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An Examination of Influential Factors on Gamification in Higher Education: A Content Analysis

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Gamification has been used in education since the early 2010s, however, the empirical studies on the effectiveness of gamification have yielded inconsistent results. Without a clear understanding of how gamification works, and which gamification design elements have a higher potential to influence learning outcomes, gamification intervention may not achieve the desired results. This study aimed to examine the factors that contributed to the successful implementation of gamification in higher education, and to identify the design elements that had most influence on student learning outcomes. Data was collected from the empirical studies conducted between 2014 and 2023. Data analysis was conducted using logistic regression and Chi-Square tests. Two gamification design elements, *Social Interaction* and *Leaderboards*, were found to have significant influence on student learning outcomes. This study provided insights for college instructors and instructional designers in the design of gamification intervention in instruction. Implications for practice and future studies were presented.

Keywords: gamification, social interaction, higher education, content analysis, instructional design

INTRODUCTION

While games have been used in teaching since ancient times, gamification is a comparatively new phenomenon. Gamification, “the use of game design elements in non-game context” (Deterding et al., 2011, p. 10) to increase engagement and motivation, gained popularity in the early 2010s. It has been a growing trend ever since with practical applications in businesses and organizations for employee training (Vanduhe et al., 2020), in marketing and sales to increase brand loyalty (Xi & Hamari, 2019), in health and wellness to promote healthy behaviors (Miller et al., 2016), and recently, to combat

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disinformation and misinformation on social media (Almaliki, 2019; Sotirakou et al., 2022).

In recent years, there has been a growing interest in using gamification in education due to the advancement in digital technology and the availability of gamified learning systems. The research in gamification has been steadily rising (Sailer & Homner, 2020). Studies have been conducted to better understand the application of gamification and its potential effects on students (for example, Brom et al., 2019; Gupta & Goyal, 2022; Morris et al., 2019; Sailer & Sailer, 2021). By tapping into natural human desire for competition, achievement, and social interaction, gamification has the potential to boost student engagement, learning performance, and overall academic success (Dichev & Dicheva, 2017).

The COVID-19 pandemic has increased the need for gamification to improve engagement and retention rates. Studies on the impact of COVID-19 on higher education have highlighted the challenges with maintaining student motivation and engagement, and detrimental effects of anxiety and stress on student learning (Chiu et al., 2021; Copeland et al., 2021; Ghislieri et al., 2023; Wu & Teets, 2021). College student disengagement and disconnection post Covid-19 pandemic has become a prominent concern in higher education. Addressing this concern and reconnecting students to the learning community has become a priority.

The primary goal of gamification in education is to increase motivation and engagement (Kapp, 2012). Research in various disciplines has explored the impact of gamification on student motivation, effort, and learning performance. Some of the key findings include enhanced engagement (Murillo-Zamorano et al., 2023; Smiderle et al., 2020), improved motivation (Lehtonen et al., 2015; Makler et al, 2017), social learning and a fun learning experience (Chen & Liang, 2022; Murillo-Zamorano et al., 2023). While research on gamification has shown positive effects on motivation and learning, the findings are inconsistent with mixed results (Dichev & Dicheva, 2017; Huang et al., 2020; Landers et al., 2018; Ritzhaupt et al., 2021; Sailer & Homner, 2020). Studies have shown no or negative effects of gamification on motivation (Balci et al., 2022; Hanus & Fox, 2015; Kyewski & Kramer, 2018).

Recently there have been a few systematic reviews and meta-analyses on the effects of gamification on cognitive, behavioral, and motivational/affective learning outcomes, all of which have pointed out a consistent problem of inconclusive results within the gamification research in education: gamification research lacks theoretical foundation and methodological rigor (Dichev & Dicheva, 2017, Sailer & Homner, 2020, Seaborn & Fels, 2015). Simply adding game elements like points, badges and leaderboards to the instruction does not automatically increase student motivation and improve learning. Without the guidance of theories and design principles, gamification interventions may not effectively achieve desired learning outcomes. More theory-guided high-quality empirical research is needed to fully understand the effectiveness of gamification in educational settings (Dichev & Dicheva, 2017; Huang et al., 2020; Ritzhaupt et al., 2021; Sailer & Homner, 2020).

Previous research has shown overall positive effect of gamification on student learning outcomes. However, the findings are mixed with regards to the effect of specific gamification design elements such as badges, levels, and leaderboards. There are no conclusive findings on what elements or combinations of elements have the most impact. The purpose of this study was to explore the latest trends in gamification research, examine the impact of gamification on student learning, and delve into the factors that influence the effectiveness of gamification in teaching and learning in higher education context. This study aimed to identify the influential factors in the design and implementation of gamification in instruction and examine the extent to which these influential factors contribute to its success. Furthermore, this study intended to shed light on how gamification as a pedagogy could be used in course design by suggesting some implementation guidelines for instructors and instructional designers.

LITERATURE REVIEW

Researchers have indicated that the effectiveness of gamification in education may vary depending on various factors, such as individual and situational factors, learning contexts, disciplinary factors, and methodology factors (Landers et al., 2018, Ritzhaupt et al., 2021, Sailer & Homner, 2020). To investigate how gamification works, it is necessary to understand what gamification is and its theoretical connection.

CONCEPTUALIZING GAMIFICATION

One of the controversies in gamification research is that there is no standard definition of the term (Seaborn & Fels, 2015). Researchers and scholars have proposed varying definitions and conceptualizations of gamification. Some focus on "the use of game design elements in non-game context" (Deterding et al., 2011, p. 10), while others emphasize the importance of creating a game-like experience (Werbach, 2014).

The term gamification originated in the digital game industry (Deterding et al., 2011). It emerged from leveraging the engaging and motivating aspects of games. The idea behind gamification is simple and basic. Digital games (especially video games) can motivate and engage players for an extended period of time. People of all ages are comfortable with playing a variety of games on smart phones, tablets, computers, and game consoles. By applying game elements such as points, badges, levels, rewards, and leaderboards in a non-gaming activity or task, students will be more engaged and motivated to complete the activity or task.

There are a few definitions in the field of gamification research, arguably the most well-known and widely used being "the use of game design elements in non-game contexts" (Deterding et al., 2011, p.10). Kapp (2012) defined gamification as "the use of game-based mechanics, aesthetics, and game-thinking to engage people, motivate action, promote learning, and solve problems" (Kapp, 2012, p.125). Seaborn and Fels (2015) suggested adopting a "standard" definition of gamification, "the intentional use of game elements for gameful experience of non-game tasks and contexts" (Seaborn & Fels, 2015, p.17).

There is a common theme in these definitions: (1) gamification is intentional; (2) it focuses on people; and (3) it seeks to change behavior by motivating and engaging people. In other words, gamification is the *intentional* use of *game design elements* in non-game contexts to *increase motivation, engagement, and interaction* (Deterding et al., 2011; Kapp, 2012; Seaborn & Fels, 2015). Gamification is *not* simply adding game elements to any context. When implementing gamification, instructors and instructional designers *intentionally* select specific game elements, such as points, badges, levels, challenges, leaderboards, and integrate them to a well-designed curriculum to create a *gamified learning experience*. These elements are carefully selected and intentionally designed to *motivate* students, provide a sense of progression, and increase engagement. The effectiveness of gamification depends on *how* it is designed and implemented (Landers, 2014; Landers et al., 2018; Sailer & Homner, 2020). Without careful consideration of the learning contexts, learner characteristics, and goals and objectives, gamification may not yield the desired outcomes.

THEORETICAL FRAMEWORKS

One consistent finding in previous reviews is that gamification research lacks theoretical foundation and methodological rigor (Dichev & Dicheva, 2017, Sailer &

Homner, 2020, Seaborn & Fels, 2015). The application of gamification in education is a comparatively new phenomenon and the connections between theory and practice have not been well established (Seaborn & Fels, 2015). Nonetheless, several theories have been used to explain why and how gamification works, and to guide empirical practices in education. These include Goal-Setting Theory, Flow Theory, Self-Determination Theory, and more recently, Theory of Gamified Learning.

In this study, *Self-Determination Theory* and *Theory of Gamified Learning* were applied in the examination and discussion of the influence gamification has on student learning outcomes. In Figure 1 the researchers present the conceptual framework for this study. It illustrates the relationship between gamification design elements and Self-Determination Theory, and between Self-Determination Theory and Theory of Gamified Learning.

