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Research Note

An approach for planning and deploying gamification concepts with social networks within educational contexts

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ABSTRACT

Gamification planning has been a topic of discussion in the last years since it can be used to increase performance, engagement, and motivation of end users. When properly applied in educational settings, gamification can lead to better learning. Furthermore, it can be boosted when tied to social networks. However, according to the literature, there are three main concerns regarding this topic: (a) instructors and teachers does not have the resources to plan and develop gamification strategies into their classes; (b) gamification needs a systematic approach to achieve the desired positive results; and (c) inexistence of systematic approaches that connect and help in the design of gamification and social network tasks within these contexts. Thus, this work proposes a solution to help instructors and teachers to plan and deploy gamification concepts with social network features in learning environments. In this paper, we detailed our approach depicting the set of items to analyze and compare it with other solutions that are focused on education. Then, it was conducted a case study over a programming course ($N = 40$) to analyze the planning and deployment phases. Our results demonstrated that our approach is the first to consider the stakeholders (i.e. instructors and teachers) as part of the process. Moreover, even though there are still some obstacles to overcome, the gamified strategies that were created achieved positive acceptance among the students and professor.

1. Introduction

Gamification approaches are methods, processes and frameworks (Mora, Riera, González, & Arnedo-Moreno, 2017) that help users to define systematically how to use game elements in a specific non-game context, as Werbach & Hunter Six Steps to Gamification (Werbach & Hunter, 2012) and Marczewski G.A.M.E framework (Marczewski, 2015). The number of these approaches have increased in the past few years, due to the popularity of the term and positive results that were achieved and the growing interest in games due to its usefulness and enjoyment, especially in the education field (Dichev & Dicheva, 2017; Hamari & Keronen, 2017; Hamari & Koivisto, 2015). According to Zichermann and Cunningham (2011) these systematic approaches are necessary to provide good results. Although a significant number of frameworks and processes have been created in the past years, there is still a lack of approaches that focus on educational areas and that consider the stakeholder as part of the process (Mora et al., 2017). These stakeholders, usually instructors and teachers, have interest on using gamification in their educational contexts. However, constraints in time and resources to help them to plan and deploy gamification are scarce (Martí-Parreño, Seguí-Mas, & Seguí-Mas, 2016; Sánchez-Mena & Martí-Parreño, 2016). Finally, there is a lack of approaches that connect gamification with social networks due to the complexity of merging them. In this work, we adopt the definition of Boyd and Ellison (2007) of Social Network Sites, according to the authors, these are web-based services that allows individuals to construct a public or private profile and manage a list of connections and interaction with other users. We believe that using SNS, as web technologies, is reasonable because according to the literature, the benefits of gamification (such as the increase in motivation, performance, and engagement of students) can be boosted when applied together with social network features (Borges, Durelli, Reis, & Isotani, 2014; De-Marcos, Garcia-Lopez, & Garcia-Cabot, 2015; Kapp, 2012; Lim, Lee, & Nam, 2007; Paiva, Bittencourt, Tenório, Jaques, & Isotani, 2016; Parikh & Verma, 2002; Tenório, Bittencourt, Isotani, Pedro, & Ospina, 2016; Zichermann & Cunningham, 2011). Finally, the literature also states that by integrating e-learning technologies and face-to-face learning ensures that the learner is stimulated through the process (Chang, 2016). Although

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our chosen social network does not have educational purposes, we aimed at identifying functionalities that could be used to improve the learning process.

Based on this premise, the main objective of this work is to develop an approach, by incrementing an existing meta process (Toda, do Carmo, da Silva, & Isotani, 2018), to help the instructor to plan and deploy gamification with social networks in their courses. To develop this approach, this work will: (a) introduce guidelines for planning and deployment of gamification; (b) develop an instrument to validate the social network and gamification concepts, along with the instructor's influence; (c) conduct a study in a real environment; and (d) analyze this process using the criteria defined by Mora et al. (2017).

Thus, it was conducted a case study within a programming course in an undergraduate computer science course. The class was composed of 40 students and a group of instructors. It was also developed a tool to evaluate the acceptance of gamification concepts within the social network frequency and the influence of the instructors in the approach. It was also provided a qualitative analysis of our approach called GAMIFY-SN based on the items proposed by Mora et al. (2017).

To present our work, we divided the paper as it follows: Section 2 presents the related works; Section 3 presents the approach, along with its methods and tools that were used to perform the case study; Section 4 presents the results and discussions; Section 5 presents the conclusions and future works.

2. Related works

This section present works that relates gamification in educational contexts. Although there are a significant number of studies in this field (Dichev & Dicheva, 2017) as the framework of Klock et al. (2015) which apply gamification in virtual learning environments, or the work of Toda, Silva, Cruz, Xavier, and Isotani (2016) that applied a meta-process in biochemistry classes, we focused on presenting works that intersects gamification and social network concepts. The earliest research was conducted by Thom, Millen, and DiMicco (2012) where the authors deployed a social network with gamification concepts in a business context. The main objective of this study was to analyze the removal of gamification concepts from the enterprise social network. The gamification of this system aimed to increase user participation by giving points to those who sent messages, uploaded photos, or used other features from the social network. The employee's interactions within the system were represented by a leaderboard. In this study, the authors reported that 3486 interactions between the subjects were analyzed with gamification elements and without the gamification elements. According to the authors, the removal of the points decreased drastically the participation and interactions within the enterprise social network. Although this work presents empirical and significant evidence on the impact of gamification removal, it does not present a systematic way to implement gamification within social networks, nor to apply it in an educational context.

Next, De-Marcos et al. (2015) performed an experiment, providing positive empirical evidence on the utilization of gamification with social networks. The authors defined four groups, besides the control group, aiming to analyze an educational game, a gamified system, a social network, and a social network with gamification concepts. According to the authors, students that were in the social network with gamification concepts groups achieved the highest scores and consequently obtained a better performance than the other groups. The study is relevant for presenting empirical evidence on the subject. However, the authors did not focus on the instructor's point of view, nor in a systematic approach to help in the implantation of the game elements within those environments.

Another relevant work is the one conducted by Wongso, Rosmansyah, and Bandung (2014) where they proposed a gamification framework model based on social engagement and Web 2.0 features. The conceptual framework is divided in five steps: Analysis, where the researchers must define the Web 2.0 and social features and gamification features (six elements, reward system, point system, achievements, challenges, feedback and leaderboards); Design, where the features defined in the previous step will be used to build a blueprint. During this phase, the researchers also prepare the learning materials, by dividing previous learning assignments in smaller ones that will allow the students' to visualize their progress; Development, where the researcher must connect the web 2.0 features and gamification elements that were chosen; Implementation, where someone is responsible to code the features within an e-learning system or build it from scratch; and Evaluation, where the learner is assessed within the system that was modified or developed. Although the framework presents some ideas regarding the use of social elements, it is focused on using existing e-learning systems as Moodle or Blackboard. Also, the authors did not evaluate or instance the framework to verify its applicability.

