

Gamifying an Online Approach for Promoting Game Development Learning and Contest

An Experience Report

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Abstract—A big challenge of virtual learning environments is to guarantee engagement and keep students motivated to use it. In this context, gamification techniques are being explored to adapt game elements to teaching and Learning in Virtual Environments (VLE) with the objective of make the VLEs more engaging and attractive for students. The gamification engages, encourages and promotes greater interaction between students, enabling growth of learning. In this context, this article presents the gamification results of a virtual learning environment for online programming teaching and competition of digital games. At the end, results showed that the gamification achieves greater engagement of users in relation to the higher frequency of use of the VLE, larger views of video lessons and a greater number of completed challenges, bringing some other advantages such as the environment that became more competitive, fun and friendly for students.

Keywords—*gamification; game-development; learning; learning in virtual environments; online competition*

I. INTRODUCTION

Nowadays, computing resources are being integrated into the Virtual Learning Environments (VLE) in order to improve the dynamics of learning in many educational contexts. Nevertheless, one of the limitations observed in VLEs focused on education concerns the engagement of students, a key factor in the process of teaching and learning [7]. A new approach that addresses this issue and incorporates games mechanics to these environments is the gamification, understood as the use of game design elements in contexts unrelated to games [2].

The gamification has been seen with the potential to improve the quality of learning by bringing a greater effort and commitment of students in teaching and learning activities by making use of game elements, for example, rewards, medals and rankings. The application in teaching can make students be motivated to perform certain tasks to achieve the objectives of the course and/or a particular discipline.

In this sense, one of the challenges of the VLEs that are focused education is to guarantee engagement and maintain the motivation of the students in their use. In this perspective, gamification concepts have been explored to adapt game

elements to teaching and learning in order to make them more engaging and attractive.

Thus, this article presents a study on the use of gamification techniques in a VLE for educational programming digital games and online competitions. The gamification techniques used to motivate certain behaviors of students were: Challenges, Scoreboard, Ranking and Progress. While game programming learning approach focuses on developing programming skills and computational thinking in students, gamification elements motivate participants and introduce principles related to learning based on collaboration and competition.

Therefore, this study was conducted in the context of a training initiative and online competition of digital game programming with video lessons that teach programming to students of different educational levels. In total, 350 students participated in this study.

The results were analyzed using logs of students in the VLE and questionnaires at the end of the study. The results show that students found the gamified VLE interesting, because it concentrates a feature that they always seek to complement the studies, which are the video lessons. What most caught their attention was the ranking provided by the environment that showed who until now won more points. What was noticed was a good use of the FAQ and chat rooms available in the Q&A section to exchange information and questions. All students who participated in the study would like to have more games available and also wanted that the ranking could be linked to Facebook so that they could show to colleagues sharing their scores.

The study allowed the gamification techniques - Challenges, Scoreboard, Ranking and Progress - used in VLE, contribute to the engagement of students in the use of the environment. This dynamic of competition creates a more interactive and attractive environment, thus promoting greater interest from students.

This article is organized as follows: Section II mentions the most popular existing VLEs and their gamification modules, Section III presents The Proposed Approach, Section IV the

Case Study, Section V the results and, finally, Section VI concludes.

II. GAMIFICATION OF VIRTUAL LEARNING ENVIRONMENTS

The gamification presents with an emerging phenomenon with a variety of application in different contexts, both educational as business, because the language of games is popular and accepted by the new generations. Since the VLE can be described as the use of multimedia technology to improve the quality of learning [1].

The use of technology supports education in many ways, however, the problem related to the motivation and engagement of students still persists [9]. In VLEs, the situation is no different. Even with the use of VLEs for effective learning, students end up facing the same motivational problem of the traditional education system, including being one of the main causes of students dropping out of online and classroom courses by VLE [10].

To increase engagement and motivation of students in VLE, an approach that has been widely used is the gamification. The gamification can be found in many types of applications and purposes, from education to the industry. In this perspective, [11] discusses on the application of gamification to teaching and learning, they describe how to design learning activities using the Gameful Design Approach [12] which provides suggestions on how to involve and promote participation through the VLE with the use of gamification and [13] how this reflects on the impact and effectiveness of gamification in education from the perspective of a teacher.

