

EVALUATION OF A GAMIFICATION METHODOLOGY IN HIGER EDUCATION

Rui Pedro Lopes¹, Cristina Mesquita¹

¹*Polytechnic Institute of Bragança (PORTUGAL)*

Abstract

The gamification neologism is applied to using game-thinking and game mechanics to solve problems and to engage audiences. In the previous year we applied the concept in the context of the Higher Education, in the course of computer science. We used several game design mechanisms in several aspects of the learning process. A reward mechanism was central to the gamification approach, providing automatic classification of students and constant and up-to-date feedback of their progress within the course.

Each chapter of the course's content was mapped to a level, in a total of five. The student had to complete all the levels to be able to succeed in the course. Each level provided three difficult levels, which the student could choose and, according to this choice, adopt a classification grade.

Several learning experiences were designed. Centered in the student, the learning experiences were designed to be active, meaningful, with social meaning, integrative, and diversified, giving the student the main learning role. The inherent increase in complexity demands the integration of different dimensions of knowledge, better achieved through diversified strategies. In this sense, we designed traditional practical assignment exercises in parallel with educational games, including card games, board games, tabletop role-playing games and quizzes.

Although adopting gamification for the learning process of higher education students promises increasing motivation and autonomy, it may also provide a clash within the student, because of the pedagogical paradigm shift. Not all students have playing experience of even like to play games. Of course it may be argued that not all students like to read, research and experiment or, more generally, not all students like to study, and this has not made learning impossible to happen. However, the gamification opportunity is to provide rich and motivational experiences that can increase the involvement of students and, consequently, the depth of learning, which is more successful if students are engaged.

In this context, the assessment of this pedagogical experience is fundamental. On one hand, it allows the teacher and the institution to evaluate the success of the paradigm shift and, on the other hand, it provides a mean for students to become part of the process, by including them in the design of the learning experiences. To be as thorough as possible, the assessment methodology includes a quantitative analysis, in the form of a final questionnaire, a qualitative approach, based on an initial interview to measure the perceptions and the perspective of students concerning the pedagogical methodologies in Higher Education, several class observation procedures and game analysis and assessment. All of these forms contribute to build a solid notion of the success of the gamification for Higher Education learning process.

Keywords: Gamification; Higher Education; Educational Games; Pedagogical assessment.

1 INTRODUCTION

Higher Education Institutions (HEI) have three primary missions: education, research and cooperation [1]. While in different weights and strategic importance, most institutions try to cope with these missions to contribute for population education at high level, scientific and technological advances and economic and social development. The Bologna Process has been giving the student a central role in the learning process. However, adequate student learning disposition is fundamental to achieve high-level academic performance [2].

The Network and Systems Management (GSR) area assume a fundamental role in Information Technology (IT). In fact, it is a very technical and technological demanding area, because of the huge range of technologies and services that the administrator must know to be able to ensure the network

is fully functional. Professionals' training has to begin with the building of a solid knowledge about the fundamental theory. However, it is through the experience acquired in practical scenarios that their activity excels. Students are required to learn and acquire practical skills that allows them to use and understand several key technologies, such as how to install and configure both disconnected and networked computer systems, how to ensure data storage resilience and survivability, install and configure basic network and remote file system services, among others.

The purpose of the work described in this paper is to understand the impact of gamification in the way students learn. Gamification, in this context, describe the process of adopting gaming concepts and elements to improve students' motivation and provide a full set of gameful learning experiences.

Students must be motivated to use the strategies as well as regulate their cognition and effort [3]. There are several factors that determine motivation, and usually they also depend on the person's characteristics. To foster motivation it is important that students understand what they can and can't do and have accurate and realistic feedback that can help them acquire the expertise needed to learn. It is also fundamental to provide tasks that should be neither too easy nor too difficult, but challenge students in appropriate ways [4].

