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Artículos científicos

**Implementación de gamificación en ambientes virtuales de
enseñanza-aprendizaje para la educación superior**

***Implementation of Gamification in Virtual Teaching-Learning Environments
for Higher Education***

***Implementação da gamificação em ambientes virtuais de ensino-
aprendizagem para o ensino superior***

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Resumen

En la educación superior, la implementación de ambientes virtuales de enseñanza-aprendizaje ha tomado un papel relevante en los últimos años. Estos espacios permiten a los estudiantes acceder a los materiales educativos desde cualquier lugar y en cualquier momento, lo que les brinda una mayor flexibilidad y autonomía en su proceso de aprendizaje. Sin embargo, aunque estos espacios son altamente eficientes, pueden resultar monótonos y poco atractivos para algunos alumnos. Es aquí donde la gamificación puede marcar una gran diferencia. Por eso, la implementación de este recurso en ambientes virtuales de enseñanza-aprendizaje en la educación superior se ha convertido en una tendencia emergente que busca mejorar la motivación, el compromiso y el rendimiento académico de los estudiantes. La presente investigación se llevó a cabo en la Facultad de Informática de la Universidad Autónoma de Querétaro mediante una metodología cuantitativa en donde se implementó un instrumento de 20 ítems en escala Likert, el cual nos permitió conocer con cifras concretas la opinión de los estudiantes con respecto a la implementación de gamificación en ambientes virtuales de enseñanza-aprendizaje, así como su percepción de alguna mejoría o aumento con respecto a su aprendizaje, motivación o interés en las materias, cursos, actividades o temas. En definitiva, la gamificación puede ser una técnica efectiva para mejorar la motivación y el aprendizaje. Sin embargo, para obtener sus beneficios, es importante diseñar las actividades, temas o materias cuidadosamente y asegurarse de integrar correctamente los objetivos de aprendizaje.

Palabras clave: ambientes virtuales de enseñanza-aprendizaje, educación superior, gamificación, motivación.

Abstract

In higher education, the implementation of virtual teaching – learning environments has taken a relevant role in recent years. These spaces allow students to access educational materials from anywhere and at any time, giving them greater flexibility and autonomy in their learning process. However, although these virtual environments are highly efficient, they can be monotonous and unappealing for some students. This is where gamification can make a big difference. In this sense, the implementation of gamification in virtual teaching – learning environments in higher education has become an emerging trend that seeks to improve the motivation, commitment and academic performance of students. The present investigation

was carried out at the Faculty of Informatics of the Autonomous University of Querétaro through a quantitative methodology where an instrument of 20 items on a Likert scale was implemented, which allowed us to know with concrete figures the opinion of the students regarding the implementation of gamification in Virtual Teaching-Learning Environments and their perception of any improvement or increase with respect to their learning, motivation or interest in subjects, courses, activities or topics. In short, gamification can be an effective technique to improve motivation and learning. However, to reap the benefits of gamification, it is important to design the activities, topics or subjects carefully making sure to correctly integrate the learning objectives.

Keywords: Virtual Teaching Environments – Learning, Higher Education, Gamification, Motivation.

Resumo

No ensino superior, a implementação de ambientes virtuais de ensino-aprendizagem tem assumido um papel relevante nos últimos anos. Esses espaços permitem que os alunos acessem materiais didáticos de qualquer lugar e a qualquer hora, proporcionando maior flexibilidade e autonomia no processo de aprendizagem. No entanto, embora estes espaços sejam altamente eficientes, podem ser monótonos e pouco convidativos para alguns estudantes. É aqui que a gamificação pode fazer uma grande diferença. Portanto, a implementação deste recurso em ambientes virtuais de ensino-aprendizagem no ensino superior tornou-se uma tendência emergente que busca melhorar a motivação, o comprometimento e o desempenho acadêmico dos alunos. A presente investigação foi realizada na Faculdade de Informática da Universidade Autônoma de Querétaro através de uma metodologia quantitativa onde foi implementado um instrumento de 20 itens em escala Likert, que nos permitiu conhecer com números concretos a opinião dos alunos em relação ao implementação da gamificação em ambientes virtuais de ensino-aprendizagem, bem como sua percepção de qualquer melhoria ou aumento no que diz respeito à sua aprendizagem, motivação ou interesse por disciplinas, cursos, atividades ou temas. Em suma, a gamificação pode ser uma técnica eficaz para melhorar a motivação e a aprendizagem. No entanto, para colher os seus benefícios, é importante conceber cuidadosamente as atividades, temas ou disciplinas e garantir que os objetivos de aprendizagem estão devidamente integrados.