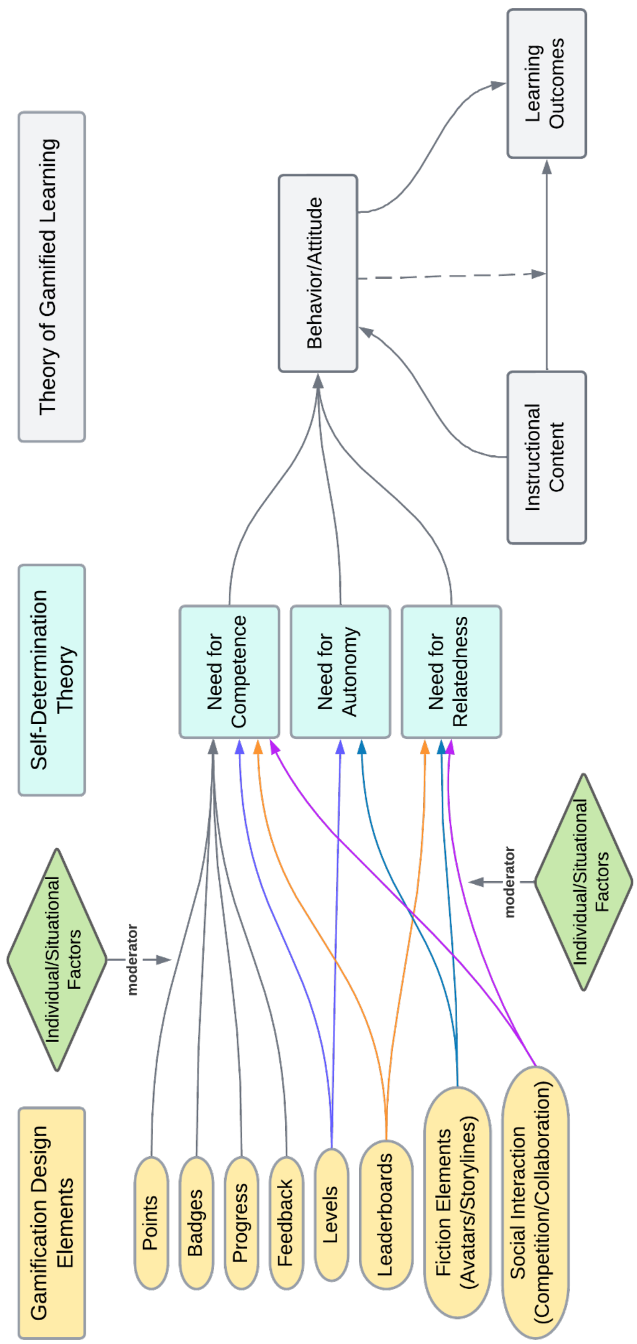

Figure 1. *Conceptual framework: the relationship between gamification design elements, Self-Determination Theory, and Theory of Gamified Learning*

Self-Determination Theory

The most-frequently used psychological theory in gamification research, Self-Determination Theory focuses on motivation and psychological needs that drive human behavior. Developed by Ryan and Deci (Deci & Ryan, 1985; Ryan & Deci, 2000), Self-Determination Theory posits that individuals have three basic needs to meet—the needs for autonomy, competence, and relatedness. Autonomy is the sense of ownership one feels in the decision he/she makes and the direction he/she chooses. Competence refers to the feeling of being able to do well in a task. Relatedness is the sense of attachment to and a sense of belonging among other people. These needs are essential for individuals to experience intrinsic motivation. When these needs are satisfied, individuals are more likely to be intrinsically motivated to perform the required tasks and experience optimal learning outcomes (Ryan & Deci, 2000).

Intrinsic motivation is what drives people to perform an activity or task for the enjoyment of the activity or task itself (Ryan & Deci, 2000). However, not all tasks are intrinsically motivating, and people can be driven by various extrinsic motivational factors, for example, their values, their personal commitment to excel, rewards, and even fear of failure (Ryan & Deci, 2000). Self-Determination Theory views extrinsic motivation as a continuum ranging from amotivation to passive compliance to active personal commitment that can be regulated through internalization and integration (Ryan & Deci, 2000) (see Figure 2). Internalization occurs when an individual identifies with the value or regulation that is initially external to himself/herself. It helps turn motivation from extrinsic to intrinsic. Integration occurs when an individual has fully internalized the value or regulation and has made it part of their own identity. Self-Determination Theory suggests that there are social and environmental conditions that facilitate intrinsic motivation and the internalization and integration of extrinsic motivation (Ryan & Deci, 2000, 2020). Note that it also suggests that social-contextual events such as feedback and rewards can facilitate or diminish competence and autonomy (Ryan & Deci, 2000). While events that allow for greater autonomy, for example, positive feedback, choice, and acknowledgement of feelings, increase intrinsic motivation, imposed goals, deadlines, and expected tangible rewards diminish it (Ryan & Deci, 2000; Deci et al., 2001).

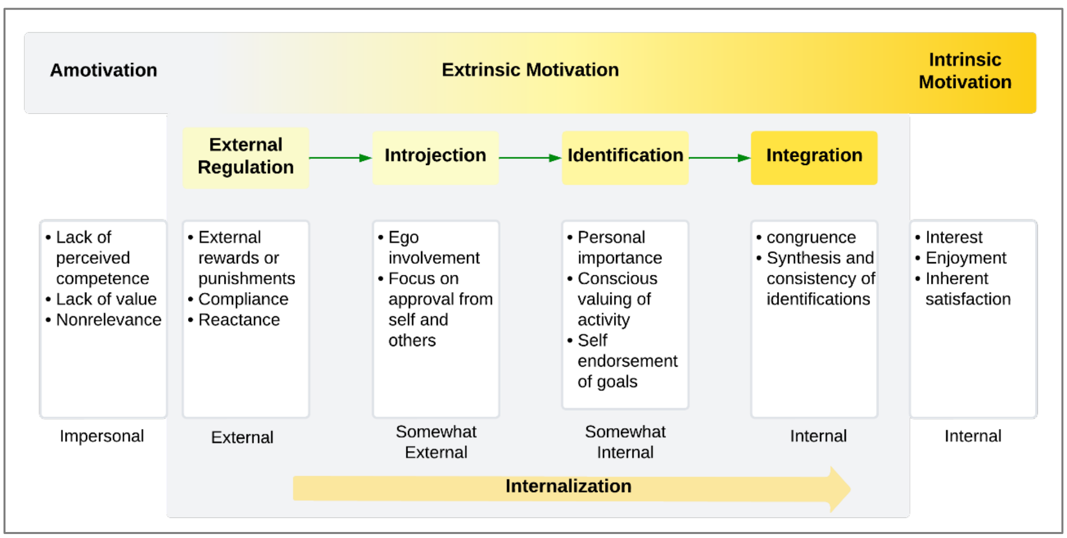

Figure 2. *Self-Determination theory's Taxonomy of Motivation (Derived from Ryan & Deci, 2020, p. 2)*

The theory has been applied and evaluated in various fields, including gamification in education. Research on motivation in education has consistently shown that intrinsic motivation is associated with higher performance (Ryan & Deci, 2020). The primary use of gamification in education is to motivate and engage students so that their learning will be enhanced. Game elements can be intrinsically motivating when applied intentionally in a meaningful way (Kapp, 2012).

Game elements such as points, badges, levels, challenges, and leaderboards are the building blocks of gamification to promote autonomy, competence, and relatedness. Points and badges facilitate competence by providing feedback on individual progress and performance. Leaderboards promote competence and relatedness by providing social comparison and feedback and can be used to facilitate internalization of extrinsic motivation, encourage competition, and foster a sense of community.

Theory of Gamified Learning

Proposed by Landers (2014), the Theory of Gamified Learning is a framework that conceptualizes the causal relationship between gamification and learning. Seeking to understand the specific process in which game elements can affect learning, the theory takes into consideration other educational variables and maps the relationship between these variables, highlighting the mediating and moderating effects of gamification in teaching and learning. The theory has four components: instructional content, game characteristics (i.e., game elements), behaviors and attitudes, and learning outcomes (Landers, 2014). Figure 3 illustrates the relationship between these components.

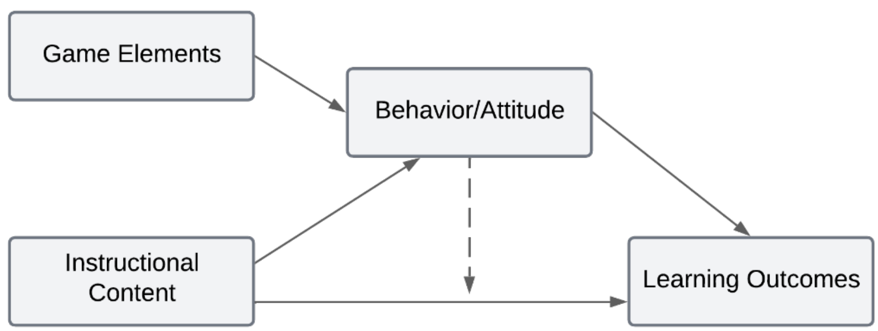

Figure 3. *Theory of Gamified Learning (Derived from Landers, 2014, p. 760.)*

As illustrated in Figure 3, there are direct paths (causal relationships) between instructional content and learning outcomes, between instructional content and behavior and attitude, and between behavior and attitude and learning outcomes, all of which are well documented and theorized in educational research. In addition, the theory states that "game elements affect learner changes in behaviors and attitudes" (Landers, 2014, p. 761). Landers proposes a direct causal relationship between game elements and learner behaviors and attitudes. For gamification to be effective, it must successfully make a change in learner behavior or attitude. Empirical studies have shown evidence for this relationship. Game elements such as points, badges, and leaderboards have been found to increase the frequency of student taking practice quizzes (Dicheva et al., 2020), class participation (Dias, 2017), and behavioral and affective engagement (Tan & Hew, 2016; Thomas & Baral, 2023).

