A Systematic Mapping of Gamification in Higher Education

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ABSTRACT

A systematic mapping was performed on gamification in higher education to understand its main benefits, the most investigated gamification techniques and the main characteristics of a gamification design needed to apply in a course. Gamification is a practice adopted to encourage motivation and commitment of individuals involved in a specific activity. The results indicated that gamification designs in high education have positive effect on motivation, engagement and leaning. Gamification provide regular feedback to students and foster student's interest, attention, attendance and interaction in classroom. The most used game elements in the selected articles were points, achievements and leaderboards, followed by levels, rewards, feedback and challenges. The effectiveness of a gamification design has been often evaluated through students' results, activities and/or perceptions.
Keywords: gamification, gamification design, game elements, systematic mapping, higher education

INTRODUCTION

Gamification is the use of game elements in non-game contexts (Deterding et al., 2011) to motivate and encourage commitment and participation of the people in these activities. Gamification has been applied in many areas such as: business, health, marketing and education. This study analyzed the application of gamification especially in higher education. This study performed a systematic mapping on three main repositories of scientific articles - Scopus, ScienceDirect and IEEE Xplore - and a research in Google Scholars.

The use of game elements in other activities is justified by the popularization of video games in the last decades as a form of entertainment. Mass popularity of video games in recent years has increased the games influence on people (Jakubowski, 2014). Video games are interactive activities that continually provide challenges and goals to the players (Domínguez et al., 2013). Games have remarkable motivational power; they utilize a number of mechanisms to encourage people to engage with them, often without any reward, just for the joy of playing and possibility to win (Dicheva et al., 2015).

The remainder of this paper is presented as follows: the Background section gives a brief overview on some subjects

discussed in work, the Related Works section presents some secondary studies that are directly linked to the topic proposed, the Research Method Section describes the method used in the mapping, the following section shows the results that were found and the final section concludes with the last observations.

BACKGROUND

Cudney et al. (2015) claim that Nick Pelling used the term gamification for the first time in 2001. Although, the term is relatively new, the use of game design element in various applications is nothing new. Even before the term was created, the idea of using game elements was already used in loyalty cards and frequent flyer programs (Shpakova, Dörfler & MacBryde 2017). Over time, the technology has evolved, allowing the use of more advanced gamification techniques.

Gamification has been recurrently defined as the use of game elements in non-game contexts (Deterding et al., 2011). Gamification has been usually confused with the use of serious games in education. However, this practice, known as game-based learning, refers to use of self-contained game artefacts deployed at some point in a learning path actuated in an educational context (Caponetto, Earp, & Ott 2014) and has been used for much longer than gamification.

Shpakova et al. (2017) define gamification as the process of making activities more like games in non-game contexts, without making it a game itself. This final differentiation underscores the nuances between gamification and serious games. Gamification only makes use of game elements, whilst a serious game is a game whose purpose is learning or training.

Landers (2014) explains the objectives of both serious game design and the gamification of learning are the improvement of learning outcomes, but the processes involved to achieve such gains are quite different. Serious games are commonly designed to affect learning directly. Otherwise, gamification designs do not usually seek to influence learning directly; instead, the goal of gamification is to increase engagement in learners to moderate or mediate the learning outcomes.

Current students who were born in the mid-1980s grew up with the internet being part of their lives. They have other ways of learning and communicating, and have decreased skill to pay attention. The lack of student motivation is a recurring problem to complete the school (Barna & Fodor 2018). This scenario occurs in higher education too, since students have not been able to complete undergraduate courses at the appropriate time (Iosup & Epema, 2014).

Gamification systematically offers rewards that incite extrinsic motivations thereby adding intrinsic motivations in a given process (Wiggins, 2016). In education, gamification aims to create an intrinsic motivation in students and encourage their commitment. Gamification creates a fun and enjoyable learning environment (Khaleel et al., 2018). In higher education, gamification has others goals too: stimulate the learning process and students participation in presentations (Jakubowski, 2014), promote self-study and communication among students (Caponetto et al. 2014), provide feedback to students, and develop their creativity (Fuchs & Wolff 2016).

Gamification can lead to better course experience for the students and to better overall course outcomes, but cannot solve courses problems like poor quality of content and improper teaching skills (Barna & Fodor 2018).

Gamification in education consists mostly of incorporating a suitable combination of game elements within learning activities (Dichev & Dicheva 2017). Many game elements have been recommended in the secondary studies from Related Works and have been used in articles selected from systematic mapping.

A scoring system is the first idea that appears to mind when it comes to gamification. Points, badges and virtual items like objects and coins are given to students as rewards (Laskowski & Badurowicz 2014). Badges can replace the scoring system. Levels may be reached when students reach certain points (Jassem & Piskadło 2014). The system usually informs the amount of points needed to reach the next level. The points received for completing the tasks may be time-based (Aşıksoy, 2018). But the game may also not suggest what should be done to acquire these rewards. Thus, the game includes the elements of surprise and curiosity (Jassem & Piskadło 2014).