Palavras-chave: ambientes virtuais de ensino-aprendizagem, ensino superior, gamificação, motivação.

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Introduction

Currently, the use of information and communication technologies (ICT) has become vital in various areas of our daily lives, from leisure to engineering, medicine, communication, transportation, business and a endless tasks. However, one of the areas where its implementation has become quite relevant is in education, since it allows users to interact with other people regardless of the distance and learn different topics according to the pace of each individual.

The present article, therefore, has the purpose of analyzing the effectiveness of the implementation of gamification in virtual teaching-learning environments for higher education in order to improve the motivation, commitment and performance of students. For this, a systematic review of the literature on this topic was carried out and surveys were applied to analyze the perception of students regarding the use of gamification during their learning process.

In this regard, it is worth mentioning that education combined with ICT has created a new environment where the student is capable of becoming the protagonist of their own learning (Suárez and Custodio, 2014). For Hernández (2017) the use of ICT in education has become essential for students and teachers, since it promotes meaningful learning that is based on the experiences, experiences and reflections of each person. Likewise, Ayala (2012) mentions that ICTs have increased the degree of significance and educational conception because they have fostered spaces for training, information, debate and reflection.

The concept of virtual education or e-learning is a teaching-learning model supported by the use of technological tools that seeks to guide and motivate students to build their own knowledge, skills and abilities (Fontalvo et al., 2007). In addition, virtual teaching allows the use of multimedia materials, easily updating content, increasing interactivity and accessibility, as well as promoting learning styles that allow for more effective and personalized learning. (Fontalvo *et al.*, 2007; Gallego y Martínez Caro, 2004).

In relation to the above, a virtual environment —according to Flores Ortiz and García Martínez (2017)— is a technological learning environment that facilitates the communication, processing, management, and distribution of information. It is also defined

as a platform implemented to transmit knowledge, create and share digital content, as well as evaluate the progress of each student (Ludus, May 6, 2022). For his part, Hiraldo (2013) refers to it as the set of synchronous and asynchronous interaction media where the teaching-learning process is carried out. Likewise, De la Rosa (2017) points out that it is an environment for learning mediated by technology that enables interaction between the student and the teacher.

Regarding gamification, Ortiz-Colón et al. (2018) and Deterding et al. 2011 explain that this is based on the use of game elements in other contexts to make an activity more fun, attractive and motivating. According to Dicheva et al. (2015), gamification uses game techniques in non-ludic contexts in order to involve and motivate users in their objectives or goals, which —according to Kapp (2012)— helps to improve the experience and commitment of the companies. people.

In the educational context, gamification is used as a method to motivate students using game elements in the educational field to activate attention, generate interest and promote learning (Baldeón et al. 2017; Lozada-Ávila and Betancur-Gómez , 2017). For their part, Landers and Landers (2014) define gamification as the use of game elements and mechanics to improve motivation, commitment, skills and the teaching-learning process. That is, it incorporates game elements and mechanics in the design of teaching activities and strategies in order to motivate and engage students in their learning.