The gamification can bring greater engagement and motivation for students in VLE use, however, the use of gamification in education is still new and there are few studies and as [15] the gamification-based learning is still in an experimental state. The application of the techniques of gamification in VLE can cause students to be motivated to perform certain tasks or challenges to achieve the course objectives.

The mechanics of a gamified VLE consists of techniques that, when used properly, promise a significant return by users [14]. The most common techniques used for the gamification of VLEs are: points, levels, rankings, challenges and missions, medals, integration, engagement loops, personalization, feedback, rules and narrative.

The mechanics of a gamified VLE consists of techniques that, when used properly, promise a significant return of users [14]. The main techniques used for the gamification of VLEs are: points, levels, rankings, Challenges and Missions Awards. The mechanism Points are open, direct and motivation by allowing the use of various types of scores, according to the proposed objective in the environment. Levels indicate the student's progress within the VLE. The Leaderboard have as main objective comparison between the players involved, basically works as a way to visualize the progression of users within the environment and generates a competition between them. The challenges and missions are the elements that guide students on the activities that must be performed within the

environment. The more challenges and missions the environment has, the more motivated students will be. The medals are visual representations of achievements within the VLE [14].

In the literature you can find several VLEs using gamification techniques, Khan Academy is a free VLE that provides math content, Physics, Chemistry, Biology, Economics, Arts and Computer. QizBox, Code School, Duolingo and Peer2Peer University are also others gamified VLEs well known. [16] presents the results of an empirical study comparing the effect of using gamification in students regarding participation and attitude in the VLE. The authors reported that the students have a better performance using the gamified VLE, also pointed out that the attitude of the students were positive. [17] present the SMILE-BR, an architecture that uses gamification concepts in a questionnaires based learning environment. [8] developed a gamified environment for programming languages courses. Environmental gamification works with exercises, tests, scoring systems, rankings, dashboard and reports.

III. THE PROPOSED APPROACH

This study was conducted in the context of an online training and competition of digital game programming that takes place annually, which objectives are: (i) encourage creativity and skills related to the design of digital games; (ii) promote the development of students' skills in the production of digital games through the use of game engines; (iii) promote a virtual learning environment and the socialization of the produced games; (iv) engage students and teachers in activities that stimulate computational thinking, game development and use of these games in academic environment.

The considered initiative was performed through a VLE with video lessons teaching how to program digital games through a commercial game engine. This tool, called Construct 2, allows students to create 2D games for mobile, web and desktop platforms through a drag and drop interface.

The initiative was organized into three stages: promotion, training and competition. The promotion stage was done through social media (Facebook, Twitter and email marketing) and some visits to schools in Natal, Brazil.

The training stage prepared students to develop games with Construct 2 tool from September to November 2015 through the use of video lessons. The video lessons were made available in the VLE, where students could access the lessons and ask questions from the Questions and Answer Section (Q&A). Each lesson taught how to create a different game involving several concepts, such as, variables, conditional structures and introducing tool features. In total, it was provided three sets of video lessons. Each set includes the necessary videos to develop a specific game. Inside each set had a game with a video lesson introducing the game and other videos called resources that explained the tool elements and programming principles for the game development.

The video lessons were developed in a format that students need to think more about how to develop the game, exercising logical thinking, organization and other skills required to the

game development. The environment promotes the reuse of explanatory videos for different games [3]. Fig. 1 illustrates an example of the games used in the training stage.



Fig. 1. Sample game used in the training stage.

The competition stage aimed to evaluate, select and award the best participants of the initiative. At this stage, participants make teams of two to five members to develop and submit a game for the final competition. Each team must have an advisor teacher, because all games developed at this stage should have educational purposes. At the end of the challenge, the best games were awarded. The VLE have the following features:

- Videos showing how to perform basic operations in Construct 2 and additional videos that provide step-by-step solutions for each game.
- Students can also upload videos they produced for demonstrating their developed games;
- Participants can form teams;
- Participants can invite others to enter in the competition or to join their teams;
- Log and monitor students' activities in the virtual environment;
- Questions and answers section, where students can chat with the support team about the video lessons or the VLE.

