such as the availability of the internet, mobile devices, or laptops.

While this systematic literature mapping has provided insights into the landscape of gamification in higher education, it is imperative to acknowledge certain limitations inherent in the study. One noteworthy limitation pertains to the source of articles. Despite the meticulous inclusion of all papers meeting the predefined criteria, the potential for oversight remains due to inaccessible full texts or constraints imposed by the selected database.

Furthermore, a notable challenge arises from the amalgamation of gamification with other closely related terminologies, such as game-based learning, serious games, and simulation, among others. The interchangeability of these terms in existing literature poses a potential obstacle to the exhaustive identification of relevant studies during the mapping process. This intrinsic complexity underscores the need for a nuanced approach in future research endeavours.

Moving forward, future investigations need to focus on both educators' and students' adoption and acceptance of gamification to comprehensively understand the implementation of gamification in higher education. To achieve this, both qualitative and quantitative studies should be conducted in specific study areas. Additionally, comparative studies across diverse student groups, considering variables such as gender, cultural background, and study programs, are crucial for discerning the intricate ways in which external factors influence students' gamification adoption process.

## References

- Ab Rahman, R., Ahmad, S., & Hashim, U. R. (2018). The effectiveness of gamification technique for higher education students engagement in polytechnic muadzam shah pahang, malaysia. *International Journal of Educational Technology in Higher Education*, 15 doi:10.1186/s41239-018-0123-0
- Ahmed, H. D., & Asiksoy, G. (2021). The effects of gamified flipped learning method on student's innovation skills, self-efficacy towards virtual physics lab course and perceptions. *Sustainability*, 13(18) doi:10.3390/su131810163
- Alhammad, M. M., & Moreno, A. M. (2018). Gamification in software engineering education: A systematic mapping. *The Journal of Systems and Software*, 141, 131-150. doi:10.1016/j.jss.2018.03.065
- Baars, M., Khare, S., & Ridderstap, L. (2022). Exploring students' use of a mobile application to support their self-regulated learning processes. *Frontiers in Psychology*, 13 doi:10.3389/fpsyg.2022.793002
- Bai, S. R., Hew, K. F., Gonda, D. E., Huang, B. Y., & Liang, X. Y. (2022). Incorporating fantasy into gamification promotes student learning and quality of online interaction. *International Journal of Educational Technology in Higher Education*, 19(1) doi:10.1186/s41239-022-00335-9
- Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD Research*, 1(1), 19.
- Bouchrika, I., Harrati, N., Wanick, V., & Wills, G. (2021). Exploring the impact of gamification on student engagement and involvement with e-learning systems. *Interactive Learning Environments*, 29(8), 1244-1257. doi:10.1080/10494820.2019.1623267
- Bovermann, K., Weidlich, J., & Bastiaens, T. (2018). Online learning readiness and attitudes towards gaming in gamified online learning - a mixed methods case study. *International Journal of Educational Technology in Higher Education*, 15 doi:10.1186/s41239-018-0107-0
- Burke, B. (2014). *Gamify: How gamification motivates people to do extraordinary things* (1st ed.). Brookline, Massachusetts: Bibliomotion, books + media. doi:10.4324/9781315230344
- Campillo-Ferrer, J. M., Miralles-Martinez, P., & Sanchez-Ibanez, R. (2020). Gamification in higher education: Impact on student motivation and the acquisition of social and civic key competencies. *Sustainability*, 12(12) doi:10.3390/su12124822
- Caño de las Heras, S., Gargalo, C. L., Weitze, C. L., Mansouri, S. S., Gernaey, K. V., & Krühne, U. (2021). A framework for the development of pedagogical process simulators (P2Si) using explanatory models and gamification. *Computers & Chemical Engineering*, 151, 107350. doi:10.1016/j.compchemeng.2021.107350