The Theory of Gamified Learning proposes the two processes by which game elements can affect learning—a *mediating* process and a *moderating* process (Landers, 2014). First, "the relationship between game elements and learning outcomes is mediated by behaviors and attitudes" (Landers, 2014, p. 762). This proposition shows a direct mediating effect of gamification on learning. As illustrated in Figure 3, game elements do not directly affect learning outcomes, but mediate the relationship between learner behavior and attitude and learning outcomes. In other words, game elements do not directly cause learning; game elements affect learner behaviors and attitudes, which in turn influence learning outcomes. Denny et al. (2018) conducted an experiment study examining the relationship between gamification and learning outcomes. They found badges significantly increased student voluntary self-testing activities (behavior), which resulted in a significant improvement in exam scores, providing empirical support for this proposition. Second, "game elements affect learner behaviors and attitudes that moderate instructional effectiveness" (Landers, 2014, p. 761). This proposition shows an indirect moderating effect of gamification on learning. A moderator is a variable that affects the direction and/or strength of the relationship between an independent variable and a dependent variable (Baron & Kenny, 1986). As presented in Figure 3, instructional content is directly linked to learning outcomes. Well-designed high-quality instructional content leads to positive learning outcomes. By integrating game elements, student engagement increases, further strengthening the causal relationship between instructional content and learning outcomes (Landers, 2014).

In summary, the Theory of Gamified Learning emphasizes that gamification itself does not directly affect student cognitive learning outcome. It proposes two processes gamification can influence learning: (1) through its direct impact on student behaviors /attitudes—direct mediating effect, and (2) through its direct impact on student behaviors/attitudes that moderate student learning—indirect moderating effect (Landers, 2014). The theory highlights the essential role instructional content plays in student learning, and that gamification is a process that uses ***design principles*** to add game elements to an existing process (i.e., instruction) to change how that process influence people (Landers, 2014; Landers et al., 2018). Gamification is intentional, aiming at a change in the outcome.

Gamification Design Elements

Gamification design elements are the basic building blocks of gamification applications. Commonly used gamification design elements include points, badges, leaderboards, levels, progress bar (or performance graphs), feedback, rewards, narratives, game fictions, avatars, etc. When carefully designed and integrated into instruction, these elements can help motivate students and create an engaging and enjoyable learning environment.

Research on gamification has been centered on the relationship between game design elements and motivation. Overall, the results are inconsistent (Dichev & Dicheva, 2017; Sailer & Homner, 2020). In this section, the researchers synthesized the empirical findings in the literature regarding the effects of the commonly studied gamification design elements on student learning outcomes (cognitive, behavioral, and affective/motivational).

Game Fiction Elements. Game fiction refers to the fictional game world and story created to engage users (Kapp, 2012). It is a key element of gamification that aims to make the experience more immersive and enjoyable. Game fiction can be used to create a sense of purpose and meaning in the activity, which can enhance motivation and engagement. Fiction elements in gamification include narratives/stories and fictional characters/avatar.

Stories have been used in instruction for centuries. Adding a storyline or narrative to gamification allows students to experience through the story while learning and applying what they learn (Kapp, 2012). In a quasi-experiment study conducted by Bai and colleagues (2023), a fantasy world was introduced. When comparing the two studies, one with fantasy and the other without, they found the introduction of fantasy significantly increased student engagement with the content and with their peers, which led to a better learning performance. Similar results were found in Rodrigues and colleges' study in which fiction was implemented (Rodrigues et al., 2022).

In their synthesis of gamification research, Sailer and Homner (2020) found a significant positive relationship between game fiction and behavioral learning outcomes. They suggested that when game fiction was included students were more likely to invest effort in completing tasks than when game fiction was not included. This confirms the mediating effect of game elements proposed by the Theory of Gamified Learning (Landers, 2014).

Points, Badges, and Leaderboards. Points, badges, and leaderboards (PBLs) are the most implemented game design elements and have been studied extensively in gamification research as they can be easily activated (Seaborn & Fels, 2015). These elements are often implemented as a combination of two or three. The use of these three elements is often referred to as the pointification approach in gamification research.

Research on the effects of points/badges/leaderboards on learning outcomes has yielded mixed results. The success of points/badges/leaderboards (and gamification design elements in general) is highly contextual. Individual and contextual factors play an important role. Gender has been identified as a moderating factor. Tsay and colleagues (2018) conducted a study investigating the impact of a gamified learning system with badges and leaderboards on student behavioral engagement and learning performance. They found positive effects of gamification in behavioral engagement, which led to enhanced learning performance. When examining personal factors, they found female students outperformed male students in behavior engagement, and students with jobs participated more in course activities than those without (Tsay et al., 2018).

According to the Theory of Gamified Learning, gamification design elements do not directly affect learning. Its impact, if any, is on students' attitude and behavior, which in turn affects learning (Landers, 2014). When studying gamification design elements, researchers need to take other factors into consideration, such as gender, age, game play experiences, learning contexts, disciplines, and so on (Landers et al., 2018).

Levels, Progress, Feedback, and Rewards. Levels, progress, feedback, and rewards are not as widely implemented as points, badges, and leaderboards, and are often used along with them. The research on those elements alone is scarce. Aguilar and colleagues (2018) conducted an experiment study examining a gamified learning system and its effects on students' intrinsic motivation. The system they used was called GradeCraft in which power ups (i.e., levels) were implemented along with other elements. The study reported an overall positive effect of the gamified learning system on satisfying students' need for autonomy (Aguilar et al., 2018). Overall, these gamification elements are under-studied, especially levels and feedback. Lack of empirical studies on elements other than points/badges/leaderboards has been a recurring issue in the previous reviews (Ritzhaupt et al., 2021).

Social Interaction. There are two types of social interaction pertaining to this study: competition and collaboration/cooperation. Social interaction plays an important role in a gamified learning environment. There are several benefits of integrating social interaction in gamification design. First, competition is a motivating factor that drives students to improve their performance. Students who like to compete are driven by several factors including the desire to win, the satisfaction that comes with winning or performing well, and the satisfaction that comes with being recognized (Franken & Brown, 1999). Competition can create a sense of achievement, which helps satisfy the need for competence (Ryan & Deci, 2000). Competition has been found to have a positive impact on affective outcomes (Ritzhaupt et al., 2021). Second, indirect competition (such as ranking on leaderboards) satisfies the need for competence (Ryan & Deci, 2000). Competition often appears along with other game elements such as points and leaderboards. In a controlled experiment, Landers et al. (2019) found that competition alone (without any other gamification design elements) can improve performance.

Third, collaboration allows for the exchange of ideas among students. The educational value of collaborative learning has been well documented. Research shows that collaboration supports the development of critical thinking skills, self-management, and leadership skills and promotes student-student interaction (Laal & Ghodsi, 2012). When students work together towards a common goal, they are more likely to be engaged and motivated to share ideas. Collaboration in gamification has been found to have a significant impact on cognitive learning outcomes (Ritzhaupt et al., 2021). Fourth, competition creates a sense of belonging, and collaboration promotes a sense of community; both help satisfy the need for relatedness (Ryan & Deci, 2000). As Sailer and Hommer suggested, a combination of competition and collaboration is a promising strategy for gamification (Sailer & Homner, 2020).

SUMMARY

Gamification has been studied extensively, especially in educational settings (Dichev & Dicheva, 2017; Seaborn & Fels, 2015). However, the findings of the studies are inconclusive. Although research has shown an overall positive effect of gamification on student learning outcomes, the findings are mixed with regards to the effect of specific gamification design elements such as badges and leaderboards. There are no conclusive findings on what elements or combinations of elements have the most impact.

Research in gamification in education are still very centered on investigating the effects of a few gamification design elements (such as badges and leaderboards) on student learning outcomes, and has yielded inconclusive results (Dichev & Dicheva, 2017; Landers et al., 2018), which could partially be attributed to the lack of theoretical foundation. Theory of Gamified Learning proposes that game elements have a direct effect on student attitudes and behavior. There are many factors that come into play in this process. Researchers and instructors will need to take these factors into consideration when implementing gamification in instruction. It is necessary to understand what gamification is and its theoretical connection before implementing it in instruction.