Competition is the most observed feature in games. Leaderboards are used to stimulate competition among students. Leaderboards represent rankings where students can compare the points and badges they have earned. Otherwise, there are games where cooperation among players is important to achieve goals and makes the game more attractive. Gamification may also include challenges that require cooperation.

Some gamification designs may contain an initial training tutorial, commonly called onboarding to familiarize students with the gamified system, to understand its rules, the tasks to be accomplished and the possible achievements.

Teachers register tasks for the students to undertake them. Tasks may have a deadline to be solved. In games, time constraints are also used to create a sense of urgency, which creates pressure for students to think and act quickly (de Armas de Armas et al., 2019). Time pressure gives learners a time limit to interact heavily or to complete tasks and can arouse more emotional feedback and encourage greater participation (Chang & Wei 2016).

Tasks and other content may be not initially available. So students must unlock them to gain access. Unlock rules obviously vary with each gamification design, but usually tasks and other content are unlocked as students solve tasks and acquire points and other achievements.

Progress bars are used as percentage based guide to learners, providing some degree of motivation. Progress bars have been also linked with task completion, goal achievement and reaching the next level (Cheong et al. 2014). This progress highlights the importance of feedback in gamification, returns relevant information to the student and generates a cycle of engagement (Klock et al. 2016) (Figure 1). The student is motivated to perform a certain action. The feedback of this action strengthens the students' motivation to carry out other activities.

FIGURE 1
CYCLE OF ENGAGEMENT, ACCORDING TO KLOCK ET AL. (2016)

Feedback is also shown when the gamified system informs the correct answer, how many points were gained, what were the total points earned, which badges and objects were acquired, if there are still badges to conquer, and so on. The time teachers take to correct tasks is one of the obstacles to getting immediate feedback on gamification projects.

Gamification can contain a story, from which a narrative that directs its dynamics is developed. Virtual items and avatars may be inserted in the story. Avatars are characters that represent players in games, chats, forums or any social media platforms. Players may enhance avatar characteristics by purchasing virtual items or skills with virtual coins.

Games may offer alternative paths as the player progress in the environment. In gamification, players may decide what options take to proceed. Gamification can even personalizes the students' experience (Lopes, 2014), adapting the tasks and challenges according to the level reached and increasing the difficulty as the students train themselves acquiring knowledge (Dicheva et al., 2015).

Finally, an interesting characteristic of games, especially digital games, is that they encourage repetition. Players repeat challenges not yet overcome as long as they still have lives in games. This feature is both motivating and engaging, and can also be reproduced in gamification. In education, a gamification design may allow students to redo a task solved incorrectly by a few attempts or until get the task right.

RELATED WORKS

This section will briefly expose some secondary studies (study that makes aggregation of information based on primary studies related to a specific research question (Keele et al., 2007)) on gamification in education. We have got these secondary studies from the systematic mapping described in Research Method section.

Caponetto et al. (2014) performed a literature review on gamification from primary school to higher education. They found that gamification techniques have been used to fostering participatory approaches and collaboration among peers, self-guided learning and strengthening student creativity.

Dicheva (2015) performed a systematic map on gamification in education. The author found that gamification increased students' attendance, engagement and participation. Dichev and Dicheva (2017) also presented a review that has been structured based on the combinations of the game elements. They verified that gamification improve performance, motivate continuous learning; and increase knowledge retention.

Alsawaier et al. (2018) explored the effects of gamification on education to promote task engagement, increase motivation, and enforce desirable learning behaviours. They found that avatars, quests and challenges, badges, points and levels were the most used game elements.

Bozkurt and Durak (2018) performed a systematic review in gamification which investigated the most preferred research methods and conceptual frameworks. They found that most studies used a combination of game elements and gamification increased students' engagement and motivation.

Subhash and Cudney (2018) conducted a systematic review on gamification in higher education. They identified that gamification designs have combined game elements in different ways and gamification improved students' motivation, engagement, confidence and performance.

Albertazzi et al. (2019) presented an overview of gamification research in many domains between 2012 and 2017. They also found that gamification increased students' motivation and engagement.

Buckley et al. (2019) found in their empirical study of gamification in education and health. They pointed out that context is extremely important for gamification designs.

Table 1 summarizes the analyses of secondary studies and highlights the positive findings of gamification designs. But Alsawaier (2018), Buckley et al. (2019), and Dichev and Dicheva (2017) also found negative findings. These studies concluded that the potentials and effects of gamification must be examined by further empirical research.