The challenges and the overall learning experiences should provide an environment adequate to foster change. It is by accepting and reflecting on change that learning is achieved. In this context, failure is actually an option. It is easier to create the appropriate environment for change within the students' beliefs and knowledge by introducing and accepting failure as part of the learning process. Failing is usually associated with reflection, since it is natural to reflect on what went wrong. It is not easy to accept failure, especially when related to oneself unless if the stakes are low. On the other hand, high-degree of motivation is usually achieved when the expectations are high [5]. Low stakes and high expectations are precisely the typical conditions of a good video game.

This pedagogical experience has been developed with 23 students of the 6th semester of Informatics Engineering (EI) degree. The teacher who designed and developed the experience has 18 years of professional experience in higher education but he had been away from educational component, for six years, assuming management functions at the same institution.

This professional scenario led him to rethink the process of teaching and learning, feeling the need of educational support to rebuild his practice. It was such motivation that led him to design and develop this educational experience focused on gamification as a teaching-learning strategy. He expected that the adoption of these concepts allow students to be more autonomous as well as more motivated towards the area of GSR.

2 DESIGN AND DEVELOPMENT OF THE PEDAGOGICAL EXPERIENCE

Gamification may be a new term, and recently it has been receiving a considerable attention in several areas and fields. This neologism, however, describe an idea that is not exactly new: using game-thinking and game mechanics to solve problems and to engage audiences. Moreover, recent research has been demonstrating that game play contributes to faster reactions as well as to increasing the brain activity, allowing people to live longer and delaying dementia [6], [7].

In this context, we intend to increase the engagement of students learning activity, thus strengthening the connection with a subject, an experience or an idea. The more engaged a student is with the learning experiences, the more effective the learning process will be.

Reward systems have always been an integral component of games. Rewards, also known as game achievement systems, allow translating the player investments into a more quantifiable, comparable and communicable form [8]. The importance of this kind of component is such that they are used even in platform-specific reward systems, such as Xbox Games Scores or Apple Game Center, bridging different games as well as pushing the gameplay experience beyond a single game. The definition of a reward structure, positive reinforcement and feedback loops are key factors for any game [9].

The taxonomy and the reward structure define the base for a game design, either digital, board or, in this context, the learning experiences of GSR. The goal of this work is to try to increase the time and attention students dedicate to learning. The path to achieving this is through motivation, which psychology divides in two groups: intrinsic and extrinsic motivation. The former derive from our core self and the latter depends, or is driven by, the environment that surround us, such as the desire to earn money or to gain social status or prestige.

Sometimes this external reinforcement often destroys the intrinsic motivation people may have, degrading the quality of certain kinds of task performance [10]. If they are intrinsically motivated to learn something, they may spend more time and effort learning, feel better about what they learn, and use it during their life. This will naturally happen if they are involved in the learning experiences, through intrinsically motivating activities. Most humans, as well as other organisms, are motivated by the development of competences in dealing with the surrounding environment. This explains their exploratory nature, towards acquiring and pleasurelessly using recent acquired skills. Skills are further improved, and satisfaction follows, through permanent challenging activities, adjusted by the difficulty level. This implies the existence of clear criteria for performance, through a concrete feedback mechanism, allowing the person to assess how well or how poorly he is doing at any time.

When immersed in the environment, humans show a creative attitude, in order to make it more pleasant or closer to their ideal surroundings. This contributes to better adapt the experiences into the existing structures of the person's mind reducing the demands of the external reality. In other words, it allows simplifying the learning process by adapting it to his mental and physical structure.

Curiosity also plays an important motivational role. In fact, it represents one of the most important factors, since it drives the actor to permanently keep investigating and experimenting until he is satisfied. Curiosity can even drive people to engage activities that represent some risk, just for the sake of knowledge or in pursuit of new experiences and sensations.

An intrinsically motivating activity is engaging by itself, for its own sake, dismissing external rewards, such as money, status or grades. As described above, the key factors for an intrinsically motivating activity include challenge, fantasy and curiosity [11]. Using game-thinking and game mechanics to solve problems and engage an audience derives from the intrinsic characteristic of humans since early development stages. The gamification in education is a pedagogical and psychological approach within the mission of HEIs.