METHODOLOGY

The purpose of this study was to investigate the influence of gamification on student learning in higher education context. It aimed to identify the influential factors of gamification on student learning outcomes and examine the extent to which these influential factors contribute to its success.

RESEARCH QUESTIONS

This study was guided by the following research questions:

1. Can the probability that a gamified learning case is successful be predicted by the use of any of the eleven gamification design elements: Goals & Challenges (GC), Fiction Elements (FE), Points (P), Badges (B), Leaderboards (L), Levels (LV), Progress (PG), Rewards (RW), Feedback (FB), Social Interaction (SI), and Theory & Instructional Design (TD)? If yes, to what extent do the significant gamification design elements influence such probability?
2. Are there significant differences in the proportions between successful and unsuccessful gamified learning cases in relation to the presence and absence of certain gamification design elements?

RESEARCH DESIGN

A correlational research design approach was adopted to determine if gamification design elements used could predict whether the implementation of gamification was successful. Correlational research is a type of nonexperimental research that examines the statistical relationship between two or more variables without manipulating them (Price et al., 2017). This research design was chosen because (1) the researcher was interested in the relationship between gamification design elements and student learning outcomes, and (2) the researcher was unable to control the variables as the sample of the study was from the existing literature.

A quantitative content analysis method was adopted in this study. Content analysis is "a research technique for the objective, systematic and quantitative description of the manifest content of communication" (Berelson, 1952, p. 18, as cited in Liu, 2022). Content analysis can be used qualitatively or quantitatively for analyzing content systematically. The content (i.e., source data) is qualitative and can be in various formats, such as texts, drawings, photographs, audio recording, videos, etc. (Liu, 2022). While qualitative content analysis makes inferences by categorizing the source data and analyzing the themes, quantitative content analysis records and quantifies qualitative source data and uses statistical methods for hypothesis testing. The general procedure of quantitative content analysis resembles any other quantitative methods (Liu, 2022). In this study, it involved identifying the problem, formulating questions, determining sample/data selection criteria, data collection, data screening, data coding, data analysis, and result interpretation.

SAMPLING PROCEDURES

The following procedures were undertaken in data collection and sampling.

Literature Search Tool and Sources

The literature search was conducted using the search tool called Library Search. Library Search is a one-stop search tool for the major collections available at the institution where this study was conducted. This search tool includes content from major databases, including academic databases such as EBSCOhost Education Source, EBSCOhost Academic Search Premier, Wiley Online Library, Sage Journals, Elsevier ScienceDirect Journals Complete, Education Database, SpringerLink Journals, Social Science Premium Collection, ERIC, Taylor & Francis Online, ACM Digital Library, Web of Science, ProQuest, and so on. The search results can be filtered using the Advance Search option within the search tool.

Search Terms

To have as wide a coverage of the potential studies as possible, when searching for literature, the following search terms are used: *gamification OR gamif* AND "higher education"*. The search terms *gamification OR gamif** was adopted from previous systematic review and meta-analysis (Sailer & Homner, 2020; Seaborn & Fels, 2015). To narrow the search, an advanced search was applied with three limitations: (1) the publication dates were between *January 1, 2014* and *December 31, 2023*; (2) the publications were written in *English*; and (3) the type of publication was *Journals*.

The search terms yielded 1038 publications. To further narrow down the search, two filters were applied: (1) *Peer-Reviewed Journals* for the Item Type, and (2) *Education and Educational Research* under Topic. 625 records were remaining after this application.

Inclusion and Exclusion Criteria

The remaining 625 publications were further screened following four inclusion criteria:

1. The studies must be conducted in formal higher education settings with undergraduate and/or graduate students as participants. This criterion excluded all the studies conducted on Massive Open Online Courses (MOOC). It also excluded the studies that recruited online participants through third-party channels.
2. The studies used an experimental or quasi-experimental research design.
3. The studies used at least one game design element as described in the data coding section below.
4. The studies examined at least one domain of learning outcomes: cognitive, behavioral, and/or affective.

This screening process was conducted in two phases. The first phase involved screening through the titles and abstracts of the publications. In the cases when the information of the above four criteria were unavailable in the abstracts, a scan of the methodology section was needed to determine the inclusion or exclusion of the publications. The publications of which the full text was not available were excluded as well. This phase yielded 118 articles for the next phase—full text screening.

In this full text screening phase, using the four inclusion criteria detailed above, the researcher carefully went through the remaining publications for coding and extracting of information. This phase resulted in a final sample of 66 publications reporting 67 experiments. Figure 4 presents the data identification and selection flow chart.

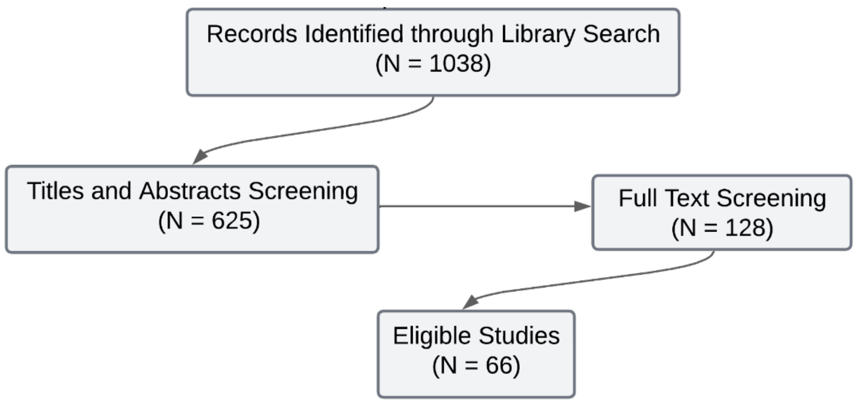

Figure 4**.** *Data identification and selection flow chart*

Final Sample

The final sample of this study consisted of 66 publications reporting 67 experiments or quasi-experiments. They were published between 2014 and 2023 and examined a total of 12,720 participants.

Ninety-six percent of the studies in the final sample were published in 40 peer-reviewed journals, including 18% in *Computers & Education*, and 11% in *Computers in Human Behaviors*. Other journal titles include *British Journal of Educational Technology*, *ACT Transactions on Computing Education*, *Journal of Computer Assisted Learning*, *Journal of Educational Computing Research*, *Simulation & Games*, to name just a few. Three publications were from international conference proceedings.

The studies in the final sample covered various disciplines in higher education. Thirty percent of the studies were in Business, including business management, marketing, economics, information system, etc.; 21% in Education, including science education, ICT, and research methods; 20% in Computer Science, with Programming being the most studied content subject.

DATA CODING

The final sample consisted of 67 experiments from 66 studies. Each experiment was treated as one case. Using content analysis, each experiment was examined to identify and code the variables of interest. The variables and coding criteria are described below, along with the process of random sampling for the second coder and the result of interrater reliability analysis.

Coding of the Variables

Learning Outcomes. This study was to explore the impact of gamification on student learning outcomes. The studies in the final sample explored a range of outcomes including learning performance (e.g., knowledge acquisition and retention), behavioral outcomes (e.g., participation, time on task), affective outcomes (e.g., motivation, satisfaction).

When coding for the response variable Learning Outcomes (LO), the researcher reviewed each sample to identify what domain of learning was assessed. A value of 1 was coded for being "***successful***" when the study reported improved outcome(s) in any of the domains of learning. A value of 0 was coded for being "***unsuccessful***" when the study did not produce the expected outcome(s). The researcher recorded the category of the domains (that is, cognitive, behavioral, or affective) each study examined.

Gamification Design Elements. Gamification design elements are the explanatory or predictor variables. Based on the literature, eleven elements were included in this research. The researcher reviewed each sample to identify the gamification design elements used in the experiment. A value of 1 was coded for being "***present***" when the element was used. A value of 0 was coded for being "***absent***" when the element was not used.

Table 1 provides a summary of coding for the response variable and all the explanatory variables used in data analysis.

Table 1. *Coding of the Response Variable and Explanatory Variables*

Variables	**Values**	
	1	**0**
Response Variable		
Learning Outcomes (LO)	Successful	Unsuccessful
Explanatory Variables		
Goals & Challenges (GC)	Present	Absent
Fiction Elements (FE)	Present	Absent
Points (P)	Present	Absent
Badges (B)	Present	Absent
Leaderboards (L)	Present	Absent
Levels (LV)	Present	Absent
Progress (PG)	Present	Absent
Rewards (RW)	Present	Absent
Feedback (FB)	Present	Absent
Social Interaction (SI)	Present	Absent
Theory & Instructional Design (TD)	Present	Absent

Interrater Reliability Analysis for Data Coding

The researcher completed the coding for a total of twelve variables (the response variable *Learning Outcomes* and eleven explanatory variables) using all 67 samples. According to Landis and Koch, 15% of the total number of the data will be considered as appropriate for the interrater reliability check (Landis & Koch, 1977). In this study, the researchers decided to use 30% (20 samples) of the total amount of data for the interrater reliability analysis. The second coder followed the same criteria of data coding as the researcher and recoded the 20 randomly selected samples.