Finally, Araújo and Pestana (2017) proposed a framework for social and physical well-being in the workplace using gamification techniques. The authors propose an approach that focus on improving well-being as well as to improve their skills in specific subjects ("soft" and "hard" skills). These skills were represented through a gamified dashboard where the gamification allowed a self-assessment of the expected behaviors. Although the framework focused on using gamification to improve motivation and skill acquisition and the dashboard present some SNS concepts, it is not applied within an educational context.

Although these studies are related, one of them do not present gamification and social network in educational context, another present an empirical study but not how to gamify using those concepts, and finally the last one provides a work in progress guidelines, however do not present empirical evidence. Based on these studies, we proposed the definition of a systematic process that can aid in the planning and deployment of gamification within social networks, and an analysis with the students and instructors that were enrolled in the course. And instanced that approach through a case study.

3. GAMIFY-SN

This section has the objective to explain the GAMIFY-SN approach, to help the instructors to plan and deploy gamification concepts within social networks. It also explains the method of analysis that was performed to collect the properties of the approach.

3.1. Guidelines

The approach requires a game designer and an instructor to work properly, with each role performing their specified tasks. The instructor (or teacher with knowledge in instructional design) is responsible for developing and applying the instructional objectives of the class. The game designer, on the other hand, is responsible to help the instructor to choose the right game elements to pursue the instructional behaviors that are intended, and to help in the evaluation process of those behaviors.

The approach is divided in four steps, each one with their own sub-steps that must be followed to assure the efficiency of the approach. These steps are: Defining the content, Defining the Game Elements, Deployment, and Evaluation (Fig. 1). Each step requires one of the two, or both, roles associated with the approach (Instructor and Game Designer).

The first step is the Definition of the Content, which is performed by the instructor. This phase contains four sub-steps, which are the analysis of content, the mapping of activities, mapping of social network features and the representation. The first sub-step consists in analyzing the previous content that was generated by the instructor to understand and define the tasks that were proposed to achieve a certain instructional objective. This content can be represented through any instructional resource used in traditional instructional lessons, e.g. lesson plans or lesson summaries. Following that, the instructor must map the

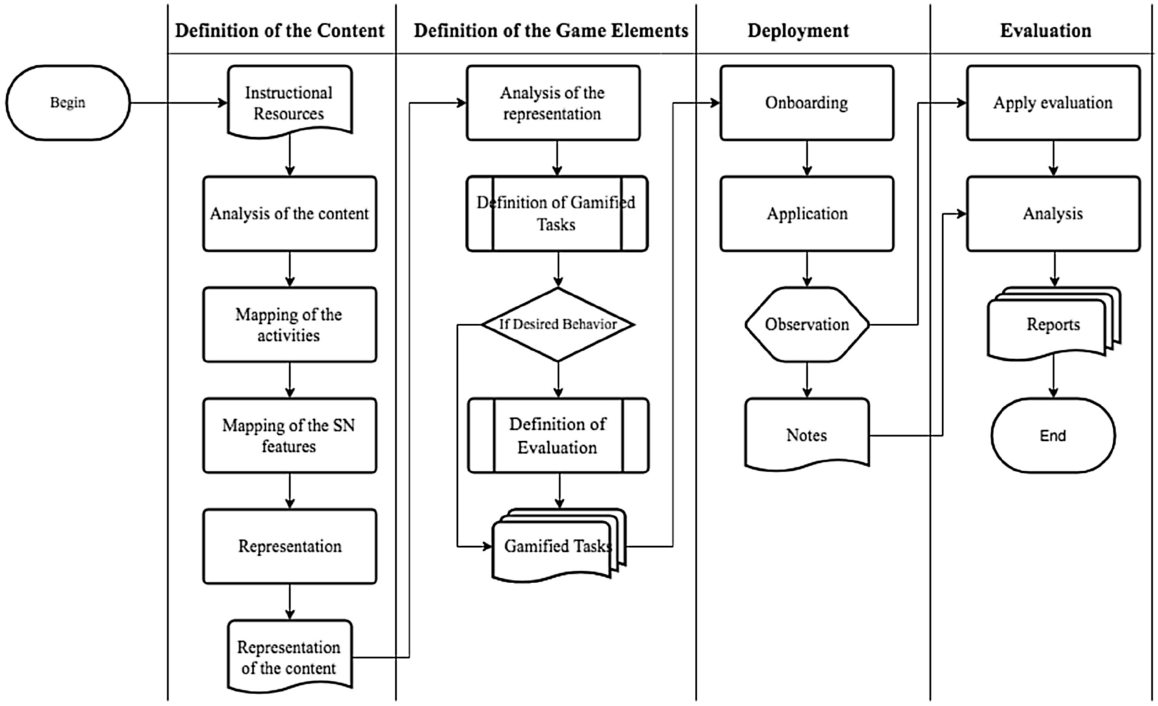

Fig. 1. Flow chart describing the GAMIFY-SN. **Normal rectangles** represent actions of each sub-step. **Wave rectangles** represent the documents that are generated or used. **Rectangle with sides** represent an action with other sub-steps within. **Diamond** represent conditions. **Hexagon** represent the observation sub-step which is performed during the deployment phase in a physical/virtual environment.

tasks that will be performed; these tasks can be represented as activities or another kind of evaluation that is used within the instructional content. Next, the instructor must select the social network features intended to be used within the tasks, to help in the understanding of the instructional content. Due to the increase of social network sites in the last decade, we provide some features that are shared by most of them (e.g. Twitter, Facebook, GooglePlus) as: Posting a comment on a users' activity, where the users can comment or reply to a status update regarding the course; Update and/or Sharing status, regarding course or content information; Post materials (photos, videos or other supported types of files) about the content or other relevant information to the course; Add course colleagues and create groups to encourage cooperation (Boyd & Ellison, 2007; Wongso et al., 2014).

These instructional tasks, tied or not to a social network feature, contain a desired behavioral outcome, and these outcomes will help the game designer to choose the right evaluation for the instructor and the mapping of the tasks will support the instructor to create the representation of the lesson plans. This representation is used to understand the logical flow of the content and how the tasks are connected to it. This structure can also help the game designer to propose a set of elements to use within the lesson or each of the tasks. Followed by the creation of the representation, it is the first step of the Definition of the game elements phase.