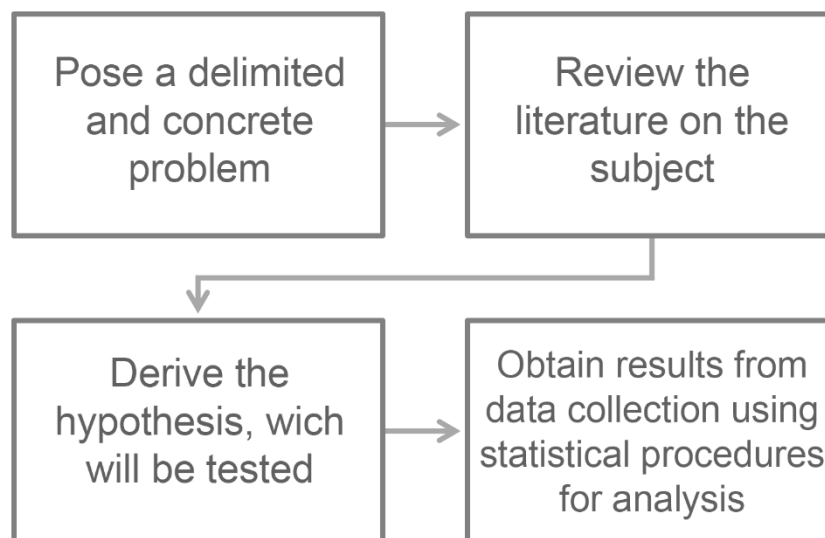
The fundamentals of gamification are three (the dynamics, the mechanics and the components), which are defined by Werbach (2012) as follows: the dynamics are the concept or structure of the game, that is, what the rules will be, the objective and goal of the activity; the mechanics are the processes that are carried out in the development of the game, that is, what will be done and how; Finally, the components are the implementation of the dynamics through avatars, badges, points, levels, rankings, gifts, among others.

Materials and methods

For the present investigation, the quantitative research methodology was implemented, which aims to explain the phenomena that occurred through the collection of quantifiable data that must be analyzed to obtain relevant information (Parra, s. f.). Polania Reyes et al. (2020) add that the quantitative approach uses data collection to test a hypothesis,

establish patterns and test theories, so they propose the following steps for its implementation (figure 1).

Figure 1. Quantitative research methodology



Source: Own elaboration based on Polanía Reyes *et al.* (2020)

For the present investigation, a survey of 20 items on the Likert scale was applied to 12 students of the Telecommunications and Network Engineering career in the field of Algorithms and Data Structures of the third semester of the Faculty of Informatics of the Autonomous University of Querétaro, in order to know their perspectives regarding their learning (before and after implementing gamification), as well as the methods used in it and their knowledge about gamification.

On the other hand, for the systematic review of the literature, various sources and information bases were used, where articles related to "gamification", "motivation", "higher education" and "virtual teaching-learning environments" were searched. In this case, the date of the publications or the databases from which they were obtained were not discriminated in order to recover the largest number.

Then the following hypothesis was raised: if game mechanics are used in virtual teaching-learning environments to support higher education, the motivation and interest of students in their learning will increase. Finally, the data collected from another survey that was applied to the same students after having interacted with a virtual environment in which gamification mechanics were incorporated was analyzed. The results will be described below.

Results

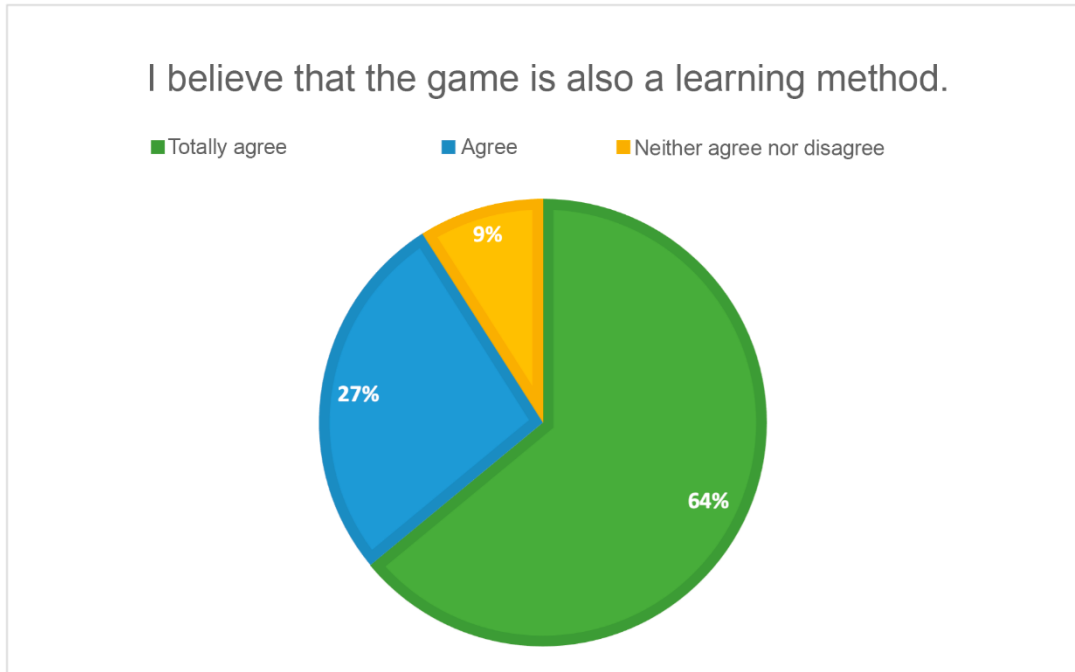
A quantitative evaluation instrument was applied through a survey with a five-level Likert scale, consisting of 20 items, to a focus group of 12 students who were studying the subject of Algorithms and Data Structures during the period 2022- 2. This group was selected due to the size of the enrollment, as well as the different topics of the subject and the mastery over these for the generation of gamified content. This instrument had the purpose of knowing and analyzing the perspectives and preferences of the students regarding the use of gamification as a teaching-learning technique.