The interrater reliability analysis was then conducted using Cohen's Kappa to determine the agreement of the coding results for the variables between the two coders (Cohen, 1960). Table 2 shows the interrater reliabilities between the two coders on all twelve variables. A value of Kappa between .40 and .59 is considered moderate, between .60 and .79 is considered substantial, and above .80 is considered outstanding (Landis & Koch, 1977). Based on this guideline, the levels of agreement between the two coders on the twelve variables were generally very good (as the values of Kappa ranged from .644 to .904). The data from the researcher, the first coder, was used for data analysis.

Table 2. *Levels of Agreement between Two Raters (N = 20)*

Variable	**Kappa**	***p*-value**

	Coefficient	
Learning Outcomes (LO)	.877	<.001
Goals & Challenges (GC)	.644	.002
Fiction Elements (FE)	.889	<.001
Points (P)	.859	<.001
Badges (B)	.786	<.001
Leaderboards (L)	.901	<.001
Levels (LV)	.811	<.001
Progress (PG)	.859	<.001
Rewards (RW)	.904	<.001
Feedback (FB)	.690	.001
Social Interaction (SI)	.667	.002
Theory & Instructional Design (TD)	.811	<.001

DATA ANALYSIS AND RESULTS

This study aimed to examine the influence of gamification on student learning outcomes and identify the gamification design elements that had significant impact on the successful implementation of gamification in higher education settings. This section provides the results of data analysis.

DATA ANALYSIS AND RESULTS FOR RESEARCH QUESTION 1

Question 1. Can the probability that a gamified learning case is successful be predicted by the use of any of the eleven gamification design elements: Goals & Challenges (GC), Fiction Elements (FE), Points (P), Badges (B), Leaderboards (L), Levels (LV), Progress (PG), Rewards (RW), Feedback (FB), Social Interaction (SI), and Theory & Instructional Design (TD)? If yes, to what extent do the significant design elements influence such probability?

The Logit Model and Variables in the Study

For research questions 1, logistic regression analysis was conducted.

In the logistic regression analysis for the present study, the response variable (RV) was Learning Outcomes, and the eleven gamification design elements were the explanatory variables (EV). The frequencies for each variable are shown in Table 3.

Table 3. *Frequencies (N = 67)*

Variables	**Values**	
	1	**0**
Response Variable		
Learning Outcomes (LO)	47	20
Explanatory Variables		
Goals & Challenges (GC)	54	13
Fiction Elements (FE)	13	54
Points (P)	48	19
Badges (B)	46	21
Leaderboards (L)	49	18
Levels (LV)	28	39
Progress (PG)	10	57
Rewards (RW)	21	46
Feedback (FB)	25	42

Social Interaction (SI)	54	13
Theory & Instructional Design (TD)	43	24

Two regression methods used for the logistic regression analysis in this study were: (a) forward selection, and (b) backward deletion.

Results of the Model with Forward Method

In logistic regression, *Forward* method "only enters explanatory variables that significantly contribute to the model" (Mertler & Reinhart, 2017, p. 193). That is, only those accounting for a significant amount of unique variance in the response variable are kept in the model. Explanatory variables "are entered one variable at a time. When no more variables account for a significant amount of variance, the process ends" (Mertler & Reinhart, 2017, p. 193).

Using *Forward* method, the results from the first logistic regression analysis showed that among all eleven gamification design element variables, only *Social Interaction* was retained in the model equation ($Wald\ \chi^2 = 6.868$, $p = .009$).

Model summary results showed that the model with this explanatory variable was significant ($\chi^2 = 7.154$, $p = .007$) and accounted for about 14.4% of the variation in the response variable (Nagelkerke $R^2 = .144$), indicating that this model significantly predicts group membership. The Hosmer and Lemeshow Goodness-of-Fit Statistic of 11.359 (p =.124) was not significant, therefore, the hypothesis that the model provides a good fit of data should be accepted. Specifically, 8 out of 20 (40%) unsuccessful gamified learning cases and 42 out of 47 (89.3%) successful cases, a total of 50 out of 67 (74.6%) cases, were correctly predicted by the model.

The results in the final step of the forward method are presented in Table 4.

Table 4. *Logistic Regression (Forward Method) Output*

	DF	Parameter Estimate	Standard Error	Wald Chi-Square	*P*	Odds Ratio
(SI)	1	1.723	0.657	6.686	.009	5.600
Constant	1	-0.407	0.570	0.680	.410	0.625

Note: Response variable: Learning Outcome (LO). Explanatory variable: Social Interaction (SI)

A significant Wald chi-square value for a given variable indicates that the variable is significantly related to the response variable. The Wald chi-square value for the variable *Social Interaction (SI)* was significant. The Parameter Estimate generates the coefficients of the fitted logistic regression model, and they are used to formulate the following logistic regression equation (1):

$$\textbf{logit}\ (\hat{p}) = -0.407 + 1.723(SI) \text{ ----------------- } (1)$$

The sign ($\hat{p}$) indicates an estimated probability value (also called *log odds*) for the response variable Learning Outcome (*LO*) to be 1, and logit represents *logit transformation* of the event probability.

An estimated coefficient indicates the contribution that explanatory variable makes to the possibility of the response variable being 1. For example, when the variable *Social Interaction* (*SI)* is 1 (that is, when social interaction was present in the gamified learning case), the logit transformation of event probability (that a gamification case is successful) increases by 1.723 (see Table 4).

Odds ratio is another statistic to explain the contribution of an explanatory variable to the model. If the odds ratio for a given explanatory variable is larger than 1, the probability of the response variable being 1 increases because of the presence of that explanatory variable. For example, the odds ratio for variable *Social Interaction (SI)* is 5.600 (see Table 4), indicating that a gamified learning case would be 5.6 times more likely to be successful if social interaction is implemented in the gamified learning experience, compared with cases that do not have social interaction implemented. If the odds ratio is smaller than 1, the probability of the response variable being 1 decreases (that is, the probability that a gamified learning case is successful decreases when that explanatory variable is present).

Results of the Model with Backward Method

In logistic regression, *Backward* method "enters all explanatory variables one at a time and then removes them one at a time based upon a level of significance for removal (the default is $p \geq .10$). The process ends when no more variables meet the removal requirement" (Mertler & Reinhart, 2017, p. 193).

Using *Backward* method, the results from the second logistic regression analysis showed that among all eleven gamification design element variables, three were retained in the model equation and they were *Fiction Element (FE), Badges (B),* and *Leaderboards (L)*.

Model summary results showed that the model with these three explanatory variables was significant ($\chi^2 = 14.213$, $p = .003$) and accounted for about 27.1% of the variation in the response variable (Nagelkerke $R^2 = .271$), indicating that this model significantly predicts group membership. The Hosmer and Lemeshow Goodness-of-Fit Statistic of .902 (p =.924) was not significant, indicating the hypothesis that the model provides a good fit of data should be accepted. Specifically, 6 out of 20 (30%) unsuccessful gamified learning cases and 45 out of 47 (95.7%) successful cases, a total of 51 out of 67 cases (76.1%), were correctly predicted by the model.

The results in the final step of the backward method are presented in Table 5.

Table 5. *Logistic Regression (Backward Method) Output*

	DF	**Parameter Estimate**	**Standard Error**	**Wald Chi-Square**	***P***	**Odds Ratio**
(FE)	1	1.886	1.094	2.974	.085	6.593
(B)	1	-1.471	0.778	3.579	.059	.230
(L)	1	1.899	0.738	6.630	.010	6.682
Constant	1	.320	0.667	0.230	.632	1.377

Note: Response variable: Learning Outcome (LO). Explanatory variable: Fiction Element (FE), Badges (B), and Leaderboards (L)

As shown in the results from the **Variables in the Equation** (see Table 5), two gamification design element variables (that are in the equation) are not significant: *Fiction Elements* (*Wald* $\chi^2 = 2.974$, $p = .085$), and *Badges* (*Wald* $\chi^2 = 5.579$, $p = .059$). They were included in the final model for three reasons. First, the model was significant in the model summary results as reported in the previous paragraph. Second, this model was the final model from the backward deletion process, and no more variables met the removal requirement (Mertler & Reinhart, 2017). As shown in Figure 5, for the option **Probability for Stepwise**, the default range is .05 for entry and .10 for removal. The significant values of the explanatory variables in the final model (see Table 5) were all smaller than 0.1.