The second phase of the process requires the structure that was generated in step one, and both the instructor and the game designer. It is divided into three sub-steps which are: Analysis of the Representation, Definition of the Gamified Tasks and Definition of Evaluation. To help the game designer to choose the game elements, we defined the concept of Gamified Task. This Gamified Task allows the use of game elements in the instructional task following the structure of an instructional task. This instructional task contains an instructional objective (which is the main goal of what is intended to be accomplished by the teacher) tied to an event that will be performed by the instructor, e.g. make the students learn a concept, through expositive classes. However, the instructional objective is tied with a game property and feedback, as the strategy that will use those elements (Fig. 2).

The objective of the gamified task is the same objective of the instructional task, e.g. make the student understand a concept definition. The instructional resources were previously defined by the instructor, which can also be some of the social network features, e.g. the social network of choice, writing tasks, digital presentations, etc. Following the instructional resources, the game designer can help to select the best game elements, divided into feedback and property. These elements were based on Dignan's framework for developing behavioral games (Dignan, 2011; Toda et al., 2016). The feedback elements can be used to help in achieving the objective of the gamified task, allowing the instructor some freedom on which elements to use on which tasks. To illustrate the use of these elements, it is presented a brief conceptualization of each one in Table 2, along with some examples on how to use them in educational contexts and the works that also used those elements.

Based on the elements presented on Table 2, the instructor, along with the game designer, can create gamified strategies within their gamified tasks, without modifying its instructional structure e.g., The objective of the task is to make the students learn a specific content about math using the features of posting comments on the SN forum. To achieve this objective, the game designer can propose the use of cooperation property and a point feedback, along with trophies to generate the following strategy: "When the students reply a post with relevant information, both students get points, and when they reach a certain amount of points they get a badge of "Big Helper" (Hypothetical name), representing the success of those students"_. Based on the desired behavior, which could be defined in the representation, the designer may also propose a form of evaluation, e.g. if the task is related to increasing student's motivation, the designer may propose the use of the Instructional Materials Motivation Survey (IMMS), which is based on Motivational Design, to measure students' motivation. After defining the gamified tasks that will be used within the class, the instructor can begin the Deployment phase.

In the Deployment, the instructor applies the gamified tasks within their lessons. This phase is represented by three sub steps: Onboarding, Application, and Observation. The Onboarding is a pre-lesson where the

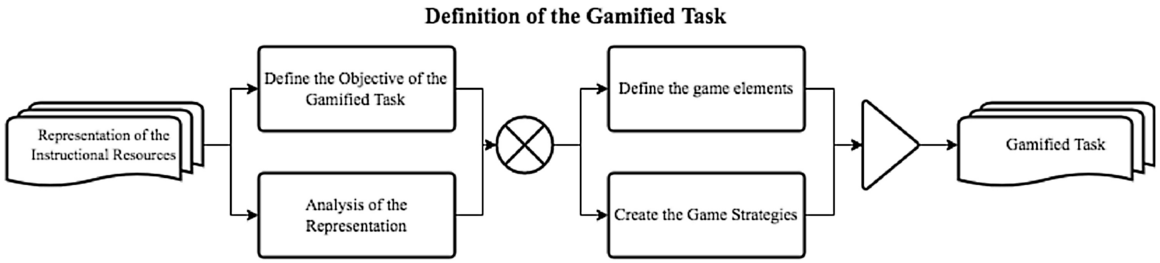

Fig. 2. Gamified Task.

instructor explains the instructions of the gamified tasks, the length and other rules associated with it. Also, the gamified tasks should not be mandatory, since the students have the choice whether they want to "play"_ the lesson or not. The application consists in the deployment of the gamified tasks as they were planned. As for the Observation sub-step, the instructor, alongside any support, may observe the behavior and acceptance of the game elements by the students. This observation can be performed through questionnaires or notes taken in classes during and after a gamified task. These notes are important for the analysis to understand how the students react to the game elements that are being applied.

Finally, after the Deployment phase, we begin the evaluation phase. This consists in the application of questionnaires to evaluate the intended behavior and the acceptance of the gamified tasks. The acceptance of the gamified tasks is important for the game designer to improve those tasks in future instances. After the evaluation, an analysis is performed by the game designer and reports are created to depict the results. In the scope of this project, the instructor aimed to evaluate the students' performance. However, it was evaluated the meta-process in 3 dimensions: the social network use and frequency, the gamification elements acceptance and the instructor's influence, from the viewpoint of the students. It was also interviewed the instructor and his assistants after the study to collect feedback about the meta-process.

3.2. Qualitative evaluation

To analyze our approach, we conducted individual in-depth interviews (DiCicco-Bloom & Crabtree, 2006; Opdenakker, 2006) with four experts, two from the computers applied to education domain and two from the gamification domain. Each interviewee received a partial documentation of the approach (as seen on https://docs.google.com/document/d/1U0YVism_m4shOA_ctSmc-JvW4qj7p5ZsxuDQE0YU224/edit?usp=sharing) to be prepared for the interview. We based our questions on the assessment proposed by Mora et al. (2017). This evaluation consisted in analyzing 21 game-related items divided into six categories, one qualitative (Principles) and five quantitative (Knowledge, Logic, Psychology, Measurement, and Interaction). They were based on relevant design principles that were commonly found in these approaches. A summary of these items can be seen in Table 1.

We used the same scale proposed by Mora et al. (2017), by verifying with the experts if our approach contained each Item explicitly (E), implicitly (I) or unreferenced (U).

Table 1
Items proposed by Mora et al. (2017).

	Item	Description
Knowledge	Objective	Specific performance goals
	Feasibility	Evaluation and analysis of the potential of applying gamification
	Risks and weakness	Probability of any negative occurrence
	Investment	Benefit resulting from the gamification
	Stakeholders	Identify and consider the people who interact with the process
Logic	Engagement cycle	Game mechanics combined with reinforcement and feedback (Dynamics)
	End-game	Pre-established end game
	On-boarding	Introduction to the new participants
	Rules	Body of regulations depicted by the designer
Psychology	Fun	Enjoyment or playfulness
	Motivation	Behavior that make people want to redo an action
	Social interaction	Interaction between participants
	Desired behavior	Expected response of participants after interaction
	Profiling	Identify the participants
	Players' taxonomy	Player type categorization
Measurement	Analytics	Algorithms and/or data used to measure key performance indicators
	Metrics	Standards of measurement
	Ethics	Recommendation of right and wrong conducts
Interaction	Storytelling	Context created by the designer
	User experience	Everything within the gamified practice that can be interacted by the participant
	Technology	Use or need of a software or component

4. Results

This section presents the contributions of this research. Initially, it is presented the qualitative assessment of our approach to demonstrate its advantage, and then it is explained the planning and deployment of the case study, along with the results that were found.

4.1. Qualitative evaluation

Based on what was exposed in Section 3.2 our interviews were conducted through instant messengers and audio calls to facilitate the communication with the interviewees. This analysis was divided into five groups, the same proposed by Mora et al. (2017). A summary of the interviewee's answers can be seen in Fig. 3.