TABLE 1
ANALYSES OF SECONDARY STUDIES

References	Subject Areas	Game Elements	Findings
Caponetto et al. (2014)	computer science, software engineering, math, science, foreign languages, health, business and logistics	achievement badges, rewards, leaderboard	force participation and collaboration, self-guided learning, completion of tasks, strengthening creativity
Dicheva et al. (2015)	computer science, game programming, engineering, math and science	points, badges, leaderboard, levels, progress bars	increase attendance, engagement, participation, material downloads
Dichev and Dicheva (2017)	computer science, communication, math, languages and health	points, badges, leaderboard, levels, progress bars	improve learning performance, participation, engagement, motivate continuous learning, increase knowledge retention
Alsawaier et al. (2018)	computer science, software engineering, programming languages and electronics	points, badges, levels, avatars and quests	positive effect on motivation, engagement and performance
Bozkurt and Durak (2018)	education, engineering, health, marketing and business	points, badges, leaderboard	increase engagement, motivation and behavior change
Subhash and Cudney (2018)	computing, engineering, communication, language, science, health and business	points, badges, leaderboard, levels, quests and feedback	increase motivation, engagement, enjoyment, effort, participation, attendance, confidence
Albertazzi et al. (2019)	education, computer science, engineering, communication, health and business	points, rewards, levels, progress	increase motivation and engagement
Buckley et al. (2019)	education and health	points, achievements, quests	context is extremely important for the gamification design

RESEARCH METHOD

Systematic mapping is a method of secondary study that systematically, i.e., based on a structured and repeatable process or protocol, explores and categorizes the studies in a given field of research and provides a structure of the types of research reports and results (Steinmacher et al., 2013). Systematic mapping results in an overview on a given subject.

The research method followed in this study was conducted during the last quarter of 2019 and aimed to perform a systematic mapping to identify an overview of the use of gamification in higher education.

Research Questions

- **Q1:** What is gamification?
- **Q2:** What are the main benefits of using gamification?
- **Q3:** What are the main techniques of gamification investigated?
- **Q4:** What are the main characteristics needed to create a course based on gamification?

Following the research procedure will be detailed with the inclusion and exclusion criteria.

Protocol procedure

(A) Execute the search string;
(B) Apply the inclusion criteria based on the article title;
(C) Apply the inclusion criteria based on the article abstract;
(D) Apply the inclusion criteria based on the full text of the article.

Inclusion and exclusion criteria

Inclusion:

- The paper should be in the context of gamification and higher education;
- The paper should report a primary study;
- The research area must be in the context of computer science, engineering, mathematics or physics.
- The paper must provide data to answer at least one of the research questions.
- The paper must be written in the English language.

Exclusion:

- Book chapters;
- Conference calls;
- Secondary studies (The secondary studies were removed for the evaluation separately so that no analysis of other authors influence this work);
- Studies that cannot be fully accessed.

Search string

The search string was created based on the PICO strategy (Beelmann, 2006), using three of the four levels.

TABLE 2
TABLE OF SYNONYMS

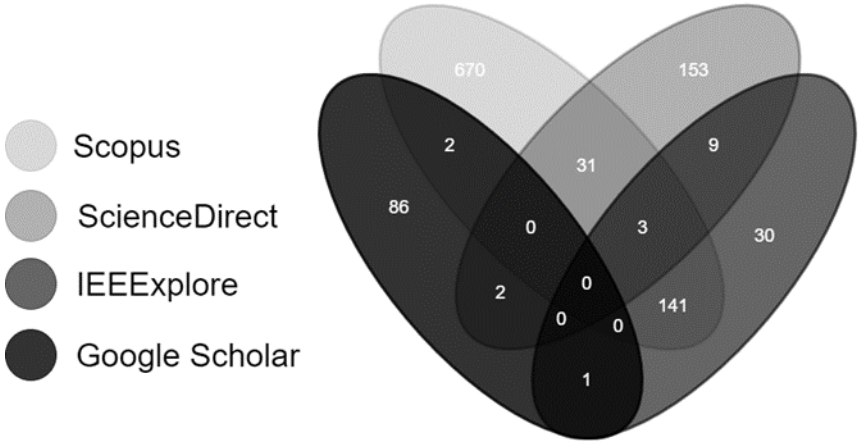
Pico	Synonyms
Population	Gamification, Gamifies, Gamifying, Gamified
Intervention	Educ*, Teach*, Disciplin*, Learning, Schooling, Training, Pedagog*
Comparison	
Outcome	Type, Characteristics, Modality, Objectiv*, Methodology

The search strings were defined by grouping keywords of the same domain with the logical operator "OR" and grouping the three domains with the logical operator "AND". Some words were used with the '*' character at the end to make it possible to find any occurrences.

TABLE 3
SEARCH STRING

TITLE-ABS-KEY ((Gamification OR Gamifies OR Gamifying OR Gamified) AND (Educ* OR Teach* OR Disciplin* OR Learning OR Schooling OR Training OR Pedagog*) AND (Type OR Characteristics OR Modality OR Objective))

FIGURE 2
INTERSECTION DIAGRAM BETWEEN SEARCH ENGINE DATABASES



As recommended by Kitchenham (2004), the search string was run on three major search engines - Scopus, ScienceDirect and IEEE Xplore - to find an excellent theoretical foundation. However, the search was also done in Google Scholar for the search to gain a little more depth, freedom, and dynamism. Thus, it was possible to search for other articles that were not found in the previous search engines. We used the keywords "gamification in higher education" in the search on Google Scholar.

The main string was changed to suit the particularities of each base, and all were executed on December 1, 2019, around 7:00 PM. The Scopus database returned a total of 845 references, ScienceDirect returned 198 and IEEE Xplore returned 184. Finally, Google Scholar found 91 more references. Totalizing 1318 articles analyzed. The references were found in more than one database. Figure 2 demonstrates how these intersections behaved.