A game is an interesting educational strategy because it can provide intrinsic motivation to students through curiosity, challenges with adaptive difficulty levels, some degree of chance and an award system. Moreover, it can also stimulate creativity. Educational games extend this by focusing the mechanics and narrative to cope with a subject curriculum, allowing the student to learn while playing.

The work described in this document defines and applies an evaluation process to assess the impact of a gamified pedagogical methodology applied in the course of GSR of an EI programme. It is structured in phases and uses several mechanisms and techniques, including observation of classes, interviews, questionnaires and game assessment.

2.1 Network and System Management: reconfigured student's assessment

Network and System Management is a third year, second semester, subject of the Computer Science course of the Polytechnic Institute of Bragança. At the end of the subject, it is expected that the learner be able to: use a basic set of virtualization tools; install and configure both disconnected and networked computer systems; manage secondary storage medium, user accounts and system startup and shutdown procedures; install and configure basic network services; install and configure network file servers and authentication domains; identify and describe the role of integrated network management in modern organizations, and use some related tools.

The curriculum is structured in four sections or chapters. Each section has several topics that should be mastered before advancing to the next section. The final assessment and the associated grade depend on the success on each of the section as well as the creativity and the knowledge level demonstrated in every topic.

Students are graded from 0 to 20, which is translated to the ECTS scale, demonstrating how she performed relative to other students (the best 10% are awarded an A-grade, the next 25% a B grade, the following 30% a C-grade, the following 25% a D-grade and the final 10% an E-grade). Success is only considered if the student has a grade equal or above 10 (0-20).

The assessment and grading follows a reward structure design pattern. All the students have to fulfill the minimum requirements to succeed, meaning that he has to overcome all the sections or "levels". This will grant him the grade 10. Within each level, the increasing number of overcome obstacles will grant the student a higher grade. Whenever a learning experience is completed, BitPoints are awarded, which can be used to "buy" extra tools or help from the teacher. The student can, at any time, see the evolution within the awards system using a standard web browser.

2.2 Learning experiences

The term learning experiences is not typically used to describe more formal learning activities, such as in classroom, transmissive methods. Centered in the student, this term describe that the learner is experiencing something that, contributes to a change in thinking, understanding, or behavior.

For this to happen, learning experiences should be active, meaningful, with social meaning, integrative, and diversified. We consider active learning experiences when the student has the main learning role. They should provide knowledge and skills that directly contribute to the learner's ability to perform more effectively in the context of workplace learning. Sharing and cooperation is fundamental, allowing the learner to interact with other active learners. The inherent increase in complexity demands the integration of different dimensions of knowledge, better achieved through diversified strategies. In this context, teaching and learning is more than the mere acquisition of content. It represents a process of learning by thinking-do-thinking [12].

The learning experiences should be adequate to motivate the students and provide the necessary challenges for learning to take place. In this context, the concept is understood as a reinforcement of the goal of an educational interaction over its location (school, classroom) or format (course, program). The organization of the structure in five levels, with three layers of difficulty in each level, allows the organization of learning experiences in stages with increasing complexity (Table 1).

Table 1 - Distribution of learning experiences.

Level	Title	Aux/Theoretical	Learning Experiences		
			Easy	Normal	Hard
1	Virtualization	Tutorial Supervision	Card Game	Assignment	Assignment
2	Disconnected Systems	Slides	Assignment	Assignment	Assignment
		Role Play	Role Play Game	Role Play Game	Assignment
3	Networked Systems	Slides	Assignment	Assignment	Assignment
		Slides	Board Game	Assignment	Assignment
4	Network Management	Demonstration	Demonstration	Assignment	Assignment
5	Final Integration	Tutorial Supervision	Assignment	Assignment	Board Game

Each difficulty layer in each level corresponds to a specific learning experience (Easy, Normal, Hard). The student has to choose at least one easy, normal or hard challenge and has to fulfill at least one to be able to successfully finish the level.

The diversity of ways in which students can learn from and interact with teachers, in addition to the level of independence they may have when learning, is considerable. In the gamified GSR, these include not only traditional transmissive approaches and practical work assignments but also designing and playing games. The latter is regarded as an integral part of the students' knowledge building, with the objective of being instructional with the main focus on the cognitive side of instruction.