4.1.1. Knowledge

Regarding the Knowledge Item, most of the interviewees (75%) agreed that the documentation contained an explicit objective of our approach, while one expert said it was not very clear, but it could be abstracted. As for the feasibility, there were mixed results. The experts from computers in educational domain agreed that feasibility was explicit for them, since the roles and its activities were clearly explained. However, the gamification experts believed that this feasibility was lacking in the document, considering unreferenced. Risks and Weakness did not achieve a consensus, with two interviewees agreeing that they were implicit, one saying it was explicitly based on their experience and other saying it was unclear in the documentation. Investment also did not achieve a consensus, but two interviewees agreed that this concept was not referenced, while one said, again, that it could be abstracted based on their experience and other said it was clear. Finally, all interviewees agreed that the stakeholder was an essential part of our approach and that it should be considered.

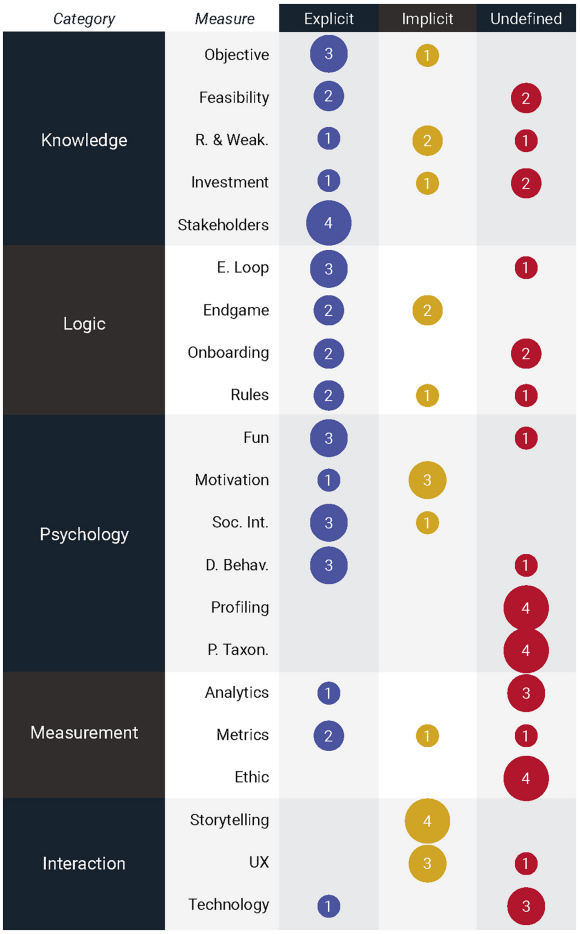

Fig. 3. Evaluation performed by the experts.

After answering those questions, the experts could make any comments they desired. One of them said that the documentation was very brief and could not provide all the information that was analyzed. Other expert said the documentation could be improved by adding more details regarding each sub-step.

4.1.2. Logic

The engagement loop was considered an explicit item in our documentation to 3 out of 4 experts (75%). However, the other experts explained that they did not consider our game elements as part of the engagement loop, answering that it was not referenced. As for the end-game, all the experts agreed that they were presented in our approach. However, half considered as an explicit concept in the documentation and the other half consider it implicit. According to the interviewees that answered the concept as being implicit, the end-game should be present at the end of the instructional activities, since those activities always contain an end. The onboarding did not achieve a consensus, with half of the interviewees considered it something explicit (due to the sub-phase in Step 3), and the other half considered it unreferenced, explaining that this phase cannot be considered an on-boarding process. Finally, 3 experts considered that our approach contained rules, with two saying that those rules were explicit and one saying it was implicit in the game mechanics. One of the interviewees did not find the rules concept.

Regarding the logic item, one of the gamification experts criticized the fact that our approach was heavily based on game mechanics rather than other important factors that should be addressed by gamification. Two of the interviewees also suggested that each strategy should be addressed with the intended behavior they were designed for. Finally, one of the gamification experts asked to improve the description of the game elements in the documentation.

4.1.3. Psychology

Psychology was the item with the highest level of agreement between the interviewees. Regarding the Fun item, 3 out of 4 interviewees considered its approach explicit enough, since gamification has the goal to make the tasks more fun. However, one of the gamification experts stated that the concept was not referenced in the documentation in the same way as it was written. Motivation achieved a full level of agreement among the experts. However, 3 out of 4 of them have stated that they considered it an implicit concept due to the gamified strategies being based on a motivational theory. All the experts agreed on the presence of Social Interaction in our approach, although one of the gamification experts stated it was implicit in the game elements. Desired behavior was considered an explicit item in our documentation. However, one gamification expert stated that the desired behavior should be connected to the gamification strategies, as they were not referenced enough in his opinion. All the experts agreed that our approach did not consider Profiling or Player Taxonomies.

Regarding the interviewees responses covering this specific group of items, we believe that our approach needs to be improved regarding its documentation. We also want to add profiling and player taxonomies to our approach, since they are important factors that are not contemplated yet.

4.1.4. Measurements

In this group of items, the experts achieved a full agreement regarding the Analytics and Ethics items. According to them, the items were not referenced in our documentation. As for the metrics, the experts did not achieve a consensus. 3 out of 4 believed that our documentation explained the metrics, in an explicit or implicit fashion. One of the interviewees said this concept was not well covered in our documentation.

The comments regarding the Measurements were suggestions on how it could be improved the approach by collecting the data for analytics. Another suggestion was to improve the documentation regarding what could be measured and how it should be measured. The ethics item, although not referenced, did not have any comments.

4.1.5. Interactions

The last group of items also had a considerable level of agreement among the interviewees. All the experts agreed that Storytelling was implicit in our approach, due to the narrative game element. However, two of them stated that the description and explanation of how to use it should be improved. Regarding the UX (user experience), 3 out of 4 found it an implicit concept, and one considered lacking references. The comment regarding this topic was directly affected by the lack of tools aiding in the process. Finally, 3 out of 4 experts agreed that our approach did not referenced any technology, while the other one stated that this concept was indeed explicit, due to the need for social networks.

In general, all the experts praised how easy it was to understand the approach, although some of the experts stated that this also made the documentation very difficult to understand and that it should be improved and detailed.