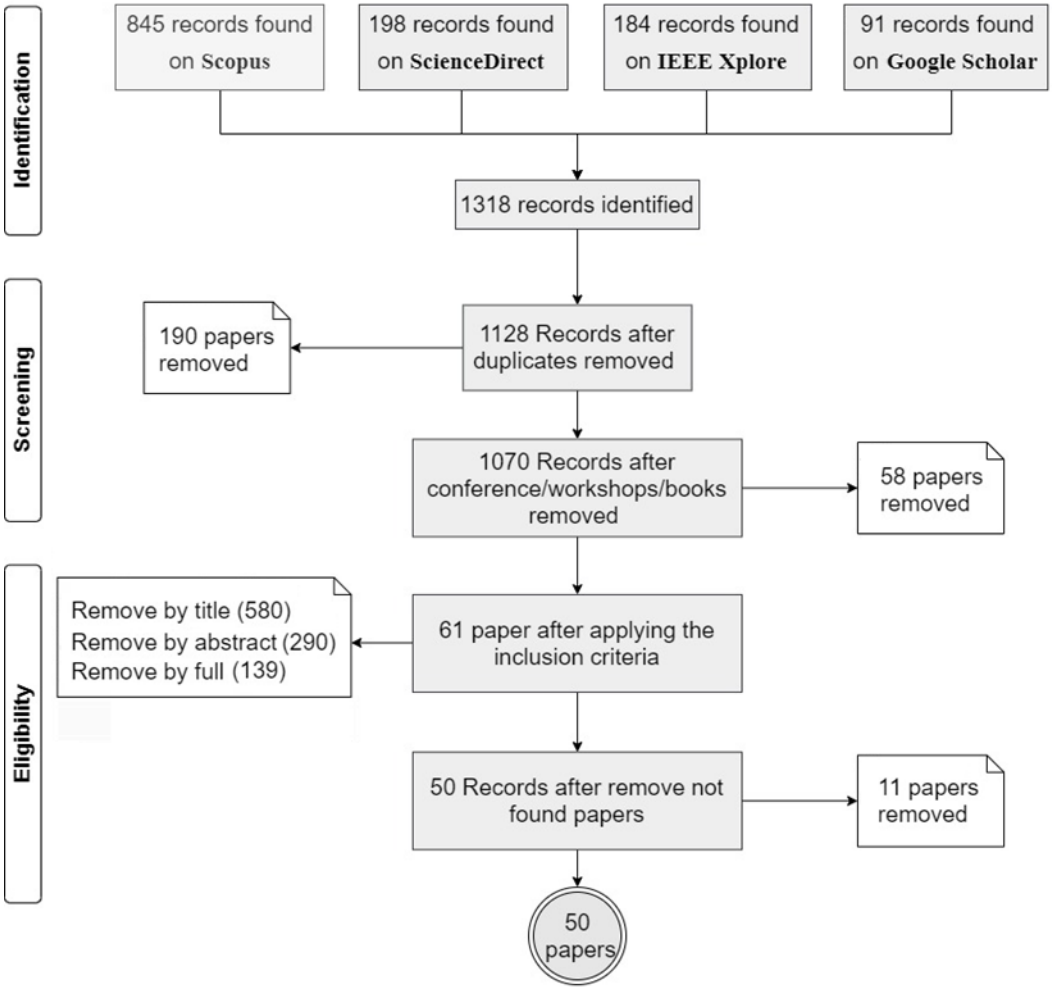
Table 4 demonstrates how the articles were selected in each of the databases, adopting the selection and exclusion criteria that were described above.

TABLE 4
EXTRACTION TABLE

Activity	Result	Number of papers
Scopus		
Articles found	845 added	845
Remove conference/workshops/books	39 removed	806
Remove by title	463 removed	343
Remove by abstract	198 removed	145
Papers not found	8 removed	137
Remove by full	110 removed	27
ScienceDirect		
Articles found	198 added	198
Remove conference/workshops/books	6 removed	192
Remove by title	151 removed	41
Remove by abstract	30 removed	11
Papers not found	0 removed	11
Remove by full	9 removed	2
IEEE Xplore		
Articles found	184 added	184
Remove conference/workshops/books	5 removed	179
Remove by title	105 removed	74
Remove by abstract	41 removed	33
Papers not found	3 removed	30
Remove by full	16 removed	14
Google Scholar		
Articles found	91 added	91
Remove conference/workshops/books	8 removed	83
Remove by title	51 removed	32
Remove by abstract	21 removed	11
Papers not found	0 removed	11
Remove by full	4 removed	7

After applying the inclusion and exclusion criteria, 50 articles were selected. Figure 3 summarizes the screening and reviewing process using a PRISMA diagram (Liberati et al., 2009). All articles selected from the systematic mapping are listed in appendix A.