A. The VLE Gamification

The gamification of the VLE was implemented with the purpose of engaging the participants in the proposed activities of the online training and competition. From this perspective, we established a structure for the VLE that incorporates gamification concepts. Indeed, it was implemented the following gamification techniques: Challenges, Leaderboard, Points and Progress.

The "Scoreboard" was used in the VLE for the purpose of scoring. The points were obtained by users who engaged in achieving some activity. When a participant finishes an activity, she is rewarded for it though points. In fact, a scoring mechanism is considered a good way to motivate and provide a greater engagement of students to a particular activity [6].

Thus, the defined gamification assigns points to the actions of students in VLE. In summary, there were eight ways to earn points:

- Watch the tutorial about the use of the VLE: 30 points;
- Watch the tutorial on the Q & A section: 30 points;
- Watch the tutorial on the profile section: 20 points;
- Update my avatar: 30 points;
- Update my profile: 50 points;
- Create a team: 50 points;
- Send video demonstration of the competition game: 40 points;
- Send first version of the competition game: 100 points;
- Watch the video lessons programming package: 200 points;
- Complete the Game Design package: 500 points.

The technique known as "Challenges" brings together the challenges and missions that guide students on the activities that must be performed within the VLE. For example, to achieve the 30 points of the activity "*Watch the tutorial about the use of the VLE*" the participant has to follow the next challenge, defined as a mission and its steps:

- **Mission:** to succeed in this initiative, you must understand exactly how to use the platform. Your mission, if you decide to accept, is to watch the demo tutorial of this platform.
- **Steps:** On the "Beginning Area", click in "Tutorial" located at the top of this page and follow the directions to be given.

The "Leaderboard" was used to stimulate the students' performance, displaying feedback from your current position, and allowing a comparison in relation to other competitors (Fig. 2). The Leaderboard was a complement to the scores and was updated automatically.











RANKING		
	Augusto Marcato 1 Place	1100 Points
	alhenan2x 2 Place	1050 Points
	edsoncastanelli 3 Place	1010 Points
	fulvius 4 Place	1010 Points
	cunhaquiroa.ch 5 Place	950 Points
	Ratos de Carrada 6 Place	850 Points
	Iguarias 7 Place	800 Points
	samuelcaldeira 8 Place	550 Points
	Leonardo Maurice 9 Place	530 Points
	Gustavo 10 Place	510 Points

Fig. 2. Leaderboard of students.

The “Progress” technique implementation is essential to enable the monitoring of the student’s progress within the VLE. It is a technique used to provide important and engaging information to the user. Fig. 3 shows the progress of a particular student within the VLE, presenting their points (a), the total number of activities he performed (b), the total points of his team (c), and the average points per team member (d).

All of these gamification techniques were used to motivate the student to use the different features offered by the VLE. Fig. 4 illustrates the layout of the environment in which the students can interact to accumulate points.

Another important section of our VLE was the Q&A section (Fig. 5), because through it we could have evidence about if the participants are understanding the content of the video lessons, or if they have other questions about gamification or VLE. Fig. 5 shows the chat between one of the administrators account and a student (a), followed by the frequently asked questions (b).

IV. CASE STUDY PLANNING

This study aimed to gamify a VLE of teaching digital games programming and online competitions to identify the

assiduity of students with the environment, find patterns of actions between students and the platform, and finally identify if the gamification played an important role in the motivation and engagement of the students.

From this definition of goal, it defined the planning of the study, including: research questions; participants; and data interpretation. The structuring of the study design and the description of the results follow the guidelines proposed in [4] and [5].

A. Research Questions

To achieve this goal, the Research Questions (RQ) prepared for this study were the following:

- **RQ1:** What were the students’ actions within the proposed gamified environment?
- **RQ2:** Did the participants use of the Q&A Section to ask questions online?
- **RQ3:** Did the VLE gamification lead to the participants’ engagement?