4.2. Case study

To instance our approach, we conducted a descriptive case study within a programming lesson of an undergraduate course in computer science (Toda et al., 2018). This case study was based on the concepts defined by Yin (2009), where we aim to explore the instance of GAMIFY-SN in a real context. To guide our case study, we defined the following research question “How does GAMIFY-SN impact a real educational context?” followed by “Does the gamified tasks pleases the

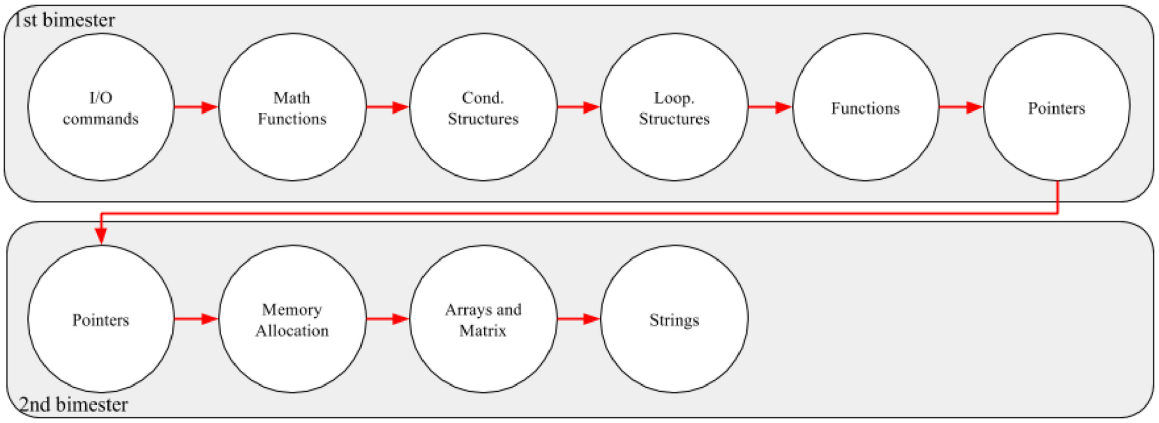

Fig. 4. Structure as seen on Toda et al. (2018).

students and instructors?" through a quantitative and qualitative viewpoint.

To instance our case study, we asked an instructor to instance our approach. Next, the classroom environment was chosen according to the instructor's choice and the instructional material that was available. The class consisted of 40 students, from an age group of 18–24 years old. The researchers were available anytime the instructor needed any support with the approach and within the classes to take notes. The researchers took notes during the Implantation phase and interviewed some students (n = 20) to obtain their feedback. The approach was instanced through a programming lesson course that lasted one semester and the researchers developed a questionnaire of 15 questions, with 3 different dimensions: Social network frequency; Gamification elements acceptance; and Instructor Influence in the approach. Six questions aimed to evaluate the frequency and use of social network, five to evaluate the gamification elements that were used and four to evaluate the instructor influence. The questions were based on a Likert scale, varying from 1 to 5, where 1 was "I fully disagree"_ and 5 was "I fully agree"_.

Findings from the case study

Initially, the instructor had access to the documentation of the approach and a meeting with the researchers to deploy it. To conduct our study, the existing approaches were modified and merged (Mesquita, Toda, Brancher, & do Carmo, 2013; Toda et al., 2016) to systematically plan and deploy gamification concepts with social networks in a classroom context. To achieve this goal, the professor was helped to analyze the structure of the course to create a representation of it. The instructional resources that were available were lesson plans which were developed to use Social Network concepts to aid in the teaching of the concepts related to programming. Those lesson plans followed a traditional approach with in-class lectures and task lists to exercise the concepts that were taught. The structure demonstrated a direct flow chart behavior where the first node was the Input and Output commands, and the last was the String commands (Fig. 4). The "pointers" concept was explained twice in this flow chart due to time restraints that hindered the teacher do finish the content before the end of the first part of the course.

After creating the representation shown in Fig. 4, the instructor selected a social network (Facebook[1]) that contained forums, message exchanges and status updates as main features. The social network also allowed to upload and download files from the course. Finally, the instructor aimed to make the students understand those concepts as the desired behavior, focusing on their performance. Then, based on the analysis of the instructional resources of the course, we started the development of the gamified tasks. Each instructional task that was associated to a content went through the Definition of the Gamified Task (as seen on Fig. 2). The main objective of the tasks was for the students to understand the concepts and to perform the programming exercises applied to them. These exercises, together with all communication between students and instructors, were made through a social network. An example of a gamified task that was created can be seen on Fig. 5. Examples on how to apply the game elements within tasks can be seen on the section **"Definition of the Game elements"** in the document presented in Section 3.2. In this example, after the analysis of the structure that was defined by the teacher and discussed with the researchers, there was a task named "Exercise the concept of input and output commands". Based on the researchers' background, they suggest the use of Points and Levels as feedback elements and Competition and Cooperation as property elements. Then, they defined the strategies "Give Points", "Accumulate points" and linked them with the properties "Help a student" (Cooperation) and "First who gets the question right" (Competition).

Before the gamified tasks began, the students were asked if they wanted to participate in the gamified course or the traditional one (with lessons, exercises, and tests). The students that opted for not taking part in the gamified course were not accounted for in the interviews and observation phase. This competition was based on the tasks given by the instructor. Each task contained a specific number of points that was given to the first student that completed it properly. When the students reached a predetermined number of points they would increase their level and acquire new skills that could be used to solve the tasks that were given. This level would be converted in the student's final grade at the end of the course. The students could keep track of their progress through a leaderboard in the forum that was updated after every class. Other gamified tasks were generated, but only added experience points to the student's current amount of experience, as the frequency of the course and participation. The incentives were given to improve their behaviors within the class. The practice was supported and conducted through the social network. After defining the gamified tasks, we began the Deployment phase.

During the Deployment phase, it was noticed that some students presented some level of enthusiasm and an increase in their participation in the classes and forum. This online participation increased during the days that the tasks were given, since the students asked for help or submitted tips on how to solve the problems. During the observation, a group of students was interviewed (n = 20) to generate a feedback on the core gamified task dynamics. Through this interview some problems regarding the students during the course were identified:

- They were not pleased with the competition dynamics, since only the first student answering correctly would obtain the points.
- They complained about the number and difficulty of the tasks.