- Caponetto, I., Earp, J., & Ott, M. (2014). Gamification and education: A literature review. Paper presented at the, 1 50.
- Chen, Y., Zhang, L. Y., & Yin, H. (2022). A longitudinal study on students' foreign language anxiety and cognitive load in gamified classes of higher education. *Sustainability*, 14(17) doi:10.3390/su141710905
- Chen, Y., & Zhao, S. (2022). Understanding chinese EFL learners' acceptance of gamified vocabulary learning apps: An integration of self-determination theory and technology acceptance model. *Sustainability*, 14(18) doi:10.3390/su141811288
- De Sousa Borges, S., Durelli, V. H. S., Reis, H. M., & Isotani, S. (2014). A systematic mapping on gamification applied to education. Paper presented at the 216-222. doi:10.1145/2554850.2554956
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining “Gamification”. *MindTrek '11: Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, 9–15. Retrieved from <https://doi.org/10.1145/2181037.2181040>
- Diaz-Ramirez, J. (2020). Gamification in engineering education - an empirical assessment on learning and game performance. *Heliyon*, 6(9) doi:10.1016/j.heliyon.2020.e04972
- Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Educational Technology & Society*, 18(3), 75-88.
- Felszeghy, S., Pasonen-Seppanen, S., Koskela, A., Nieminen, P., Harkonen, K., Paldanius, K., . . . Mahonen, A. (2019). Using online game-based platforms to improve student performance and engagement in histology teaching. *Bmc Medical Education*, 19 doi:10.1186/s12909-019-1701-0
- Ferriz-Valero, A., Osterlie, O., Martinez, S. G., & Garcia-Jaen, M. (2020). Gamification in physical education: Evaluation of impact on motivation and academic performance within higher education. *International Journal of Environmental Research and Public Health*, 17(12) doi:10.3390/ijerph17124465
- Furdu, I., Tomozei, C., & Kose, U. (2017). Pros and cons gamification and gaming in classroom. *Brain.Broad Research in Artificial Intelligence and Neuroscience*.
- Fuster-Guillo, A., Pertegal-Felices, M. L., Jimeno-Morenilla, A., Azorin-Lopez, J., Soliveres, M., & Restrepo-Calle, F. (2019). Evaluating impact on motivation and academic performance of a game-based learning experience using kahoot. *Frontiers in Psychology*, 10 doi:10.3389/fpsyg.2019.02843
- Garcia-Iruea, M., Fonseca, M. J., Hijon-Neira, R., & Chambel, T. (2020). Gamification and computer science students activity. *Ieee Access*, 8, 96829-96836. doi:10.1109/ACCESS.2020.2997038