FIGURE 3
SCREENING AND REVIEWING PROCESS



RESULTS

This section examines the selected articles in the Research Method section. The interest in this subject has intensified since 2011. Most of the papers between 2011 and 2013 have described the characteristics of gamification and game elements. There are few gamification designs before 2013. Gamification designs were adopted in computer science, engineering, mathematics and physics courses, according to the inclusion criteria.

What is gamification?

Gamification is defined as the use of game elements to create an active learning environment by engaging students in the process of knowledge acquisition (Loos & Crosby, 2017). Gamification is an educational approach that uses game elements in non-game contexts (Deterding et al., 2011) to enhance the learning experience and learning achievements.

Gamification design must define clear learning goals. Gamification aims to increase students' motivation, engagement, performance and enjoyment; increase the time and attention that students dedicate to learning; and improve students' participation and activities.

What are the main benefits of using gamification?

The results indicate that gamification designs have positive effect in terms of motivation, engagement and performance. Gamification improves course quality; provide regular feedback to students, foster student's attendance, interest, attention and

interaction in classroom. Gamification increases the percentage of passing students, the amount of exercises solved and tasks completed, and participation in challenging assignments or voluntary activities. Gamification improves content comprehension, retention, and recaps; possibly due to the practical application of concepts in game-like experience.

Students usually have a positive perception of gamification designs. Gamification may allow students to be free to perform learning actions. If the gamified environment allows reattempts, students tend to redo the exercises until they are solved correctly. Although gamification may foster competition among students, cooperative gamification strategies increase social interaction among students.

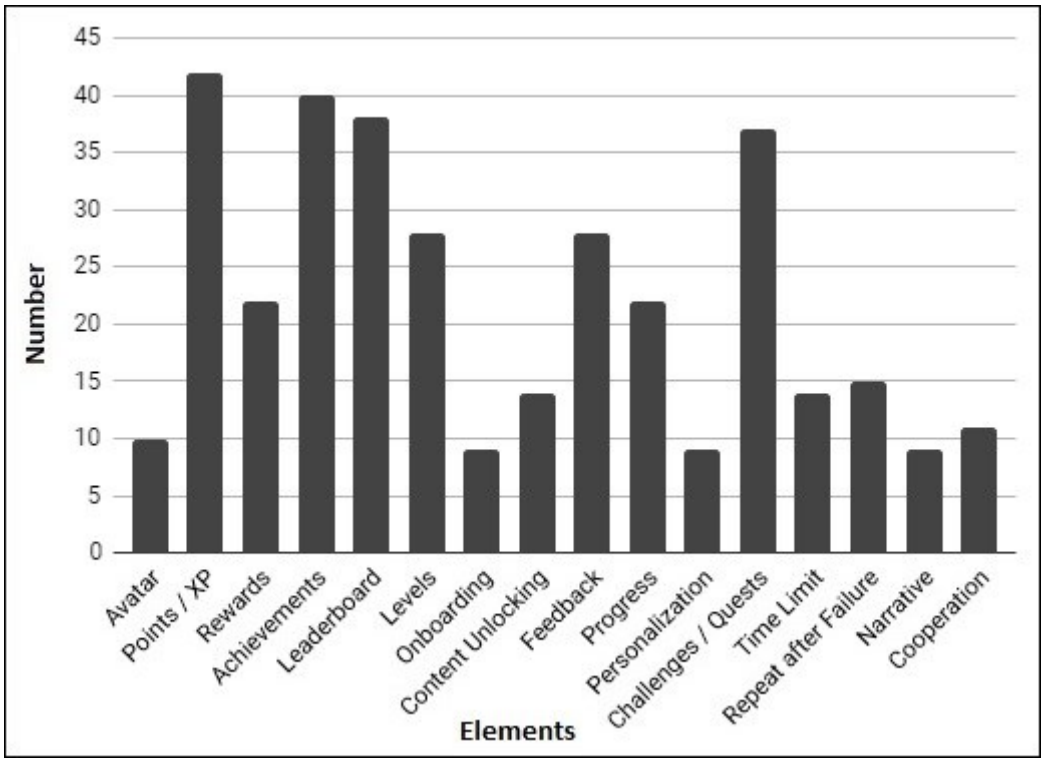
Students indicated that they felt more motivated to learn, despite gamification does not result in better grades in some cases (Domínguez et al., 2013). Gamified learning can induce students to gain points and badges, and reach higher positions in the ranking (Smiderle et al., 2019). Students feel immersed and curious to explore the readings, and feel entertained in learning. A gamified environment can attract students' attention and motivation through storytelling and adventuring (Yue, 2015).

Gamification approaches generally have positive impacts. In poor results, perhaps the gamification design was not adequate or aligned with its own goals De Byl (2013) suggested that gamification did not modify students' performance with respect to attendance and completing assessment items. Tundjungsari (2018) related that students had lack of motivation to self-learning and complete all level of the game. So, students suggested enhancing the application by adding more game elements.

What are the main investigated gamification techniques?

Figure 4 lists the game elements used in gamification designs in the selected articles from systematic mapping. The most used game elements were points, achievements and leaderboards, followed by levels, rewards, feedback and challenges. Coins, stars and other virtual objects are grouped into rewards. Badges, medals and trophies are represented in achievements. Challenges comprise themselves, tasks, missions, quests and quizzes.