For each level, Table 1 summarizes the organization of the auxiliary and theoretical component, designed for the student to learn and reflect on the theoretical component of the curriculum. The transmissive method is associated to the slides that supports it, the tutorial supervision enforces an autonomous, although guided, learning process and the role play incentives the cross-student learning by fostering communication and team work. The role-play has the form of a TV contest, similar to a quiz show, in which students represent the producer, director, presenter, jury, competitor and audience. They have to structure the questions, decide and time the answers and manage all the show details.

Concerning the practical learning experiences, there are traditional practical assignments, which present to the student an exercise or problem that has to be understood and solved with network and system tools of their choice. Some are easier and others more demanding, to allow students to choose according to the confidence and motivation they think they have. This also contributes to the student regulate the learning rhythm and, usually, after completing an easy learning experience, they return and try to finish a normal or even a hard, to pursue higher grade.

Among the traditional practical assignments, several games were also designed and built. The first game, available in the first level, layer easy, is a card game, called Virtualization Game. The objective of the game is to learn concepts related to operating system virtualization. The students have to design the cards according to a fixed set of rules. The cards, similar to memory cards, have a question and a consequence to follow, should they fail.

The second level, layer easy and normal, include a tabletop Role-Playing Game [13]. This game is played in person, around a table, where all the actions and consequences are communicated orally. The game is played by 4 or 5 students, where one performs the role of the Game Master and the remaining assume the role of Datuist monks, the heroes of the adventure. The educational content of this game is related to isolated systems, in particular the recovery and survivability of data.

In the third level, students can play a strategy board game, called Cabinet, of the worker placement type [14]. This game opposes two students, where they compete for resources to build and maintain an enterprise-wide data-center. They have to deal with racks space, energy consumption, hardware, operating systems and network services to be able to fully operate it and win the game.

Finally, in the fifth level, there is another board game, designed to summarize all the previous concepts. It is called Knowledge Pursuit and it follows the same rules as Trivial Pursuit. It includes 50 questions for each of the following six categories: Virtualization; Isolated Systems: Disks and Storage; Isolated Systems: Security and User Accounts; Networked Systems: DNS & DHCP; Networked Systems: NFS & SMB; Integrated Network Management.

This set of learning experiences provides a diverse and broad set of approaches to challenge the students. They allow students to choose the difficulty level and the kind of experience, including traditional practical assignments or designing and playing games. Moreover, this diversity also contributes to maintain high level of motivation and curiosity, as they integrate educational content with the possibility for fun.

3 METHODOLOGY

The inclusion and adaptation of game-thinking and associated mechanics to a HEI subject in the context of the EI course follows the student-centered guidelines of the Bologna Process. Students are positioned in the center of all activity, with the responsibility and the freedom to make choices and perform activities within the game action. This provides an adequate environment for the student to actively participate in his own learning process.

The gamification concept, adopted for the learning process of higher education students, promises increasing motivation and autonomy. However, it may also provide a clash within the student, because of the considerable pedagogical paradigm shift. Not all students have playing experience of even like to play games. Of course it may be argued that not all students like to read, research and experiment or, more generally, not all students like to study, and this has not made learning impossible to happen. However, the gamification opportunity is to provide rich and motivational experiences that can increase the involvement of students and, consequently, the depth of learning, which is more successful if students are engaged.

The assessment of the pedagogical experience of gamification of GSR has two main goals. On one hand, it allows the teacher and the institution to evaluate the success of the paradigm shift and, on the other hand, it provides a mean for students to become part of the process, by including them in the design of the learning experiences.

The evaluation methodology is designed considering the involvement of students with the process and must reflect on the available pedagogical techniques and approaches. They must understand, from the beginning, what this paradigm shift represents and what is the role of each one of them. This is best achieved by stimulating them to think about the subject, by posing questions, considering individual positions and reflect on the overall learning process.

In addition, it is also necessary to understand the levels of satisfaction and motivation of the students in several moments of the process. At the end, a final assessment is made to compare the initial perception of the students.