- Garcia-Iruela, M., & Hijon-Neira, R. (2020). What perception do students have about the gamification elements? *Ieee Access*, 8, 134386-134392. doi:10.1109/ACCESS.2020.3011222
- Ghawail, E. A. A., & Yahia, S. B. (2022). Using the E-learning gamification tool kahoot! to learn chemistry principles in the classroom. *Procedia Computer Science*, 207, 2667-2676. doi:10.1016/j.procs.2022.09.325
- Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? -- A literature review of empirical studies on gamification. Paper presented at the 3025.
- Hernandez-Fernandez, A., Olmedo-Torre, N., & Pena, M. (2020). Is classroom gamification opposed to performance? *Sustainability*, 12(23) doi:10.3390/su12239958
- Hosseini, C., Humlung, O., Fagerström, A., & Haddara, M. (2022). An experimental study on the effects of gamification on task performance. *Procedia Computer Science*, 196, 999-1006. doi:10.1016/j.procs.2021.12.102
- Ibanez, M. B., Di-Serio, A., & Delgado-Kloos, C. (2014). Gamification for engaging computer science students in learning activities: A case study. *Ieee Transactions on Learning Technologies*, 7(3), 291-301. doi:10.1109/TLT.2014.2329293
- Iosup, A., & Epema, D. (2014). An experience report on using gamification in technical higher education. Paper presented at the 27-32. doi:10.1145/2538862.2538899
- Ismal, M., Ahmad, A., Mohammad, J. A., Fakri, N., Nor, M., & Pa, M. (2019). Using kahoot! as a formative assessment tool in medical education: A phenomenological study. *Bmc Medical Education*, 19 doi:10.1186/s12909-019-1658-z
- Jusas, V., Barisas, D., & Janciukas, M. (2022). Game elements towards more sustainable learning in object-oriented programming course. *Sustainability*, 14(4) doi:10.3390/su14042325
- Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. San Francisco: Pfeiffer.
- Kim, S., Song, K., Lockee, B., & Burton, J. (2018). *Gamification in learning and education: Enjoy learning like gaming* (1st ed.). Cham: Springer International Publishing.
- Legaki, N. Z., Xi, N. N., Hamari, J., Karpouzis, K., & Assimakopoulos, V. (2020). The effect of challenge-based gamification on learning: An experiment in the context of statistics education. *International Journal of Human-Computer Studies*, 144 doi:10.1016/j.ijhcs.2020.102496
- Leon, A., & Pena, M. (2022). Gamification tools in the learning of shipbuilding in the undergraduate marine engineering education. *Computer Applications in Engineering Education*, 30(2), 458-471. doi:10.1002/cae.22465

- Lopez-Jimenez, J. J., Fernandez-Aleman, J. L., Gonzalez, L. L., Sequeros, O. G., Valle, B. M., Garcia-Berna, J. A., . . . Toval, A. (2022). Taking the pulse of a classroom with a gamified audience response system. *Computer Methods and Programs in Biomedicine*, 213 doi:10.1016/j.cmpb.2021.106459
- Majuri, J., Koivisto, J., & Hamari, J. (2018). Gamification of education and learning: A review of empirical literature. Paper presented at the, 2186 11-19.
- Manzano-León, A., Camacho-Lazarraga, P., Guerrero, M. A., Guerrero-Puerta, L., Aguilar-Parra, J., Trigueros, R., & Alias, A. (2021). Between level up and game over: A systematic literature review of gamification in education. *Sustainability (Basel, Switzerland)*, 13(4), 1-14. doi:10.3390/su13042247
- Martinez-Jimenez, R., Pedrosa-Ortega, C., Liceran-Gutierrez, A., Ruiz-Jimenez, M. C., & Garcia-Marti, E. (2021). Kahoot! as a tool to improve student academic performance in business management subjects. *Sustainability*, 13(5) doi:10.3390/su13052969
- Morales-Trujillo, M. E., & Garcia-Mireles, G. A. (2021). Gamification and SQL: An empirical study on student performance in a database course. *Acm Transactions on Computing Education*, 21(1) doi:10.1145/3427597
- Ng, L. K., & Lo, C. K. (2022). Flipped classroom and gamification approach: Its impact on performance and academic commitment on sustainable learning in education. *Sustainability*, 14(9) doi:10.3390/su14095428
- Ngan, O. M. Y., Tang, T. L. H., Chan, A. K. Y., Chen, D. M., & Tang, M. K. (2018). Blended learning in anatomy teaching for non-medical students: An innovative approach to the health professions education. *Health Professions Education*, 4(2), 149-158. doi:10.1016/j.hpe.2017.11.001
- Ortega-Arranz, A., Er, E., Martinez-Mones, A., Bote-Lorenzo, M. L., Asensio-Perez, J. I., & Munoz-Cristobal, J. A. (2019). Understanding student behavior and perceptions toward earning badges in a gamified MOOC. *Universal Access in the Information Society*, 18(3), 533-549. doi:10.1007/s10209-019-00677-8
- Ortiz-Martinez, E., Santos-Jaen, J. M., & Palacios-Manzano, M. (2022). Games in the classroom? analysis of their effects on financial accounting marks in higher education. *International Journal of Management Education*, 20(1) doi:10.1016/j.ijme.2021.100584
- Perryer, C., Celestine, N. A., Scott-Ladd, B., & Leighton, C. (2016). Enhancing workplace motivation through gamification: Transferrable lessons from pedagogy. *The International Journal of Management Education*, 14(3), 327-335. doi:10.1016/j.ijme.2016.07.001
- Petersen, K., Feldt, R., Mujtaba, S., & Mattsson, M. (2008). Systematic mapping studies in software engineering. Paper presented at the doi:10.14236/ewic/ease2008.8