FIGURE 4
GAME ELEMENTS USED IN ARTICLES

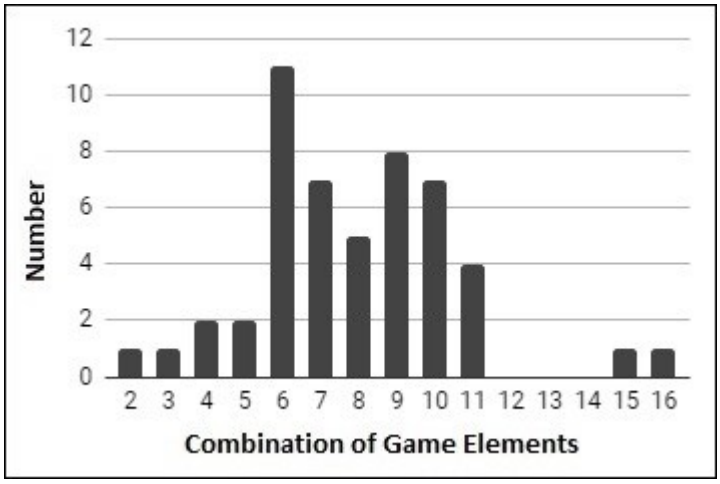


These results match the findings from Subhash and Cudney (2018). These authors found that points, badges, and leaderboard were the most used game elements in gamification designs in higher education. In addition, they stated that levels, missions, quests and instant feedback were also used in gamified courses.

The articles cited other elements such as alternative paths, objectives, social engagement, trading, chance, surprise, team formation, audios, images and videos. But these elements were not included in the chart because they had few occurrences. Buckley et al. (2019) found a great presence of teams and social graphs in their studies. But our results mainly match their findings too.

Using points, badges, and leaderboard and other game elements would not guarantee the success of a gamification design. Researchers must exam and test which meaningful combinations of game elements had positive effects in motivation and learning (Landers, 2014). We also examined the combination of game elements used in gamification designs from systematic mapping. Figure 5 indicates that the majority of gamification designs have used 6 to 9 game elements. De Armas de Armas et al. (2019) recommend that a gamified platform should not load too many elements since it can distract students.

FIGURE 5
NUMBER OF GAME ELEMENTS COMBINED IN SELECTED ARTICLES



What are the main characteristics required to create a course based on gamification?

Gamification design usually assigns students to two groups. The control group will learn and will be evaluated by the existing methods in the course. The experimental group will participate in the gamified learning process. The assignment of students can occur randomly or students can be voluntary to join the experimental group.

Gamification design can be implemented through in-class activities, but usually requires technological resources to apply it (Dicheva et al., 2015). Gamification is usually deployed through Learning Management System (LMS), such as Moodle (Barna & Fodor 2018), BlackBoard (Domínguez et al., 2013) and Youtopia (Jakubowski, 2014). These platforms are used to set course assignments, rewards, and track student performance. In addition, gamification was also deployed through software (Cheong et al. 2013), websites (Kim et al. 2016), apps for mobile devices (Daud et al., 2017) (Tundjungsari, 2018). These platforms must be well planned and well developed. If they are improperly designed, inefficient or use inappropriate techniques, students may feel unmotivated to use them (Dicheva et al., 2015).

The effectiveness of a gamification design is often evaluated through students' results, activities and/or perceptions. The assessment of the students' results is an objective analysis that measures the points achieved (their grades in exams); ratio of failures, passing ratios, attendance, number of mandatory or additional tasks completed, extra-assignment scores, and so on.

Students' activities, attitudes and decisions may be quantified to measure their engagement and participation. This assessment complements the objective analysis of gamification. Thus, the gamified learning environment captures and stores the relevant indicators from students' activities. The recorded information may include time spent on activities, number of distinct days of participation, number of answers submitted, percentage of students who made repeated attempts, number of attempts students made after reaching the passing threshold (course requirements), decisions on what activity to perform next, and so on. Students interactions with the learning platform records the content viewed, resources clicked and contributions to forums, which includes threads created, visits, responses, replies and likes.

Assessing students' perceptions verifies whether they understand what gamification is and whether they recognize the importance, usefulness and value of gamification in the learning process. Students' intrinsic motivations (interest, pleasure, effort) in learning are measured through a survey questionnaire or interviews. These instruments appraise students' experience, opinions, impressions, insights and satisfaction about the gamification approach. Students may also be enquired about their understanding of the course content, the gamification techniques used and effect of specific game elements, that is, which ones they liked, disliked or were indifferent.

The effectiveness of the gamification may change according to students' characteristics. In these cases, teachers should understand the different abilities and personalities of students to properly design gamification (Kocadere & Çağlar 2018). Teachers should identify student (player) types of with specific characteristics. Different game elements can alter learning outcomes too. So, gamification design can be adapted considering player types or most preferred elements and can explore how different player types

respond to the different game elements.