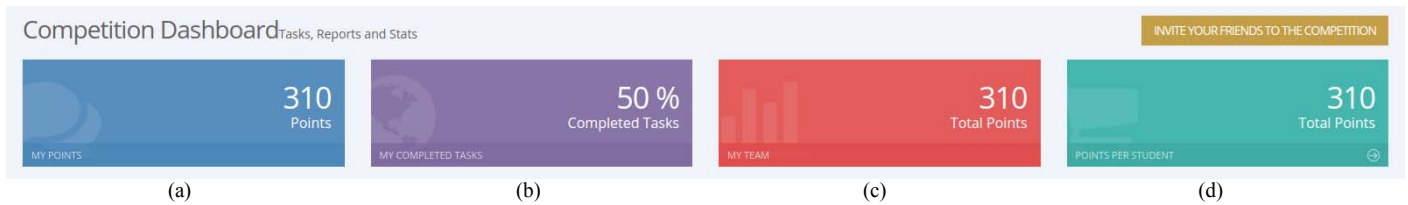


Fig. 3. Example of a student’s progression metrics.

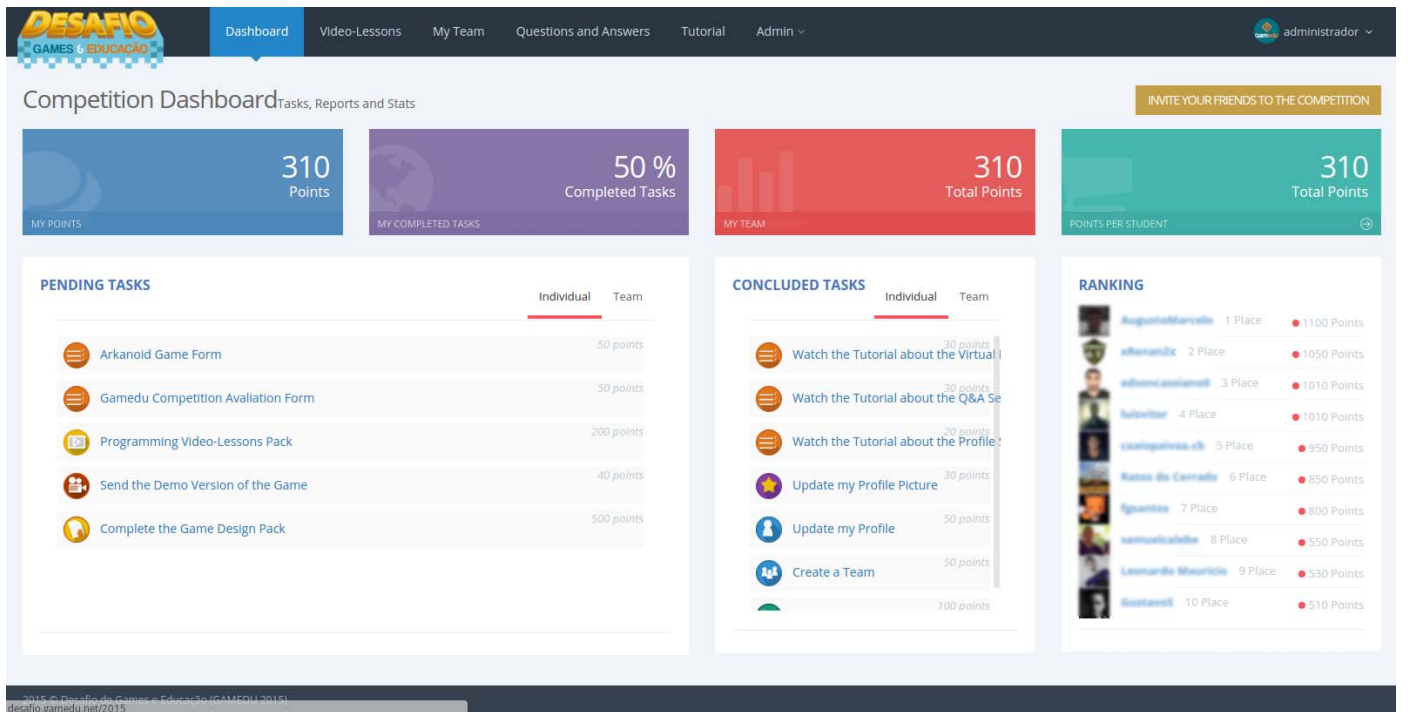
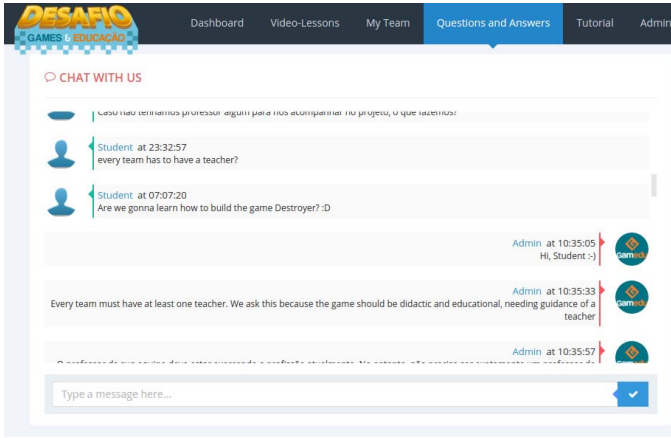