For this evaluation, gamified content was designed for the following topics: algorithms; data structures, queues, stacks, and lists; and sorting algorithms. Then, a dynamic of progression and achievements was implemented, which shows an evolution and gives the sensation of progress and improvement in a game; In addition, it generates satisfaction when solving a problem. Specifically, the following mechanics were implemented: rewards, which provide benefits depending on achievements; challenges, for tasks that involved a challenge; and competition and classification, which makes students strive to see themselves in the first places. As for the components, the badges, points, unlocks, leaderboards and progress bars have been implemented.

The designed activities were based on the resolution of exercises and the unlocking of increasingly complex exercises. This gave students points with which to progress and visualize it on a progress bar, which increases motivation. Another activity used was the resolution of questionnaires; based on the results in these, they were assigned badges and a change in the position table was shown depending on the performance of each student, which increases their commitment to their learning.

In addition, they were asked if they considered that the game was also a way of learning; in this sense, 64% of the students totally agreed, 27% agreed and only 9% neither agreed nor disagreed (figure 2).

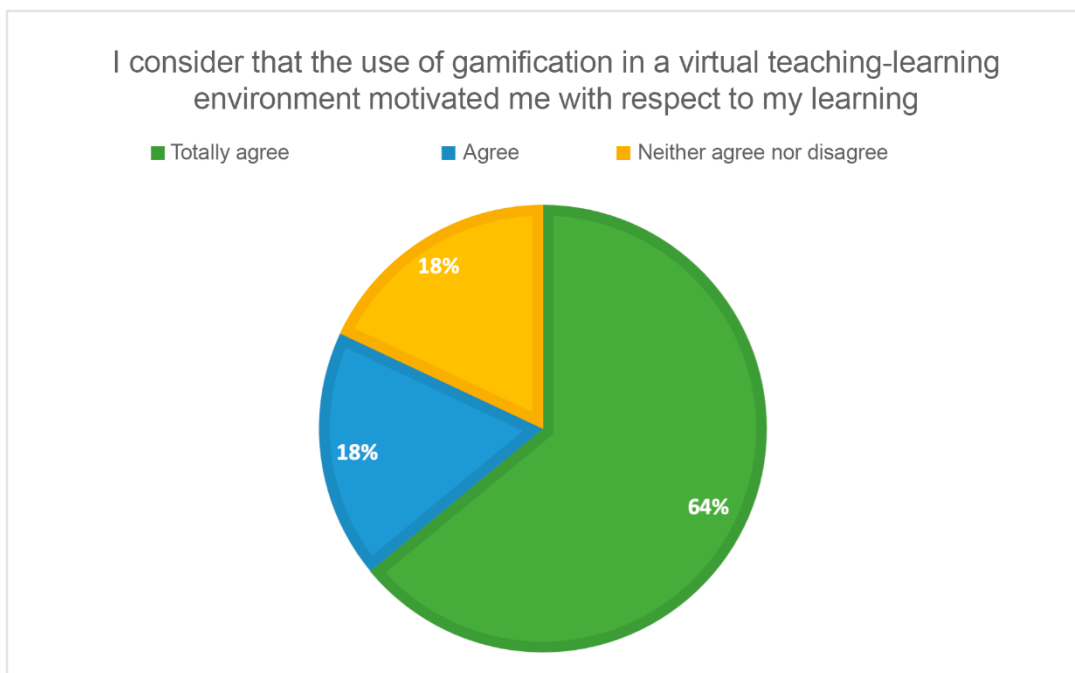
Figure 2. Game as a learning method



Source: self made

Regarding the use of gamification in a virtual teaching-learning environment (AVEA), 63.6% fully agreed that the use of gamification in an AVEA motivated their learning, 18% agree and 18% neither agree nor disagree (figure 3).