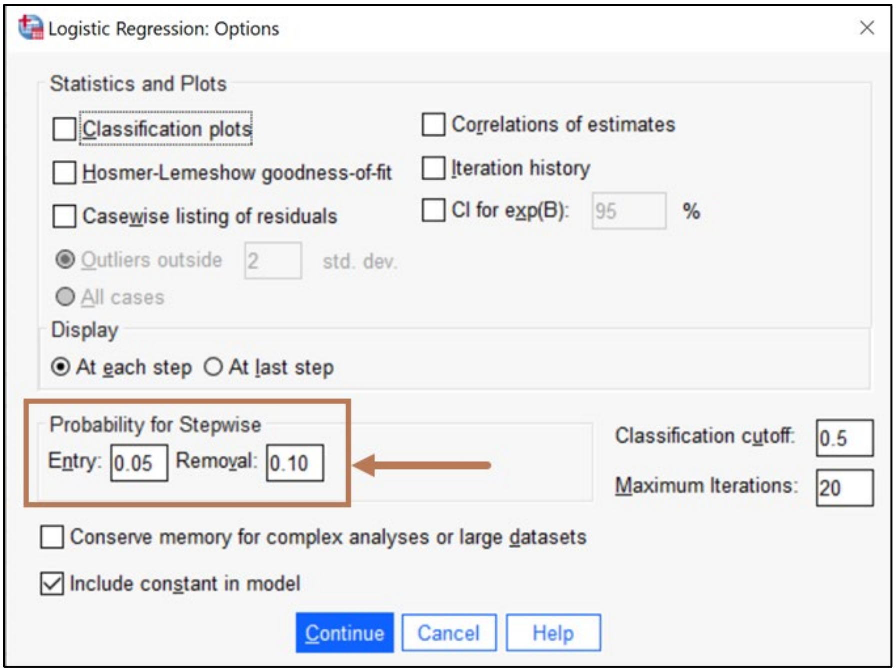

Figure 5. *Backward deletion criteria (from SPSS)*

Third, note that the significant value in Table 5 (from the SPSS results **Variables in the Equation**) is reporting the Wald test significance for the variables. However, when *Backward* method is used, likelihood ratio tests are conducted (IBM, 2023) and the results are shown in an SPSS table titled "**Model if Term Removed**" (see Table 6). For this study, these three variables significantly influence the change in the likelihood ratios of the model if any of them are removed from the model (*p* = .031, .036, and .005 for the three variables respectively).

Table 6. *Model if Term Removed*

	DF	Model Log Likelihood	Change in -2 Log Likelihood	*P*
(FE)	1	-36.054	4.636	.031
(B)	1	-35.927	4.381	.036
(L)	1	-37.702	7.932	.005

Therefore, all three variables are retained in the final model. The Parameter Estimate generates the coefficients of the fitted logistic regression model, and they are used to formulate the following logistic regression equation (2):

$$\textbf{logit}\ (\hat{p}) = 0.320 + 1.886(FE) - 1.471(B) + 1.899(L) \text{ ----------------- } (2)$$

The sign ($\hat{p}$) indicates an estimated probability value (also called *log odds*) for the response variable Learning Outcome (*LO*) to be 1, and logit represents *logit transformation* of the event probability. The interpretation of the coefficients, odds ratios, and the model are similar as described in the first model and equation (1).

Summary of Results in the Two Models

In the logistic regression analysis, forward selection and backward deletion methods were used and two models were generated. In the first model (see equation 1), *Social Interaction* was included in the final model. In the second model (see equation 2), *Fiction Element, Badges,* and *Leaderboards* are included in the final model. The two models varied in the presence of the explanatory variables. Upon closer investigation, the two models have produced similar results: *Social Interaction* was the only significant variable included in the first model while *Leaderboards* was the only significant variable in the second model. In this study two types of interaction were identified as social interaction: competition and collaboration/cooperation. If a study included competition and/or collaboration/cooperation, the *Social Interaction* variable was coded as 1 for being present. In addition, as leaderboards are related to competition, if a study implemented *leaderboards*, a value of 1 was given to the variable *Social Interaction* for that study. It is not surprising that *Leaderboards* was retained as a significant predictor in the second model.

As for the other two variables in the second model, *Fiction Elements* and *Badges*, as explained earlier, these two variables were retained in the model because their significant value were smaller than .10, the default value for removal. They play a significant enough role that they shall not be removed, otherwise the model will change significantly.

DATA ANALYSIS AND RESULTS FOR RESEARCH QUESTION 2

Question 2. Are there significant differences in the proportions between successful and unsuccessful gamified learning cases in relation to the presence and absence of certain gamification design elements?

Chi-Square Test and Results

In the data analysis for research questions 2, a nonparametric analysis method – Chi-Square test (test of independence) was used. Each of the eleven gamification design elements was examined with Chi-Square (χ^2) tests by the two types of gamified learning cases (successful or unsuccessful). That is, eleven 2x2 Chi-Square (χ^2) tests were conducted, in which

- The Row Variable (A) = each of the gamification design element variables, with 2 categories (a1 = present, a2 = absent)
- The Column Variable (B) = gamified learning cases (learning outcomes), with 2 categories (b1 = successful, and b2 = unsuccessful)

All eleven variables were examined, and only two of them were significant. The following are the results from the two significant (χ^2) tests.

Social Interaction by Learning Outcome. The overall (χ^2) test result was significant: χ^2 (1, N=67) = 7.734, p = .005, and effect size Phi (φ) = .215, p = .006, indicating that the proportions of the two types of gamified learning cases (successful and unsuccessful) were significantly different between those in which social interaction was implemented, and those in which social interaction was absent. In 47 cases that were successful (b1), 42 (89.4%) included social interaction, and 5(10.6%) did not. In 20 cases that were unsuccessful (b2), 12 (60.0%) included social interaction, and 8 (40.0%) did not.

Leaderboards by Learning Outcome. The overall (χ^2) test result was significant: χ^2 (1, N=67) = 4.772, p = .029, and effect size Phi (φ) = .267, p = .029, indicating that the proportions of the two types of learning cases (successful and unsuccessful) were significantly different between those in which leaderboards were present, and those in which leaderboards were absent. In 47 cases that were successful (b1), 38 (80.9%) used leaderboards, and 9 (19.1%) did not. In 20 cases that were unsuccessful (b2), 11 (55.0%) used leaderboards, and 9 (45.0%) did not.

The other nine Chi-Square tests (between Learning Outcomes and each of the other nine gamification design elements) were NOT significant. The nonsignificant results indicated that the proportions of the two types of gamified learning cases (successful and unsuccessful) were not significantly different between those in which a particular gamification element was present, and those in which that element was absent.

All the eleven Chi-Square test results were summarized in Table 7.

Table 7. *Summary of Chi-Square tests*

Variable A Gamification Elements		**Variable B Learning Outcomes**		**Chi-Square Results** *df = 1, N = 67*		
		0[a] n = 20	1[b] n = 47	χ^2	*p*	*Phi (φ)**
**Social Interaction	0[c]	8 (40%)	5 (10.6%)	7.734	.005	.340
	1[d]	12 (60%)	42 (89.4%)			
**Leaderboards	0	9 (45%)	9 (19.1%)	4.772	.029	.267
	1	11 (55%)	38 (80.9%)			
Goals & Challenges	0	5 (25%)	8 (17%)	0.571	.450	.092
	1	15 (75%)	39 (83%)			
Fiction Elements	0	19 (95%)	35 (74.5%)	3.782	.052	.238
	1	1 (5%)	12 (25.5%)			
Points	0	6 (30%)	13 (27.7%)	0.038	.846	.024
	1	14 (70%)	34 (72.3)			
Badges	0	4 (20%)	17 (36.2%)	1.705	.192	.160
	1	16 (80%)	30 (63.8%)			
Levels	0	14 (70%)	25 (53.2%)	1.629	.202	.156
	1	6 (30%)	22 (46.8%)			
Progresses	0	17 (85%)	40 (85.1%)	0.210	.091	.151
	1	3 (15%)	7 (14.9%)			
Rewards	0	14 (70%)	32 (68.1%)	0.024	.877	.019
	1	6 (30%)	15 (31.9%)			
Feedbacks	0	13 (65%)	29 (61.7%)	0.065	.798	.031
	1	7 (35%)	18 (38.3)			
Theory & Instructional Design	0	8 (40%)	16 (34%)	0.217	.642	.057
	1	12 (60%)	31 (66%)			

Notes: (*) all the Phi (φ) tests had the same significant level of p as in each of the χ^2 tests.
(**) significant gamification elements
a. unsuccessful; b. successful; c. element absent; d. element present.