The impact of the gamification approach, from a pedagogical point of view, is an action-research process, considering that all those involved can contribute both to the thinking that informs research and practice and to knowledge development. The main research concern is related to the self-initiative

and autonomy of the students, as well as the pedagogical techniques. The results of the assessment should contribute to the process of gamification design.

A quantitative approach is not possible to use in this scenario, since it would require some means to perform statistical comparison of specific indicators. In fact, it is not possible to compare the student results from last year, since we are dealing with different persons. It is also not possible to compare the success of the same students between subjects, since the degree of difficulty is also different. This leads to a qualitative research method, taken in a single case study in the context of action-research process [15]. The research methodology is structured in seven key steps (Table 2). In each step, data is gathered with different instruments, using specific interviews and observation of students in different learning activities.

Table 2 - Key steps in the action-learning process.

Key steps	Description	Timing
Step 1	Definition of goals and development of the supporting document. Design of the gamified learning experiences related to the contents of the GSR. Design of the evaluation process. Design of the monitoring process (collaborative reflection with the pedagogical supervisor).	September to January
Step 2	Clarification of the project's goals to stakeholders (Dean, Department, Programme coordination, Pedagogical council)	January
Step 3	Initial assessment: analysis of the students' conceptions about the teaching and learning experiences in higher education and their expectations in relation to the learning process through gamification (interviews).	February
Step 4	Presentation and discussion of the project of learning through gamification with the students. Inform consent.	February
Step 5	Implementations process. Development of 21 learning experiences centered in the contents of the course contents. Observations process.	February to June
Step 6	Collaborative work (reflections and teacher support)	March to June
Step 7	Process evaluation (questionnaires to students; analysis of the evaluation data, Teacher reflections and discussion with the pedagogical supervisor)	June and July

3.1 Interview Structure

Semi-structured interviews, conducted with the help of a guide, are performed both in the beginning and in the end of the process, thus resulting in knowledge about the achieved gains. The participants in the interviews have to be volunteers, and they should provide a good representation of the audience. The group has six students, of different age, sex and enrollment category. If possible the same students will also be interviewed in the end of the process.

Initially, all the participants are appropriately informed of the process and consent is requested to each one of them. The initial interview provides the moment of reconnaissance, considering several aspects: the initial assessment about the knowledge of pedagogical methodologies, the degree of satisfaction with each one of them, the methodologies they feel are more motivating, and others. It is also important to understand the expectations about the GSR, its content and curriculum, and the learning outcomes. It proceeds with game related knowledge, to understand and make the student think about the gamification and how it can contribute to the learning process and own motivation.

3.2 Observation process

During the semester there are four observation moments, to assess the students stimulation, involvement and participation. One of the observation moments was performed in an expositive class and the remaining three were performed to learning experiences with games. Another teacher (pedagogical supervisor) performs the observation to pay attention to different indicators related to motivation, interaction and the undergoing learning experience. 50% of the students up to a maximum of 12 will be observed, considering equitable distribution of gender. Each student is observed in a total of three times in different moments of the class, where each observation has at last no longer than 2 minutes.

Observation details are registered in a specific form, to better systematize data. However, the observation process is not a mere exercise in data collection but also a process to create awareness of what is experienced in class, enhancing professional reflection about the learning opportunities.

The form starts by identifying the date, time, and the student's name, sex and age. In addition it also records the number of students participating in the learning experience. It also registers the level of initiative (1 to 4), learning experiences, involvement (1 to 5) and interaction, either verbal or non-verbal.

Initiative describes the ability to begin or to energetically follow a plan or task, comprising the will to overcome the obstacles and constantly searching for creative opportunities. It also describes the number and quality of attempts, as well as the search for necessary knowledge and tools. There are four levels of student's initiative: Level 1: No attempt is made to solve problems or overcome obstacles; Level 2: Waits for someone else to take the initiative to help him to solve the problem; Level 3: Tries to solve the problem, asking for help; Level 4: Is determined to solve the problem, searching and providing a personal position about it.