Fig. 4. Layout of the gamified VLE.



(a)

Frequently Asked Questions	
Who can participate in the Challenge?	+
Gamedu hallenge 2015 is free?	+
Can i compete with as many games in the Challenge?	+
A student can participate in more than one team?	+
The team members must be from the same institution?	+
Teachers can guide to how many times?	+
Can i form a team without any teacher?	+
How many teachers can participate in the same team?	+
My team has members from different education levels (primary, secondary, technical or higher). What category we compete?	—
The game needs to be educational?	+
How to learn to develop games in the Competition?	+
How long I have to develop my game?	+
What will be the reward challenge?	+
The game can be done which platform?	+
What is the deadline for sending the game?	+
Scoring	+
Tutorial error platform	+

(b)

Fig. 5. The Q&A section.

B. Participants

For the study context, the target group was composed of 350 students interested in programming digital games. All students were from Brazilian institutions of K-12 education, technical school or higher education, attending the study entirely at distance.

C. Analysis unit

The unit of analysis in this study was each student registered in the VLE. In each class, it was monitored if the student accessed the video lessons and other VLE sections, session time, tasks performed and the amount of times each

content was viewed. They also had their opinions collected through web forms, applied to the end of the initiative.

To achieve the objectives, we analyzed different types of user data: demographic data (age and gender), data on the VLE (publications in chat rooms and other sections), data collected through questionnaires, and navigation data of participants collected in the VLE (accessed video lessons, session time and frequency of access).

Most of these data were collected through a log system developed for access to information for all users on the system. The Logs system was developed with the aim of discovering the behavior of students in the system and find patterns of use, so all the information obtained had to be relevant. Thus the Log system could get 22452 lines of logs, where each line was a summary of a user action on the environment.

V. RESULTS

In this section, we present the answers to the research questions of this study based on all the data collected and analyzed from logs and questionnaires.

A. RQ1: What were the students' actions within the proposed gamified environment?

The first question to be answered refers to the actions of students (in general) inside the VLE: actions most commonly performed, most accessed sections, number of views of video lessons and challenges completed by students.

The graph shown in Fig. 6 presents a summary of all the students' actions in the system.

Students Access

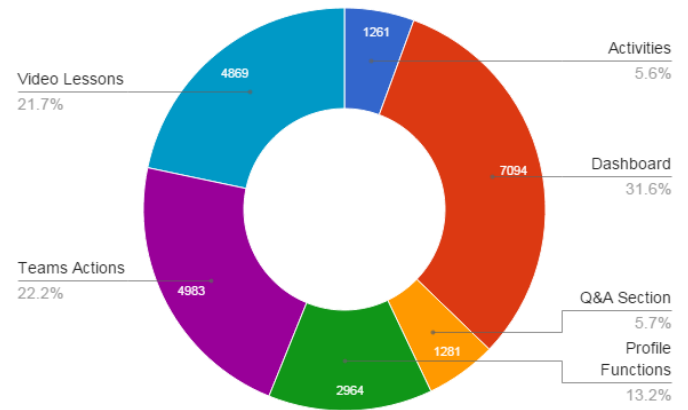


Fig. 6. Statistics of the students access to the system modules.