Consistency with Logistic Regression Results

Chi-Square tests produced the same results as logistic regression analyses. Chi-Square test results showed that *Social Interaction* and *Leaderboards* were significantly related to the successful implementation of gamification, which is consistent with the two models in the logistic regression. As discussed earlier, the variables Social Interaction and Leaderboards are closely related to each other. A value of 1 was given to the variable Social Interaction for a study if it implemented leaderboards. Chi-Square tests results provided further support for the results of logistic regression analyses.

The two tests provided strong evidence that for the implementation of gamification to be successful, social interaction and leaderboards need to be included in the design of gamified learning.

DISCUSSION AND CONCLUSION

This study investigated the factors that influence the successful implementation of gamification in higher education settings. The purpose of the study was to determine what gamification design elements were more likely to influence the success of a gamified learning case; in other words, what elements had the most influence on student learning outcomes.

This section first summarizes the current state of empirical gamification research in higher education. It then provides discussions of the findings for the research questions. The implications for practice and future research are discussed, followed by the limitations of this study.

CURRENT STATE OF EMPIRICAL GAMIFICATION RESEARCH IN HIGHER EDUCATION

The application of gamification in education is a comparatively new phenomenon. One consistent finding in the syntheses of early scholarship is that gamification research lacks theoretical foundation and methodological rigor (Dichev & Dicheva, 2017, Seaborn & Fels, 2015). The field has grown ever since and the research is more focused on understanding how individual game design element works, and on advancing theories in the field (Rapp et al., 2019). As the field keeps growing, it is necessary to find out if the previous findings of lacking theoretical foundation and methodological rigor still hold.

In their synthesis of literature, Seaborn and Fels (2015) found that the majority (87%) of the experiments did not address theoretical foundation. In this study the researcher reviewed and analyzed 67 empirical studies of gamification on student learning outcomes in higher education settings, published between 2014 and 2023 in peer-reviewed journals. Forty-three out of 67 (65%) studies discussed theories, instructional design principles, or theoretical models (see Table 3). Self-Determination Theory was the most applied theory, in 44% of studies, followed by Goal Setting Theory (9%) and Theory of Gamified Learning (9%). Four studies applied instructional design principles in their design of gamification. This finding showed that gamification research has made progress in applying and validating theories, and in improving its usefulness in education (Rapp et.al, 2019).

Nonetheless, there are still challenges facing gamification research in education. One-third (33%) of the studies did not mention theoretical foundation. Theories are essential to research as they provide frameworks for understanding how things work and how concepts are related to each other, for guiding the research process and for making sense of research findings and translating them to practice (Bhattacherjee, 2012). Without the guidance of theories and instructional design principles, gamification interventions may not effectively achieve desired learning outcomes. This was evident in the results reported in the experiments included in this study. Although many reported positive effects of gamification on student learning outcomes, 30% of the experiments did not yield the results they expected (see Table 3). The inconclusive results found in this study are consistent with the findings in previous syntheses (Dichev & Dicheva, 2017, Huang et al., 2020; Ritzhaupt et al., 2021; Sailer & Homner, 2020).

In summary, although progress has been made, gamification research in higher education still faces various theoretical and methodological challenges (Dichev & Dicheva, 207; Landers et al., 2018; Rapp et al., 2019). More theory guided empirical studies are needed in order to advance the field of gamification research.

GAMIFICATION DESIGN ELEMENTS

Gamification is the intentional use of game design elements in non-game contexts to increase motivation, engagement, and interaction (Deterding et al., 2011; Kapp 2012;

Seaborn & Fels, 2015). For gamification intervention to be effective, instructors will need to identify the issue and the course of actions that can solve the issue, and then carefully select the design elements that can help facilitate this process, whether it is to increase self-test practices, online discussion participation, or improved time on task. Therefore, it is imperative to investigate gamification design elements and identify the ones with the greatest potential. The purpose of this study was to examine the effects of gamification on student learning outcomes. It aimed to identify specific gamification design elements that had significant influence on learning outcomes. The results of data analyses showed that *social interaction* and *leaderboards* were the two gamification design elements that have the most impact on student learning outcomes, followed by *badges* and *fiction elements*.

Social Interaction

Social interaction has been found to have the most significant impact on student learning outcomes. This result is consistent with the findings in Sailer and Homner's (2020) meta-analysis on gamification and learning. In their study they identified three types of social interaction: competition, collaboration, and competition-collaboration combination, and found that the competition-collaboration type of social interaction has a significant effect on behavioral outcome (Sailer & Homner, 2020). This result is also consistent with Huang, Ritzhaupt, and colleges' (2020 and 2021) syntheses of literature in which they found competition has positive impact on affective outcomes and collaboration positively affect cognitive outcomes (Huang et al., 2020; Ritzhaupt et al., 2021).

It is not surprising that this study found that social interaction has a significant impact on learning outcomes. In this study, social interaction refers to competition and collaboration/cooperation between individual students and/or groups/teams and was coded based on this definition. Self-Determination Theory (Ryan & Deci, 2000) proposes that there are three basic psychological needs: the needs for competence, autonomy, and relatedness. These needs are essential for individuals to experience intrinsic motivation. When these needs are satisfied, individuals are more likely to be intrinsically motivated to perform the required tasks and experience optimal learning outcomes (Ryan & Deci, 2000). Competition and collaboration/cooperation support basic psychological needs for competence and relatedness. Landers and colleagues (2019) conducted an experiment in which they only applied one design element—competition. Their finding has shown that competition alone can improve performance (Landers et al., 2019), providing empirical support for Self-Determination Theory.

Social interaction plays an important role in everyday life and has been researched extensively in social science. However, there has been no studies in gamification research in education that examines the effect of social interaction as a gamification design element on learning outcomes, with the exception for one—Sailer and Homner's (2020) meta-analysis, and their analysis focused more on the methodological rigor of gamification research. In gamification research, the discussions on gamification design elements are generally centered on the classic elements in game design, such as points, badges, leaderboards, levels, challenges, etc. Little attention has been given to other design elements such as social interaction. This study contributed to literature in that it has included social interaction as a gamification design element. More empirical studies are needed to intentionally implement social interaction in the design of gamification in instruction and examine its impact on student learning outcomes.

Leaderboards

Leaderboards have been found to be significantly related to the successful implementation of gamification. This finding is consistent with the existing literature (Dias, 2017; Garcia-Cobot et al., 2019, Landers et al., 2017, Landers & Landers, 2014, Mekler et al., 2017, Sailer & Sailer, 2021). Leaderboards are the rankings of performance of individual students or teams. As leaderboards rank students/teams based on their achievements, they create a sense of competition among students as they compare their performance with others, hence, facilitate the satisfaction of the need for competence. Landers and Landers (2014) found in their experiment that leaderboard alone could improve student time on task (behavioral outcome), similar results were found in Mekler and colleagues' study (Mekler et al., 2017).

In gamification practice, leaderboards are often used along with points, badges, and/or levels. When comparing points, levels, and leaderboards, Mekler et el. (2017) found that levels and leaderboard significantly improved participants' tagging performance (behavioral outcome). Sailer and Sailer (2021) implemented points and a team leaderboard in a flipped classroom. By using a team leaderboard, they incorporated both competition and collaboration (i.e., social interaction) in the experiment. The result was promising. They found that the use of points and a team leaderboard had positive effects on student intrinsic motivation and a positive indirect mediating effect on application knowledge (Sailer & Sailer, 2021). Their study validated the two theories used in this research—Self-Determination Theory and Theory of Gamified Learning, highlighting the importance of theoretical foundation in empirical research.

Nonsignificant Gamification Elements

Badges, although not statistically significant, have been found to be negatively related to the successful implementation of gamification (see Table 5). Badges provide feedback about students' achievements. Depending on the design, badges can be visually appealing and can be easily implemented in most Learning Management Systems. Studies on the effectiveness of badges yielded positive but mixed results. In some experiments included in this study, badges have been found to have no effect on learning outcomes (Balci et al., 2022; Kyewski & Kramer, 2018; Morris et al., 2019), or negative impact (Hanus & Fox, 2015). Badges are generally implemented and examined along with other elements such as points and leaderboards, with a few exceptions (Dicheva et al., 2020; Hamari, 2017). Dicheva et al. (2020) found students who used the system in which badges were implemented practiced more (behavioral outcome) than those in the system without badges, leading to a better academic performance.

The findings on the effectiveness of badges in the literature are mixed. The nonsignificant but negative impact of badges found in this study has added to the mixed results of research, providing further evidence that the effectiveness of gamification may vary depending on various factors, such as individual and situational factors, learning contexts, disciplinary factors, and methodology factors (Landers et al., 2018, Ritzhaupt et al., 2021, Sailer & Homner, 2020).

Fiction elements have been found to be related to the successful implementation of gamification in this study, which is consistent with the findings in the previous meta-analysis (Sailer & Homner, 2020). Although the element itself is not significant, its contribution to the model significance is undeniable (see Table 5). The result provided further support that game fiction can enhance student engagement by creating a more immersive experience that captures students' attention and motivates them to put in more efforts in the course activities.