The observation procedure is specially designed to assess the intrinsic motivation level, in which the following categories will be observed: self-determination, competence, involvement in the task, curiosity and interest. The extrinsic motivation, such as pursue of a higher grade, concern with the competition and recognition or an overall concern with the other students, will be assessed in the interview.

The intrinsic motivation categories will be translated into a five point scale: Level 1: Absence of intrinsic motivation; Level 2: Some curiosity is demonstrated, although lacking in involvement; Level 3: Continuous involvement in the task; Level 4: High level of curiosity and interest; Level 5: Intense involvement, with self-determination and demonstrating high degree of competence.

The learning experiences as described in Table 1, fall under: Slide presentation, Designing and playing a Card Game, participating in a Role-Playing Game, playing a Board Game. If the learning experience is a game, a complementary set of details is also registered, comprising interactions (defined as watching, speaking, listening, touching, moving): Player-player interaction, Player-game interaction, Player-self interaction, Outside the game.

3.3 Questionnaires

The main purpose of the questionnaire was to get student feedback on the gamification strategy used in the context of Network Management Systems course. It aimed to characterize the expectations and the opinion of students regarding several aspects, such as autonomy, motivation, and pedagogical approach among others. It includes the following four dimensions with several questions each: Teaching-learning strategy; Gamification as a learning strategy; Satisfaction and motivation with the learning strategy; Evaluation system.

It also allows assessing the students' opinion concerning the success of the learning experiences, both for learning and for motivation.

4 DATA ANALYSIS

The data of all the instruments used was submitted a hard process of content analysis using appropriate tools to assess the perceptions and practices that emerged from all the process. Interviews were analyzed through an interpretative process, to build categories inductive by the voice of the students.

Observations were recorded and analyzed using specific scales to register the involvement, interaction and knowledge in action indicators. Finally, the interviews were analyzed with the statistical tool R project.

4.1 Interviews

From the analysis of the content of the initial interviews [16], intended to interpret the students' perceptions regarding the teaching-learning strategies in higher education, 4 categories emerged:

1. Teaching-learning strategies
2. Satisfaction levels concerning pedagogical strategies
3. Motivation for games
4. Expectations towards GSR

In category 1, Teaching-learning strategies, all the interviewees referred that the kind of methodology used by HE teachers are based on exposition, based on slides to present the content. Students, during classes and after listening to the teacher's explanation, perform exercises, as confirmed by the opinion of a student: "*Learning is done through slides, teacher presents slides (...) is always like that, slides, exercises, slides, exercises*".

In category 2, Satisfaction levels concerning pedagogical strategies, three categories emerge: less positive aspects, positive aspects and preferred classes type. Students refer, as less positive aspects, the inadequate scientific and pedagogical preparation of some teachers, the lack of quality of the pedagogical material, the existence of excessively expositive classes, the excessive number of practical assignments, the lack of articulation between the different curricular units, and the difference between the content and methodologies towards the labor market. As positive aspects, students refer the existence of good teachers that "*know how to present the content, giving feedback (...) and helping students with all the doubts and questions*". The interviewees value autonomous work that they perform at home, according to the Bologna model. Concerning the preferred class types, students fell more involved in classes that appeal to their participation and cooperation. They consider that there should be theory-practice integration, where good indications regarding research and inquiry are provided. They refer that, although they value the cooperation, this is hard to achieve, since not all colleagues are available to collaborate in discussions and work research.

In category 3, Motivation for games, the interviewees refer that they very motivated to develop a learning strategy based on games. They say that games are an interesting way to learn, because they stimulate competition, enable autonomy and persistence.

Finally, in category 4, Expectations towards GSR, they expect that gamification gives them more practical learning and empower their critical thinking, competition and cooperation between peers and help them to become more autonomous and to be successful.

4.2 Observations

The observations analysis about the involvement and participation of students during the expositive class revealed low levels of involvement (2 in 5, average). Some indicators show limited concentration, looking away during the activity, fiddling, daydreaming, easily distracted with the computer or with the mobile phone.