- Pinter, R., Cisar, S. M., Balogh, Z., & Manojlovic, H. (2020). Enhancing higher education student class attendance through gamification. *Acta Polytechnica Hungarica*, 17(2), 13-33. doi:10.12700/APH.17.2.2020.2.2
- Polito, G., & Temperini, M. (2021). A gamified web based system for computer programming learning. *Computers and Education: Artificial Intelligence*, 2, 100029. doi:10.1016/j.caeai.2021.100029
- Rincon-Flores, E. G., & Santos-Guevara, B. N. (2021). Gamification during covid-19: Promoting active learning and motivation in higher education. *Australasian Journal of Educational Technology*, 37(5), 43-60.
- Ropero-Padilla, C., Rodriguez-Arrastia, M., Martinez-Ortigosa, A., Salas-Medina, P., Ayora, A. F., & Roman, P. (2021). A gameful blended-learning experience in nursing: A qualitative focus group study. *Nurse Education Today*, 106. doi:10.1016/j.nedt.2021.105109
- Sailer, M., & Sailer, M. (2021). Gamification of in-class activities in flipped classroom lectures. *British Journal of Educational Technology*, 52(1), 75-90. doi:10.1111/bjet.12948
- Saleem, A. N., Noori, N. M., & Ozdamli, F. (2022). Gamification applications in E-learning: A literature review. *Technology, Knowledge and Learning*, 27(1), 139-159. doi:10.1007/s10758-020-09487-x
- Sobrinho-Duque, R., Martinez-Rojo, N., Carrillo-De-Gea, J. M., Lopez-Jimenez, J. J., Nicolas, J., & Fernandez-Aleman, J. L. (2022). Evaluating a gamification proposal for learning usability heuristics: Heureka. *International Journal of Human-Computer Studies*, 161. doi:10.1016/j.ijhcs.2022.102774
- Song, D. L., Shi, D. Q., Wang, R. S., & Xu, H. (2018). Splitting and combining as a gamification method in engaging structured knowledge learning. *Sustainability*, 10(3). doi:10.3390/su10030800
- Tsay, C., Kofinas, A., & Luo, J. (2018). Enhancing student learning experience with technology-mediated gamification: An empirical study. *Computers & Education*, 121, 1-17. doi:10.1016/j.compedu.2018.01.009
- van Roy, R., Deterding, S., & Zaman, B. (2019). Collecting pokémon or receiving rewards? how people functionalise badges in gamified online learning environments in the wild. *International Journal of Human-Computer Studies*, 127, 62-80. doi:10.1016/j.ijhcs.2018.09.003
- Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Philadelphia, PA: Wharton Digital Press.
- Wirani, Y., Nabarian, T., & Romadhon, M. S. (2022). Evaluation of continued use on kahoot! as a gamification-based learning platform from the perspective of indonesia students. *Procedia Computer Science*, 197, 545-556. doi:10.1016/j.procs.2021.12.172

Yang, Q., & Lee, Y. C. (2021). The critical factors of student performance in MOOCs for sustainable education: A case of chinese universities. *Sustainability*, 13(14) doi:10.3390/su13148089

Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review*, 30, 100326. doi:10.1016/j.edurev.2020.100326

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps* (1st ed.). Sebastopol, Calif: O'Reilly Media.

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