As presented by the graph, the access to Dashboard module showed a larger number than the other (7094 total accesses). It is important to clarify that this module was the start page of the environment (Fig. 4). In addition to the gamification techniques that could be viewed through the Dashboard, as Progress and Challenges leaderboard, it was also through the Dashboard that participants obtain access to all other modules.

Then, with 4983 accesses, there are the team's actions, which include the following functionalities: create, edit, add or

remove users, and conversations in the team chat room. After that, we have the access to video lessons with a close number of accesses (4869), suggesting that students were interested in training stage of this initiative. Then, there are the Profile functions that enable the user to modify their profile (2964 accesses), the Q&A section that were available to the students to answer their questions (1281 accesses), and finally the remaining actions, such as accessing the activities to be performed in the competition (1261 access).

Another graph also generated from the analysis of the logs is shown in the Fig. 7. It shows a count of the number of students who performed specific actions at least once. The first bar represents the number of students who completed at least one Challenge. We obtained a total of 247 students who had at least one involvement with the proposed challenges. The second bar is related to students that submitted or accessed questions addressed in the Q&A section (263). Finally, we have the number of students who watched at least one video. Here, it is observed a lower number (196) when compared to the first bar because some Challenges did not depend on video lessons.

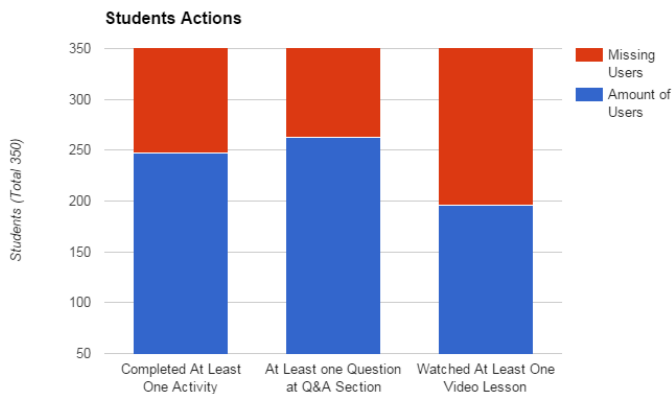


Fig. 7. Amount of users with at least one from the detailed action.

B. RQ2: Did the participants use of the Q&A Section to ask questions online?

One of the sections that received the analysis of logs was the section of Q&A. We took it into consideration because it is an important section. From this analysis we can identify whether we are actually helping to solve the doubts of students within the environment.

From the analysis of data collected from the logs, it was possible to see a frequent access of students in chats and in the environmental Q&A Section. First, as expected, these modules were more used to answer questions related to the publication dates of video lessons, new activities and goals of gamification. As shown in the graph of Fig. 6, you can see that the access of students to the Q&A section functions resulted in 5.7% of all user actions (1281 hits from a total of 22452), which seems to be a small amount.

With the progress of the competition, this section has become more common to use for resolving questions about the content that was being passed in the video lessons or the interaction between student's groups to develop the games.

Thus, through the Fig. 7 and Fig. 8, the analysis that can be made was that 263 students from 350 of the total users created at least one question or accessed the Q&A section to read the FAQ. Also, from the total of 1281 doubts by 263 engaged students, we have an average of almost 5 doubts per user.

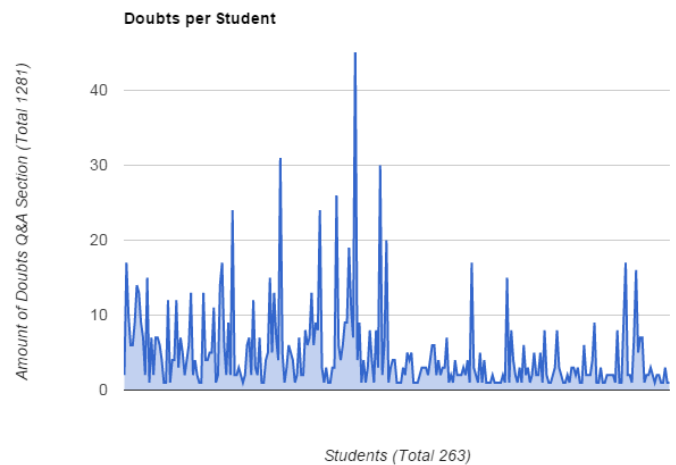


Fig. 8. Amount of doubts per student.