[1] http://www.facebook.com

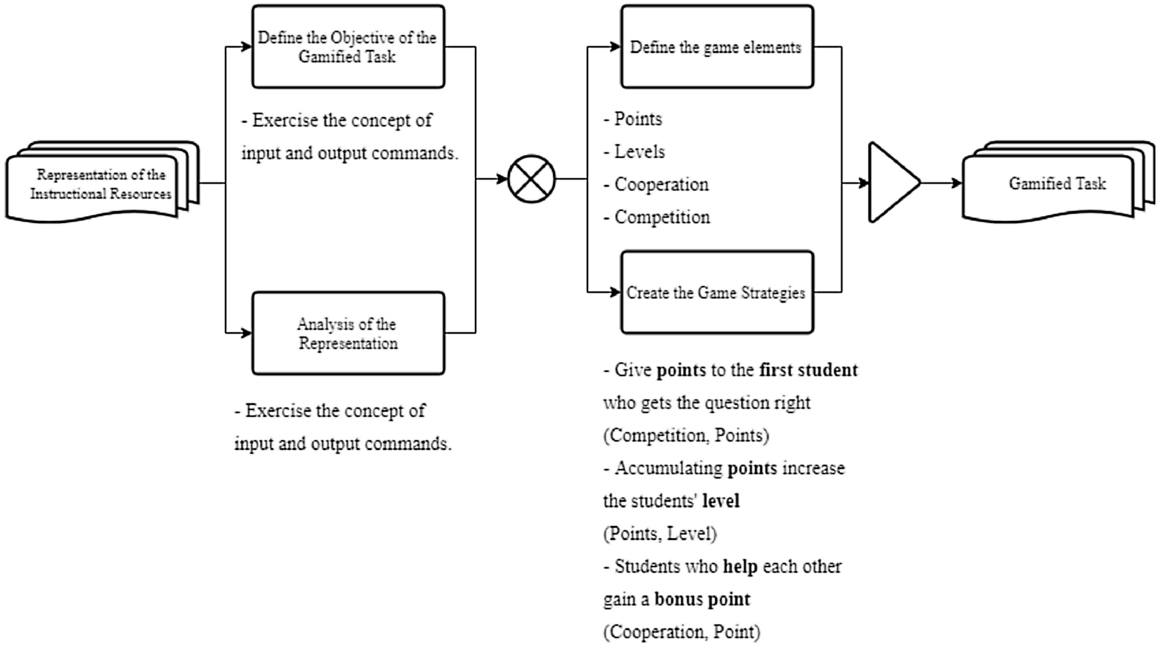

Fig. 5. Definition of a Gamified Task example.

- They were pleased with the use of the social network to exchange messages with the instructors.
- They were pleased with the progress representation but not with the leaderboard that was shown to every student in the class.
- They perceived/felt that they were learning more/having a better performance because of the progress representation.

After the Deployment phase, we began the Evaluation phase. The instructors wanted to evaluate the performance and engagement of the students during the course. They performed (qualitative) interviews with the students and asked them to answer a self-evaluation questionnaire to understand how the students perceived their performance, after the gamified course. According to the instructors, the student's grades improved in relation to past lessons. However, we cannot affirm with certainty that the students' grades were influenced or related to our approach since this was not a focus of the work.

Next, our questionnaire composed of 15 questions was applied after the final evaluation, to minimize the bias in the student's responses. Most of the students were pleased with the gamified course, obtaining an average of 3.5, especially with the experience points system that obtained an average of 4.02. A summary of our results can be observed in Fig. 4. The statistics demonstrate that the gamification was well accepted by the students, especially the progression system. Regarding the social network, students reported that they increased the access on the study group during the gamified experience, and socialized more with their peers, to help them in solving the problems that were given.

The most important results were the instructors' influence in the gamified activity. The students evaluated the following points in the questionnaire: the instructor's feedback, that was given when the exercises were delivered; the instructor's incentive, that was given through the social network and during classes to encourage the resolution of problems; the instructor's interference within the gamified task, with specific potential changes in the rules or mechanics during the tasks that were given; and the instructor's explanation of the rules, performed every time a new task was given.

Students also reported that the feedback and instructions were crucial to their satisfaction of the gamified task (Fig. 6). The students also stated that the social network gained a new meaning in their academic life and started to use the community to exchange materials and tasks from other subjects. We identified some correlations (ρ) among our variables. Using Pearson's correlation coefficient, we identified that the progression system of gamification was well accepted by students due to the instructor's feedback ($\rho = 0.74$) and instructions ($\rho = 0.71$). The progression was also well accepted by students that liked the level system ($\rho = 0.76$). This result may imply that to have a well-accepted progression mechanic, the instructor's instructions and feedback must be present, e.g. the instant feedback that the students received when submitting the exercises and the instructions given by the instructors before every gamified activity. In our sample, a higher coefficient values for the instructor's variables was found. According to our data, the instructor's instructions, incentive and feedback are strongly related ($\rho > 0.7$). This may imply that to have a good gamification, the instructor must be an active part of the process, explaining the rules, giving instantaneous feedback and encouraging participation.

To analyze the point of view of the instructors, interviews to understand the planning and implantation phase were performed. The instructors stated that the gamified core task was fun, and the social network community was a good tool to improve communication between them and the students. However, they found it very laborious. Due to the game elements that were chosen, a student would have to deliver 4 tasks, which means that they needed to perform up to 40 exercises to reach the maximum level (10). In other words, they would need to solve a total of 1600 to reach the maximum level. To reduce the workload, some rules and mechanics were modified, as well as the number of students per group and the experience points of the questions, to give chance to every student to reach the maximum level.

Another point focused by the instructors was the automation of the process, helping them to choose the elements and strategies to be used, without the physical need for the gamification expert. They also stated that even though the experience was fun and engaging, it took a lot of time to plan and to manage. In summary, three main obstacles were reported by the instructors: planning the resources, automation of the process and time and corroborating the results found by the literature (Martí-Parreño et al., 2016; Sánchez-Mena & Martí-Parreño, 2016).

5. Discussion, practical implications and conclusions

Based on our results, we believe that our approach can aid in the planning of gamification in classroom environments using web technologies (as SNS) to improve the students' experience. Based on the

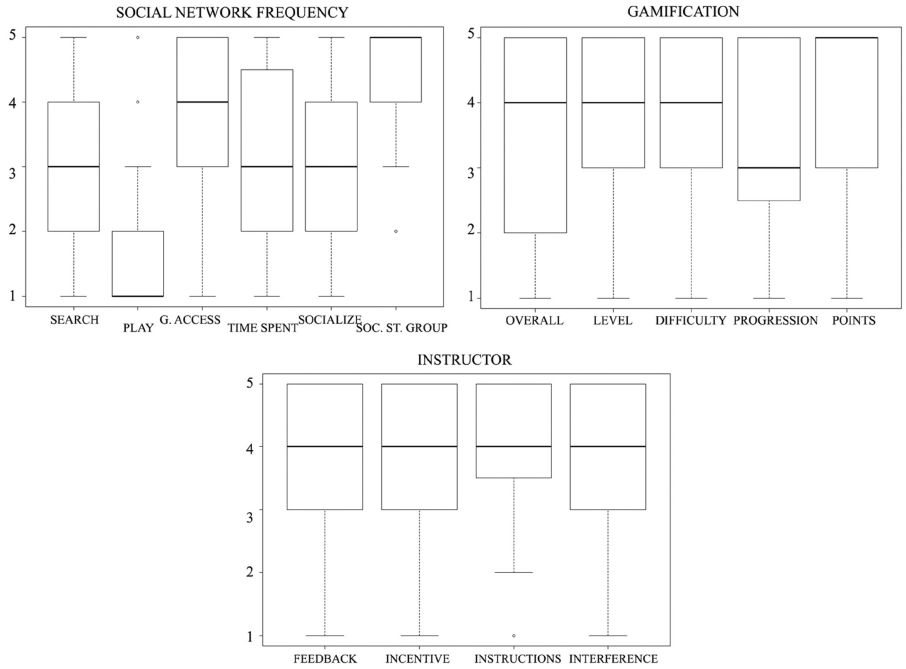

Fig. 6. Box plot of the results.

comments provided by the specialists, we understand that our approach lack some of important aspects to be considered within gamification. On the other hand, those aspects were not mentioned by the instructor that used the approach, during the interview, and the results of our case study demonstrated a good acceptance by the students and the instructors. The instructor's comments on the approach were crucial to understand the flaws to improve it in the next iterations. As for practical implications, we believe the difficulty of managing the gamification that is planned can be related to the number of elements used within the context. However, this topic is out of the scope of this project (which aims at aiding the instructor) but can be explored in future studies.