DISCUSSION

We described in results that gamification use game elements to motivate learning and engagement. One may argue that points, scoring systems and tasks have always been used in education to evaluate students' learning and performance. However, gamification differs from traditional approaches because it incorporates these and other game elements in a playful and fun environment. Gamification goes beyond points and badges to align learning experiences with game mechanics (Loos & Crosby, 2017) . Gamification works because it addresses human desires such as reward, achievement, status and altruism. Gamified experiences are much more engaging as they make fully transparent the goals, points, status and levels (De Byl, 2013).

For instance, teachers have always imposed deadlines on exams or tasks deliveries to create pressure on students. Gamification can adapt this time pressure to evoke emotional feedback and enhance participation. A gamification design can also block tasks or achievements initially. So students must unlock this content according to their progress in the gamified environment.

Caponetto et al. (2014) found that gamification strategies have usually been carried out online through a LMS platform, whose functions had been specifically designed to meet the needs of a gamified process. Dicheva et al. (2015) pointed out that the lack of proper technological support is one of the major obstacles for applying game elements to education. We can go further to explain these obstacles. We also found that gamification is usually deployed through a LMS. But these platforms become an obstacle if they cannot evaluate tasks quickly or automatically. Thus, they would not be able to provide immediate feedback to students (Domínguez et al., 2013):The great effort and time required for planning a gamification design (Jassem & Piskadło, 2014) and ill-defined goals and challenges (Mahmud et al., 2014) are also seen as obstacles to gamifying education.

Alsawaier (2018) states that there remains a need for further exploration of the full impact of gamification on engagement and motivation. Further empirical research need to be conducted to examine the potentials of gamification. We found that some studies (Agapito & Rodrigo, 2018) (Gil et al., 2015) (Loos & Crosby, 2017) argue that there is still no evidence that gamification actually encourages student motivation and engagement in higher education. It would be necessary to design gamification for longer in different disciplines and courses to analyze the results. Mahmud et al. (2014) pointed out that more research is needed to prove the benefits of gamification in the long term.

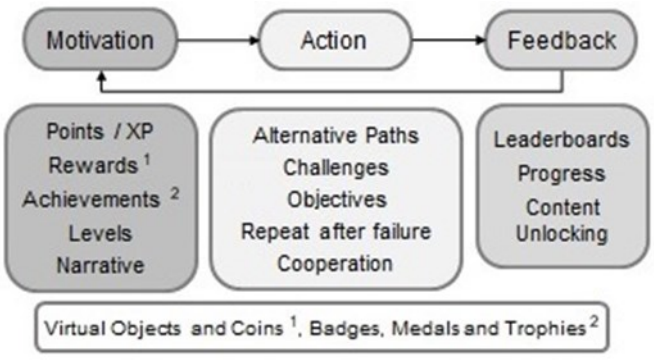
CONCLUSION

We performed a systematic mapping on gamification in higher education to understand its main benefits, the most investigated gamification techniques and the main characteristics of a gamification design needed to apply in a course. The search was carried out on Scopus, ScienceDirect and IEEE search engines and was also done in Google Scholar. The mapping resulted in 50 selected articles.

Analysis of the articles indicated that gamification designs in high education have positive effect on motivation, engagement and leaning. Gamification provide regular feedback to students and foster student's interest, attention, attendance and interaction in classroom. The most used game elements were points, achievements and leaderboards. Levels, rewards, feedback and challenges were often cited in articles as well. The effectiveness of a gamification design is commonly evaluated through students' results, activities and/or perceptions. The authors suggest adapting gamification designs according to students' characteristics to further stimulate engagement and learning and have got even better results.

Our conclusions are limited to the articles that we had selected from the systematic mapping. Although we defined a research method and applied inclusion and exclusion criteria, the review process is partially subjective. So, our results could be slightly different. In addition, we did not analyze books, dissertations and theses and we only considered gamification designs in computer science, engineering, mathematics or physics. Other contexts in higher education may also have adopted effective

FIGURE 6
FRAMEWORK WITH GAME ELEMENTS TO GENERATE A CYCLE OF ENGAGEMENT



gamification designs, which could also be suitable to these courses.

We also plan for future work to propose gamify the Game Design offered to postgraduate students by Systems Engineering and Computer Science Program from COPPE-UFRJ. Gamification is a subject taught in the course. Thus, we could assess the benefits of gamification in the course itself. We believe that a game design course is a favourable environment for adopting a gamification strategy and having a positive impact on student engagement, participation, creativity and learning. We intend to use the most cited elements in systematic mapping. We expect to create a cycle of engagement using those elements to enhance student intrinsic and extrinsic motivations in the course. Dicheva et al. (2015) indicated that we must seek and share ways to not limit gamification designs to extrinsic rewards. Intrinsic motivations should also encourage learning. For now, we have only sketched a framework (Figure 6) based on the cycle of engagement in Figure 1 to highlight the role of each element in an incoming gamification design.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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APPENDIX A
ARTICLES INCLUDED IN SYSTEMATIC MAPPING