C. RQ3: Did the VLE gamification lead to the participants' engagement?

As the results of the analysis of logs, among the gamification techniques that possessed the best analysis are the Challenges and their complements (Leaderboard and Progress). By combining the data from the logs and the database was possible to see which students have completed their activities, when completed and there was actually a greater user engagement to complete them.

As shown previously on the chart analysis illustrated in Fig. 7, it was revealed that there was a big number of students (247) with completed tasks proposed by the gamification. Therefore, one of the main factors that can be calculated using the log system was completed tasks by students. We had a total of 942 completed tasks of a total 247 students on the system, so we had about 70% of all students completing at least one task.

In Fig. 9, we can also see a graph showing the amount of challenges completed by each student. Excluding the total number of students who were not interested in completing the challenges (103), we have more than 70% of students interested in this technique of gamification and also have an average nearly 4 tasks completed per student.

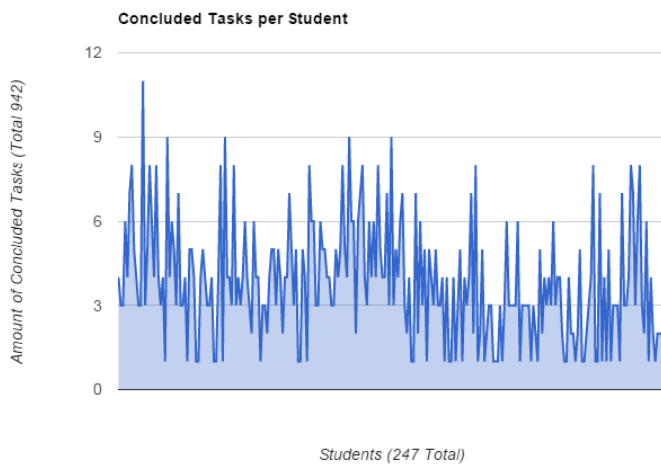


Fig. 9. Amount of Students concluded tasks.

D. Threads to validity

During the execution of the study we found some possible threats to validity. The first one was related to the VLE being released almost 3 months before the teaching video lessons are fully ready. The VLE was made available for students to get used to it. In this period of time, there was a withdrawal of 411 participants (54% of total participants), which no longer accessed the environment after the video lessons become available. These quitter's participants were not taken into consideration in this study, but because of this very large drop of participants some other students may have been influenced not to participate or lose interest in the competition

The fact mentioned was due to two reasons, the first to be considered was the delay for insertion of video lessons on the environment due to technical problems in editing videos. The second was due to available initiative VLE be totally free, so most students may accessed it only by curiosity or some other irrelevant reason. Indeed, there were no restrictions on what kind of users could access the environment. Young people interested in learning game programming, or even old people moved by curiosity, these all are people expected by the researchers to attend the initiative.

VI. CONCLUSIONS AND FUTURE WORK

As stated in the research question number one, the study analyzed all the actions performed by the students in the observed Virtual Learning Environment (VLE). This analysis had a lot of data and it was useful to find out important information about how to handle the game programming education through a VLE. This data show information about the use of gamification in VLEs, such as how the used techniques affect student engagement, which modules are used in the VLE and what students appears to miss, so we can implement improvements in the environment in the future.

What should be taken into consideration is that users kept greater access to environment due to addition of gamification in the form of Challenges, Leaderboard and Progress. It was possible to see a group of users who remained encouraged by the leaderboard and their positions, increasing their frequencies

of access to the VLE. Another group of users also made a difference in the data collected. Even without watching the video lessons, they kept motivated and interested in completing the challenges.

At the end of the results, we could confirm that the gamification achieves greater engagement of users with respect to higher frequency of use of the VLE, larger views of video lessons and a greater number of complete challenges, bringing some other advantages, such as the environment becomes more competitive, fun and friendly for students.

Although this study covered the gamification in a specific VLE, all the experience gained by the data could be used for other studies on related topics and also left an opportunity for future comparative studies about upcoming online competition environments of game programming. Also, as future work we intend to implement some other gamification techniques in the VLE to solve other problems observed in the initiative.

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