During the classes with games (Virtualization Game, Cabinet and City of Dred), although showing an initial skeptical attitude, unknowing of rules and best strategies, the students started to gain confidence and participating in all the process. The data on the students' motivation show that levels 4 and 5 dominate 90% of observations.

The data also describe enhanced interactions of reciprocity between the students and their peers and the students and the teacher, as well as a strong implication with the game. Teacher found ways to engage with the students, observing and supporting their motivation, getting involved to scaffold and extend learning and play.

The greatest difficulty was related get up to speed with the game. The initial process of learning and getting comfortable with the rules is not immediate, although students shown cooperation to include, as quickly as possible, the colleagues in the games.

4.3 Questionnaires

In total, there were 14 responses to the questionnaire. All of the respondents were attending the subject for the first time and 4 were frequenting the programme for 3 years. Three students had an additional registration (4th year), 4 students were frequenting for 5 years and 3 had over 5 registrations.

Students were also asked about their preferred EI area. 43% answered Computer Engineering, the same area of the GSR subject, 36% referred Computer Science, which includes programming concepts and tools, and 14% mentioned Information Systems, related to databases and information management.

Concerning the learning experiences, students were asked about the overall satisfaction with each type of learning experiences (Table 3). These included both the games and practical assignments. The Knowledge Pursuit game is not listed, because it wasn't ready at the time when the students answered the questionnaire.

Table 3 - Satisfaction with the learning experiences.

Learning Experience	Type	Mean	Std. Dev.
Virtualization Game	Card Game	4,08	1,32
City of Dred	RPG	3,44	1,51
Cabinet	Board Game	4,31	1,18
Problems and Exercises	Practical Assignment	3,79	1,12

It is clear from the results that students are very satisfied with the games, showing a mean value higher than 4 in almost all of them. The exception is City of Dred, probably because the game requires a strong imagination and involvement of the student with the adventure, as well as skills that are not traditional in a technological programme. This result further reinforces our opinion that this kind of game can benefit from previous experience and student preparation.

Students are also satisfied with the scientific (79%) and practical (79%) knowledge acquired during the semester. They are further satisfied with the possibility of collaboration and knowledge building with their colleagues (85%).

Concerning the assessment mechanism, students didn't reveal a strong indication of the reasons for choosing a specific difficulty layer. 28% of the students referred that they chose the easiest learning experiences because they wanted to succeed, in opposition to 43%. However, 79% of the students said that their motivation to choose higher difficulty learning experiences was to get a higher grade, ignoring the fact that they could be too difficult (71%). They also think that the possibility to choose the difficulty allows them to learn at a self pace (94%). Finally, when asked about if they prefer to be evaluated by exam, they strongly disagree (71%).

Students are able to monitor their progress constantly through a custom built online platform. This platform allows them to have update feedback of the completed levels, the learning experiences and the collected BitPoits. 48% think that this possibility helps them organize their progress.

Students also recognize strong pedagogical (71%) and scientific (79%) competences of the teacher, which helps maintaining a respectful and strong connection in class.

It is almost unanimous, among the respondents, that gamification contributes to higher motivation and learning success. With a mean value of 4.15, where 5 is the highest, and a standard deviation of 0.9, we can conclude that students are very satisfied with this pedagogical methodology.

5 CONCLUSION

Higher Education Institutions have the responsibility for contributing to the advance of science, cooperation with the enterprises and the community, and education at a high level. In the context of a Informatics Engineering of a HEI, we applied a gamification process to all the aspects of the course's organization. The assessment system was built around a reward mechanism, complemented with soft currency for autonomy building, and the learning experiences were designed to include educational games as well as traditional practical assignments.

We also evaluated this process with a three-instrument process: class observations, interviews and a final questionnaire. It is clear, from the overall evaluation work, that there is a substantial change in the motivation of students, comparing with their motivation in expositive classes. This means that students felt drawn to the gamification process, truly interested in and driven to engage in it. They have shown a high persistence in solving problems, higher levels of complexity and creativity, demonstrating they worked with confidence and perseverance for long periods of time.

The project and the results are, at this moment, being presented and discussed among the teacher community. Some of the teachers of other courses are demonstrating interest in developing similar experiences.

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