In this work, we focused on explaining the guidelines, application and analysis of the GAMIFY-SN approach. The guidelines presented in this work can help the instructors and teachers to plan and deploy gamification with social networks within their lectures, requiring only instructional resources. Our results proved the success of the Gamified Task that was implanted within the social network environment, corroborating the results found in De-Marcos et al. (2015). Another result of this work is the strategy that can be replicated in other programming courses that follow the same curricula. Finally, we provide some insights on the instructor's point of view of the design and implantation of the gamification process, which is not well reported in the literature. Based on what was exposed we believe that some of the contributions of this work are:

- The approach that support gamification planning and deployment.
- Empirical evidence on the use of this approach.
- Validation of the documentation by specialists.
- Summarization of strategies that can be used within educational contexts, especially in classroom contexts.

A practical challenge of our work is how to automate the process to ease the task or even exclude the game designer, so the instructor can use the gamification without the aid of a game designer and without having to know everything that is related to game studies and gamification. We believe that by using data-driven gamification we can minimize the presence of the game designer, by using data of other gamified studies or contained within gamified systems to generate strategies that can be easily read and understood by the instructor.

Some limitations of our case study include the technical problems in the deployment phase, where the number of exercises was not previously considered in the planning. Another limitation is an evaluation that focused mainly on the reports of the students and the point of view of the instructors and their motivation, engagement and performance was not properly evaluated and discussed in this work. Finally, the analysis was performed by the experts, based on the documentation and guidelines of the approach; however, since there is no valid tool to evaluate, we conducted our analysis based on a previous one that was performed by Mora et al. (2017), in which they interviewed the experts and asked if the approach contained each of the items that were proposed for the assessment. For future works, we intend to model a macro process that will contain all the features collected by Mora et al. (2017), also integrating features from other gamification approaches. We also intend to formalize the assessment of the framework by applying a valid tool to measure each of the items that were proposed. Finally, we intend to perform a deeper investigation regarding the point of view of the instructors, to collect requirements to implement a tool to automate this process, allowing the instructors to author their own gamified strategies.

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Appendix A. Game elements strategy

Table 2
Game elements strategy.

	Element	Description (As seen in Dignan, 2011; Mesquita et al., 2013)	Strategy	Example
Feedback	Points	A token granted for measuring users' actions	Give points to the students that post relevant comments on the SN	Mesquita et al. (2013)
			Give points to students that submitt the work	Hakulinen and Auvinen (2014)
	Reputation	Represent the hierarchy of a game community, through titles or leaderboards	Use leaderboards to measure students' performance	Mesquita et al. (2013)
			Use anonymous leaderboards, allowing the students' to assess their own performance	Iosup and Epema (2014)
	Achievements	Fixed goals or objectives that measure degrees of success of user's actions	Use milestones as the content, to boost self-worth and user's satisfaction	Bunchball (2010)
	Progress	Form of feedback that allow the user to assess their own progress	Use progress bars or progress boards to show student's development through the class	Mesquita et al. (2013)
			Use individual progress maps and collective progress maps	Toda et al. (2016)
	Level	Form of hierarchy layers related to the game domain, that also can be used as gradual systems	Use accumulative points to give levels to the students, incentiving them to play, achieve and excel	Iosup and Epema (2014)
			Use layers of content to use levels as a form of progress	Toda et al. (2018)
	Trophies	Represent the recognition for the user's actions	Give badges to the students that achieve a certain level	Bunchball (2010)
			Give badges to students that answer properly questions in class	Iosup and Epema (2014)
Property	Cooperation	Occur when two or more players work as a team towards a common goal	Create teams to engage students in teamwork	Iosup and Epema (2014)
			Make teams to produce and compare resources among themselves in order to improve it	Müller, Reise, and Seliger (2015)
	Competition	Occurs when two or more players engage among themselves towards a common goal	Create a challenge to make the students compete among themselves in order to acquire knowledge	de Sousa Monteiro, Gomes, and Mendes Neto (2014)
			Create teams and make them compete among themselves	Passos and Medeiros (2011)
	Renovation	Occurs when the user is allowed to re-do an action	Allow the student to re-do a task or activity	Lee and Hammer (2011)
	Narrative	Occurs when the designer create a background to contextualize the user outside its reality	Create a storyline to join multiple levels	Bell, Sheth, and Kaiser (2011)
			Create a storyline that allows the students to form groups and discuss with their peers their next actions	Sung and Hwang (2013)
	Pressure	Occurs when time or social interactions are used as means to engage the user to perform an action	Give badges to students that complete a task within a limited time	Hakulinen and Auvinen (2014) and Kapp (2012)
			Promote competition among teams with a limited time	Toda et al. (2016)
	Economy	Occurs when there is an element that is used to perform transactions between users	Give points that the students can exchange for vantages during classes	Toda et al. (2016)
			Give points that the student can exchange for items within an environment	Kim, Park, and Baek (2009)
	Decision	Occurs when the user is presented with choices that will affect their experience	Provide the student with the ability to decide when to deliver a task	Lee and Hammer (2011)
	Puzzle	Occurs when cognitive challenges are used to satisfy the user's internal needs of problem solving	Provide students with challenges that stimulate their cognition	Kapp (2012)
	Chance	Occurs when the same opportunity is offered to all the users	Provide the students the same kinds of feedback independent of hierarchy or class	Mesquita et al. (2013)
	Secret	Occurs when there is hidden or unlockable content that can be accessed by the user	Provide the students with currency that can be used to unlock content as they progress	Raymer (2011)
			Unlock content as the student accumulates experience or badges	Challco, Mizoguchi, and Isotani (2016)
	Novelty	Occurs when new information and experience are presented to the user, as it progress	Present the content in a hierarchically, so that students can understand it in a logical way	Mesquita et al. (2013)
	Randomness	Occurs when probability is inserted, being affected exclusively by the user's luck	Provide the student with lottery tickets to gain vantages during tests in class	Toda et al. (2016)

References

Araújo, J., & Pestana, G. (2017). A framework for social well-being and skills management at the workplace. *International Journal of Information Management, 37*, 718–725.