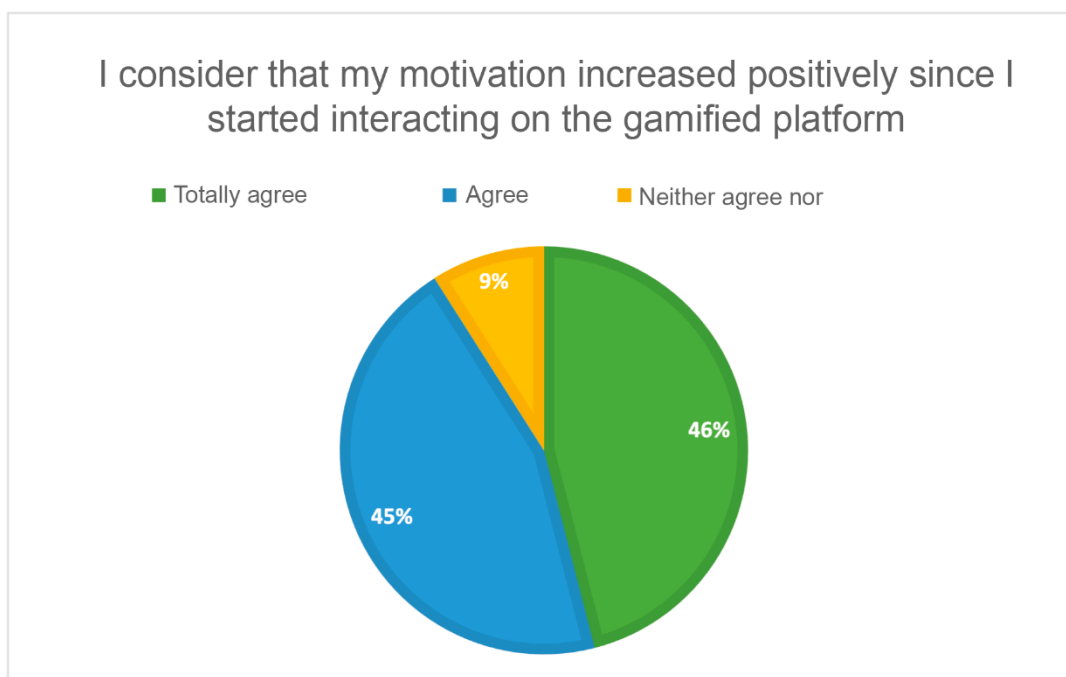
Figure 3. Motivation and gamification



Source: self made

Likewise, most of the students were able to notice that their motivation increased positively from the interaction in the AVEA. In figure 4 we can see that 46% and 45% of the students fully agree and agree, respectively, while only 9% neither agree nor disagree with the above.