Authors	Title	Year	Database
Barna and Fodor	An Empirical Study on the Use of Gamification on IT Courses at Higher Education	2018	Google Scholar
Dominguez et al.	Gamifying learning experiences: Practical implications and outcomes	2013	Google Scholar
Iosup and Epema	An experience Report on Using Gamification in Technical Higher Education	2014	Google Scholar
Jakubowski	Gamification in Business and Education Project of Gamified Course For university students	2014	Google Scholar
Jassem and Piskadto	On The Development Of An Open-Source System For Introducing Gamification In HE	2014	Google Scholar
Laskowski and Badurowicz	Gamification in Higher Education a Case Study	2014	Google Scholar
Lopes	An Award System for Gamification in Higher Education	2014	Google Scholar
Awais et. al	An Adaptive Feedback System to Improve Student Performance Based on Collaborative Behavior	2019	IEEE Xplore
Barrio et. al	Can Gamification Improve the Benefits of Student Response Systems in Learning? An Experimental Study	2016	IEEE Xplore
De Armas de Armas	Analysis of Gamification Elements in the Virtual Learning Environment Context	2019	IEEE Xplore
De Pontes et. al	Analyzing the Impact of Leaderboards in Introductory Programming Courses' Short-Length Activities	2018	IEEE Xplore
Dixit et. al	Gamification: An Instructional Strategy to Engage Learner	2018	IEEE Xplore
Filipcík and Bieliková	Motivating Learners by Dynamic Score and Personalized Activity Stream	2014	IEEE Xplore
Fuchs and Wolff	Improving programming education through gameful, formative feedback	2016	IEEE Xplore
Kermek et. al	Preparation of a hybrid e-learning course for gamification	2016	IEEE Xplore
Kim et. al	The effects of Gamification on engineering lab activities	2016	IEEE Xplore
Matsubara et. al	Game Elements in a Software Engineering Study Group: A Case Study	2017	IEEE Xplore
Pérez-Berenguer and García-Molina	INDIeAuthor A Metamodel-Based Textual Language for Authoring Educational Courses	2019	IEEE Xplore
Souza et. al	Gamification in Software Engineering Education: An Empirical Study	2017	IEEE Xplore
Smiderle et. al	Studying the Impact of Gamification on Learning and Engagement of Introverted and Extroverted Students	2019	IEEE Xplore
Yue	An exploratory study of gamified classroom via Prezi	2015	IEEE Xplore
Agapito and Rodrigo	Investigating the impact of a meaningful gamification-based intervention on novice programmers	2018	Scopus
Asıksoy	The effects of the gamified flipped classroom environment (GFCE) on student's motivation, learning achievements and perception in a physics course	2017	Scopus
Çakiroğlu and Kiliç	How to gamify? Example scenarios for participation in synchronous online learning	2018	Scopus
Chang and Wei	Exploring Engaging Gamification Mechanics in Massive Online Open Course	2016	Scopus
Cheong et. al	Using design science research to incorporate gamification into learning activities	2013	Scopus
Cheong et. al	Towards the gamification of learning Investigating student perceptions of game elements	2014	Scopus
Daud et. al	Modeling a mobile gamification model to increase student engagement - An analysis using analytic hierarchy process	2017	Scopus
De Byl	Factors at play in tertiary curriculum gamification	2013	Scopus
De-marcos et. al	On the effectiveness of game-like and social approaches in learning Comparing educational gaming, gamification	2016	Scopus
Dichev and Dicheva	Support for independent learning in evolving computer science disciplines	2013	Scopus

Ferianda	Increasing student's interaction in distance education using gamification	2018	Scopus
Fischer et. al	Gamification of learning management systems and user types in higher education	2018	Scopus
Gil et. al	Validating gamification mechanics and player types in an E-learning environment	2015	Scopus
Hakulinen	Empirical study on the effect of achievement badges in TRAKLA2 online learning environment	2013	Scopus
Herbert et. al	An investigation of gamification typologies for enhancing learner motivation	2014	Scopus
Huang and Hew	Do points, badges and leaderboard increase learning and activity A quasi-experiment on the effects of gamification	2015	Scopus
Jang et. al	Gamification of online learning	2015	Scopus
Jurgelaitis et. al	Implementing gamification in a university-level UML modeling course A case study	2018	Scopus
Kasahara et. al	Applying gamification to motivate students to write high-quality code in programming assignments	2019	Scopus
Khaleel et. al	Gamification elements for learning applications	2016	Scopus
Kocadere and Çağlar	Gamification from player type perspective: A case study	2018	Scopus
Loos and Crosby	Gamification methods in higher education	2017	Scopus
Mahmud et. al	Gamification of engineering courses	2017	Scopus
Reischer	Does gamification in MOOC discussion forums work	2017	Scopus
Rose et. al	Gamification Using elements of video games to improve engagement in an undergraduate physics class	2016	Scopus
Strmecki	Gamification in e-learning Introducing gamified design elements into e-learning systems	2015	Scopus
Tundjungsari	Mobile Learning Design Using Gamification for Teaching and Learning in Algorithms and Programming Language	2020	Scopus
Barata et. al	Studying student differentiation in gamified education: A long-term study	2017	ScienceDirect
Yildirim	The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons	2017	ScienceDirect