Bell, J., Sheth, S., & Kaiser, G. (2011). *Secret ninja testing with HALO software engineering. Proceedings of the 4th international workshop on social software engineering – SSE '11*. New York, New York, USA: ACM Press43–47.

Borges, S.d. S., Durelli, V. H. S., Reis, H. M., & Isotani, S. (2014). A systematic mapping on gamification applied to education. *Proceedings of the 29th annual ACM symposium on applied computing – SAC '14* (pp. 216–222).

Boyd, D. M., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication, 13*, 210–230.

Bunchball (2010). *Gamification 101: An introduction to the use of game dynamics to influence behavior*.

Challco, G. C., Mizoguchi, R., & Isotani, S. (2016). An ontology framework to apply gamification in CSCL scenarios as persuasive technology. *Revista Brasileira de Informática na Educação, 24*, 67–76.

Chang, V. (2016). Review and discussion: E-learning for academia and industry. *International Journal of Information Management, 36*, 476–485.

de Sousa Monteiro, B., Gomes, A. S., & Mendes Neto, F. M. (2014). Youubi: Open software for ubiquitous learning. *Computers in Human Behavior, 55*, 1145–1164.

De-Marcos, L., Garcia-Lopez, E., & Garcia-Cabot, A. (2015). On the effectiveness of game-like and social approaches in learning: Comparing educational gaming, gamification & social networking. *Computers & Education, 95*, 99–113.

Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain: A critical review. *International Journal of Educational Technology in Higher Education, 14* 36p.

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education, 40*, 314–321.

Dignan, A. (2011). *Game frame*. Free Press.

Hakulinen, L., & Auvinen, T. (2014). The effect of gamification on students with different achievement goal orientations. *2014 international conference on teaching and learning in computing and engineering*, 9–16.

Hamari, J., & Keronen, L. (2017). Why do people play games? A meta-analysis. *International Journal of Information Management, 37*, 125–141.

Hamari, J., & Koivisto, J. (2015). Why do people use gamification services? *International Journal of Information Management, 35*, 419–431.

Iosup, A., & Epema, D. (2014). *An experience report on using gamification in technical higher education. Proceedings of the 45th ACM technical symposium on computer science education – SIGCSE '14, 2008*. New York, New York, USA: ACM Press27–32.

Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*.

Kim, B., Park, H., & Baek, Y. (2009). Not just fun, but serious strategies: Using meta-cognitive strategies in game-based learning. *Computers & Education, 52*, 800–810.

Klock, A. C. T., da Cunha, L. F., de Carvalho, M. F., Rosa, B. E., Anton, A. J., & Gasparini, I. (2015). *Gamification in e-learning systems: A conceptual model to engage students and its application in an adaptive e-learning system. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), volume 9192*. Cham: Springer595–607.

Lee, J. J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly, 15*, 1–5.

Lim, H., Lee, S. G., & Nam, K. (2007). Validating E-learning factors affecting training effectiveness. *International Journal of Information Management, 27*, 22–35.

Marczewski, A. (2015). *Even ninja monkeys like to play: Gamification, game thinking and motivational design*. Gamified UK.

Martí-Parreño, J., Seguí-Mas, D., & Seguí-Mas, E. (2016). Teachers' attitude towards and actual use of gamification. *Procedia – Social and Behavioral Sciences, 228*, 682–688.

Mesquita, M., Toda, A., Brancher, J., & do Carmo, R. (2013). Utilizing gamification concepts tied with social networks to support students in programming classes. *Proceedings of the XV Simpósio Internacional de Informática Educativa*, 127–132.

Mora, A., Riera, D., González, C., & Arnedo-Moreno, J. (2017). Gamification: A systematic review of design frameworks. *Journal of Computing in Higher Education,* 516–548.

Müller, B. C., Reise, C., & Seliger, G. (2015). Gamification in factory management education - A case study with Lego Mindstorms. *Procedia CIRP 26,* 121–126.

Opdenakker, R. (2006). Advantages and disadvantages of four interview techniques in qualitative research. *Forum Qualitative Sozialforschung, 7*, 13.

Paiva, R., Bittencourt, I. I., Tenório, T., Jaques, P., & Isotani, S. (2016). What do students do on-line? Modeling students' interactions to improve their learning experience. *Computers in Human Behavior, 64*, 769–781.

Parikh, M., & Verma, S. (2002). Utilizing Internet technologies to support learning: An empirical analysis. *International Journal of Information Management, 22*, 27–46.

Passos, E., & Medeiros, D. (2011). Turning real-world software development into a game. *2011 Brazilian symposium on games and digital entertainment (SBGAMES)*.

Raymer, R. (2011). Gamification: Using game mechanics to enhance eLearning. *Elearn Magazine*.

Sánchez-Mena, A., & Martí-Parreño, J. (2016). Gamification in higher education: Teachers' drivers and barriers. *Proceedings of the international conference of the future of education*.

Sung, H.-Y., & Hwang, G.-J. (2013). A collaborative game-based learning approach to improving students' learning performance in science courses. *Computers & Education, 63*, 43–51.

Tenório, T., Bittencourt, I. I., Isotani, S., Pedro, A., & Ospina, P. (2016). A gamified peer assessment model for on-line learning environments in a competitive context. *Computers in Human Behavior, 64*, 247–263.

Thom, J., Millen, D., & DiMicco, J. (2012). Removing gamification from an enterprise SNS. *Proceedings of the ACM 2012 conference on computer supported cooperative work,* 1067–1070.

Toda, A. M., do Carmo, R. M. C., da Silva, A. P., & Isotani, S. (2018). GAMIFY-SN: A meta-model for planning and deploying gamification concepts within social networks – A case study. In Á. Rocha, H. Adeli, L. P. Reis, & S. Costanzo (Eds.). *Trends and advances in information systems and technologies* (pp. 1357–1366). Cham: Springer International Publishing.

Toda, A., Silva, Y., Cruz, W., Xavier, L., & Isotani, S. (2016). Um processo de Gamificação para o ensino superior: Experiências em um módulo de Bioquímica. *Anais do Workshop de Informática na Escola, Vol. 22,* 495–504.

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.

Wongso, O., Rosmansyah, Y., & Bandung, Y. (2014). Gamification framework model, based on social engagement in e-learning 2.0. *2014 2nd international conference on technology, informatics, management, engineering, and environment (TIME-E),* 10–14.

Yin, R. K. (2009). *Case study research: Design and methods, Vol. 5*. Sage Publications.

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