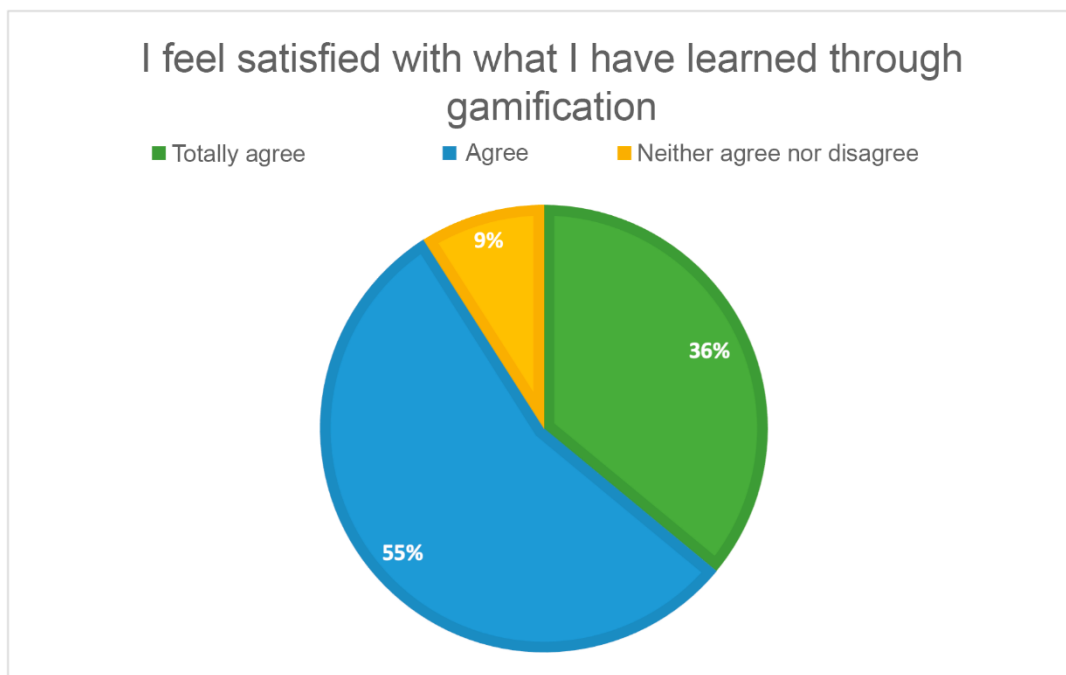
Figure 4. Increased motivation



Source: self made

In addition, students were asked how satisfied they were with their gamification-mediated learning in an AVEA. In this sense, 36% fully agree, while 55% agree and only 9% neither agree nor disagree. From this, it can be inferred that there is an acceptance of the use of technologies and gamification in learning (figure 5).

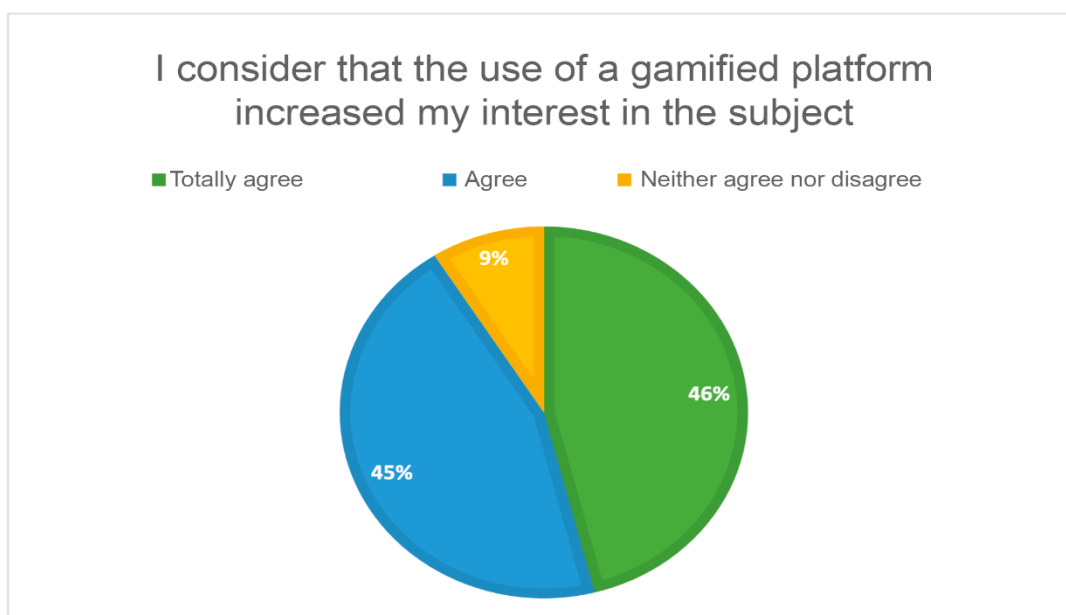
Figure 5. Satisfaction with what has been learned



Source: self made

It was also possible to appreciate that the interest in the students regarding the subject of Algorithms and Data Structures increased considerably when implementing gamification as a teaching method in the virtual teaching-learning environment. Figure 6 shows that 46% and 45% totally agreed and agreed, respectively.