Fiction elements, especially narratives and storylines, aim to make the learning experience more immersive and enjoyable, and to create a sense of purpose and meaning in the activity, which can enhance motivation and engagement (Kapp, 2012). In their experiment, Frost and colleagues (2015) used a hero's adventure storyline and reframed assignments and assessments as quests to fight "monsters". They found that gamification has a small but positive effect of gamification on relatedness, one of the three basic psychological needs. The authors attributed leaderboards and the storyline to the small but positive effect (Frost et al., 2015). In the other two experiments (Bai et al., 2023; Rodrigues et al., 2022), the introduction of fantasy has been found significantly increased student engagement with the content and interaction with peers, which led to a better learning performance.

However, fiction elements are the least used design elements; only 13 out 67 (17 %) of experiments included in this study implemented fiction elements. Among those 13 experiments, only 4 integrated narratives or fantasy stories throughout the course (Arufe Giraldez et al., 2022; Bai et al., 2023, Frost et al., 2015; Rodrigues et al., 2022). This may be because an immersive gamified system is costly to design and develop and requires the collaboration of instructors, instructional designers, graphic designers, programmers, etc. (Ritzhaupt et al., 2021). Nevertheless, adding fiction elements in gamification design has shown to be worthwhile. Research has pointed out that one limitation of gamification (or a gamified learning system) has been its novelty effect—it may not sustain student interest in the long term (Huang et el., 2020; Sanchez et al., 2020; Tsay et al., 2020). The four experiments (Bai et al., 2023, Frost et al., 2015; Giraldez et al., 2022; Rodrigues et al., 2022) have provided empirical evidence that narratives and fictional storylines help overcome this novelty effect.

It is without a doubt that creating fictional stories and narratives is time and labor intensive, and not every instructor is a creative writer or graphic designer. With the recent advancement and availability of Generative AI such as ChatGPT, it is worthwhile to explore the potential of this new tool. Creating a fictional story may become an easier task than one thinks.

The rest of the gamification design elements—*goals & challenges, points, levels, progress, rewards, feedback, theory & instructional design*—were not found to have any significant influence on the success of gamification implementation. There can be several reasons for this result. Some elements were not present in many studies and their contribution could not be identified, for example, *progress* (or the progress bar), which was only implemented in 10 out of 67 studies. Progress is comparatively easy to implement in a gamified learning system. It provides instant feedback to students about their performance and is worth further exploration. The nonsignificant result of the element *theory & instructional design* is consistent with the findings in the literature. As discussed earlier in this section, there is still a big portion (30%) of the empirical experiments included in this study that did not discuss or mention theoretical foundation, highlighting the challenge facing gamification research in higher education.

It is worth noting that nonsignificant results do not necessarily mean that these design elements have no influence on student learning outcomes. It only indicates that they were not significant in this study, which was limited to 66 studies and not all studies have strong theoretical foundation and methodology rigor. This finding may be used as a reference.

IMPLICATIONS AND FUTURE STUDIES

This study investigated the influential factors of gamification in higher education. It examined the commonly used gamification design elements and identified the ones most influential to the successful implementation of gamification. Social interaction and leaderboards have been found to be significantly associated with the successful implementation of gamification in higher education settings. Below are some implications for practice and future research.

Implication for Practice

The main implication of this study is related to the design of gamification in higher education settings. It is critical to understand what gamification is and is not. Gamification is the *intentional* use of *game design elements* in non-game contexts to *increase motivation, engagement, and interaction* (Deterding et al., 2011; Kapp, 2012; Seaborn & Fels, 2015). Gamification is *not* simply adding game elements to any context. It is a *design* process that enhances the learning process that is already existing (Landers et al., 2018). It is also critical to understand that gamification itself does not have a direct impact on student cognitive learning outcomes. Instructional content is the most important factor that affects student learning (see Figure 3). Without well-designed instructional content, even gamification with state-of-the-art design cannot help. In addition, the effects of gamification on learning are through its impacts on student behaviors and attitudes (Landers et al., 2014) (see Figure 3). There are many factors affecting the effectiveness of gamification. When designing gamification, instructors and instructional designers will need to consider individual and situational factors that may affect the effectiveness of the gamification intervention. Such individual and situational factors include (and not limited to) gender, age, learning environment (online vs in person), and disciplines, etc. (Landers et al., 2018; Ritzhaupt et al., 2021; Sailer & Homner, 2020).

Social interaction plays an important role in everyday life. The three basic psychological needs—the need for competence, autonomy, and relatedness—are motivational resources. Relatedness is essential for motivation and well-being (Ryan & Deci, 2000). When students feel related to their peers and community, they are more likely to be motivated and engaged in learning activities.

Based on Self-Determination Theory and Theory of Gamified Learning, the researchers put forward the following suggestions for instructors and instructional designers regarding the design of gamification application:

Design for the need for competence. The need for competence refers to the feeling of being able to do well in a task. To facilitate the satisfaction of this need, instructors and instructional designers can (1) provide clearly defined goals and objectives of the gamified learning experience, which gives students a sense of direction and purpose; (2) use a progress bar that allows students to track their progress; (3) incorporate levels for students to advance through, which gives them a sense achievement; (4) provide timely and meaningful feedback on students' performance (feedback is the second most important factor on learning); and (5) use team leaderboards to motivate students to collaborate with peers and improve their performance.

Design for the need for autonomy. The need for autonomy is the sense of ownership one feels in the decision he/she makes and the direction he/she chooses. To facilitate the satisfaction of the need for autonomy, instructors and instructional designers can (1) provide students with choices such as different activities/tasks or different levels of difficulty to choose from; (2) allow for personalization such as avatars; (3) use fictional narratives or storylines to create a personal and immersive gamified learning experience; (4) provide multiple pathways to success; and (5) provide constructive feedback with actionable comments and directions for improvement.

Design for the need for relatedness. The need for relatedness is the feeling of a sense of attachment to and a sense of belonging among other people. To facilitate the satisfaction of the need for relatedness, instructors and instructional designers can (1) incorporate social interaction (competition and collaboration) in the gamified learning environment by using group work and team leaderboards; (2) provide opportunities for various social interaction such as commenting, the use of emojis and the *Like* button, and peer feedback; (3) create narratives or storylines that resemble the real-world experiences. Narratives do not have to be fictional; they can be real world scenarios that students can feel related to.

In summary, at the time when student disengagement and disconnection is at an all-time high level, it is imperative for instructional designers and instructors to make collaborative effort to help alleviate this issue by providing opportunities that facilitate the satisfaction of the basic psychological needs of students. It is also important to note that gamification is intentional, aiming at a change in the outcome. It is a process that uses design principles to add game elements to an existing process (i.e., instruction) to change how that process influence students (Landers, 2014; Landers et al., 2018). Effective instructional content is the key. Well-designed gamification facilitates the changes in the learning outcomes.

Implications for Future Studies

Gamification research has come a long way in the past 20 years. The field has made progress but there are still challenges (Nacke & Deterding, 2017; Rapp et al., 2018). Empirical studies on gamification are still very much concentrated on classic game elements such as points, badges, leaderboards, and levels, and research on other elements still lacks (Ritzhaupt et al., 2021). Design elements such as narratives, fictions, and social interaction have great potential in improving student learning outcomes. Future studies can explore those under-researched elements and examine how they impact student attitudes and behaviors in the gamified learning environment. In addition, sizable studies still lack theoretical foundation, as is evident in the findings of this study and in other reviews and meta-analyses (Landers et al., 2018; Ritzhaupt et al., 2021; Sailers & Homner, 2020). There are many factors that come into play when implementing gamification in instruction. Well-established and field-tested theories help researchers identify those factors. Self-Determination Theory and Theory of Gamified Learning are such theoretical frameworks that can be applied to gamification research. While Self-Determination Theory focuses on the elements that affect human motivation, Theory of Gamified Learning centers on the factors that affect the gamification design and implementation process. It is imperative that future studies use theories to guide the gamification design, implementation, and evaluation process, and to validate and advance theories in the field. Afterall, gamification is a design process. It is about students. It is about bringing changes to students.

LIMITATIONS

There are a few limitations to this study. First, this study employed a correlational research design approach. Correlational research can only determine the association between the variables and cannot establish causal relationships (Sprinthall, 2003). The sample is from existing literature. The methodological rigor of the empirical studies included in this research directly affects the correctness in the association between the variables found in this study. Second, this study was only able to retain 67 cases in the final sample due to strict inclusion criteria. For an expected odds ratio to be 3.0, a sample size of 96 is needed for logistic regression analysis (Liu et al., 2019). The comparatively small sample size may limit the generalizability of the study. Therefore, the results from this study can only provide a reference for future research and practice.

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