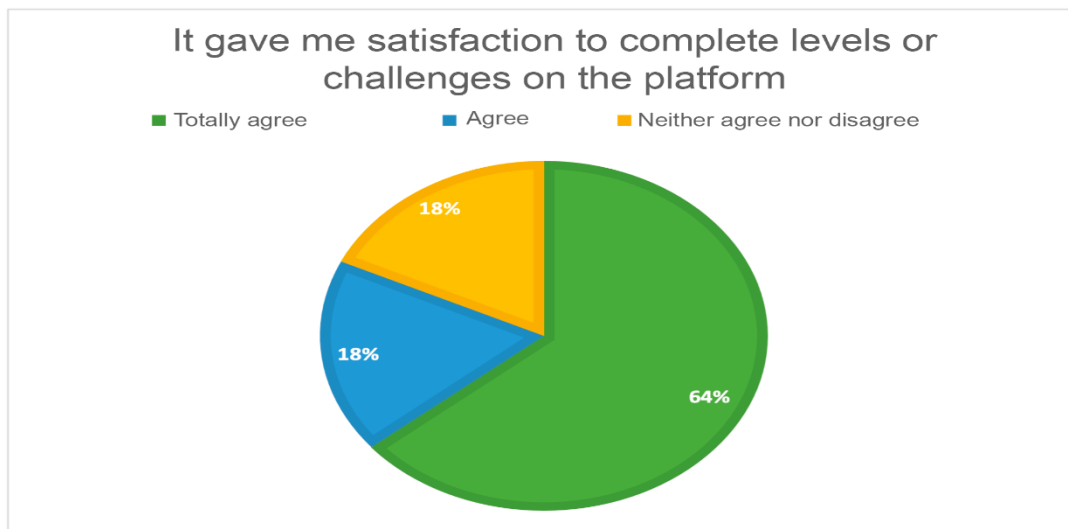
Figure 6. Interest in the subject



Source: self made

On the other hand, regarding the use of dynamics and components of the games in the teaching-learning process, the students think the following: first, the majority (64% totally agree and 18% agree) the fact of completing or passing levels or challenges gave them satisfaction, which indicates that they are accepting the dynamics of the game and are beginning to be interested in their learning (figure 7).

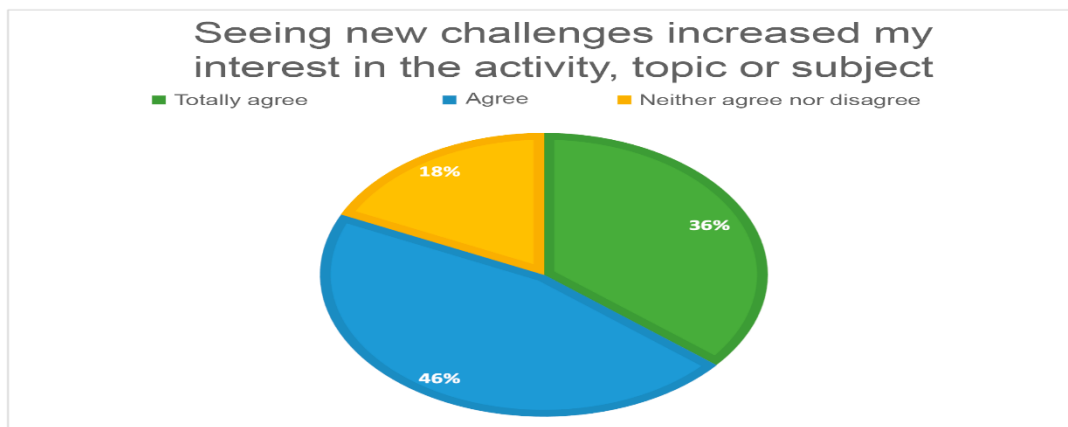
Figure 7. Levels or challenges



Source: self made

Likewise, the new challenges caused the students to increase their interest in the subject studied. In this sense, 36% fully agree, 46% agree and 18% neither agree nor disagree that the challenges increased their interest (figure 8).

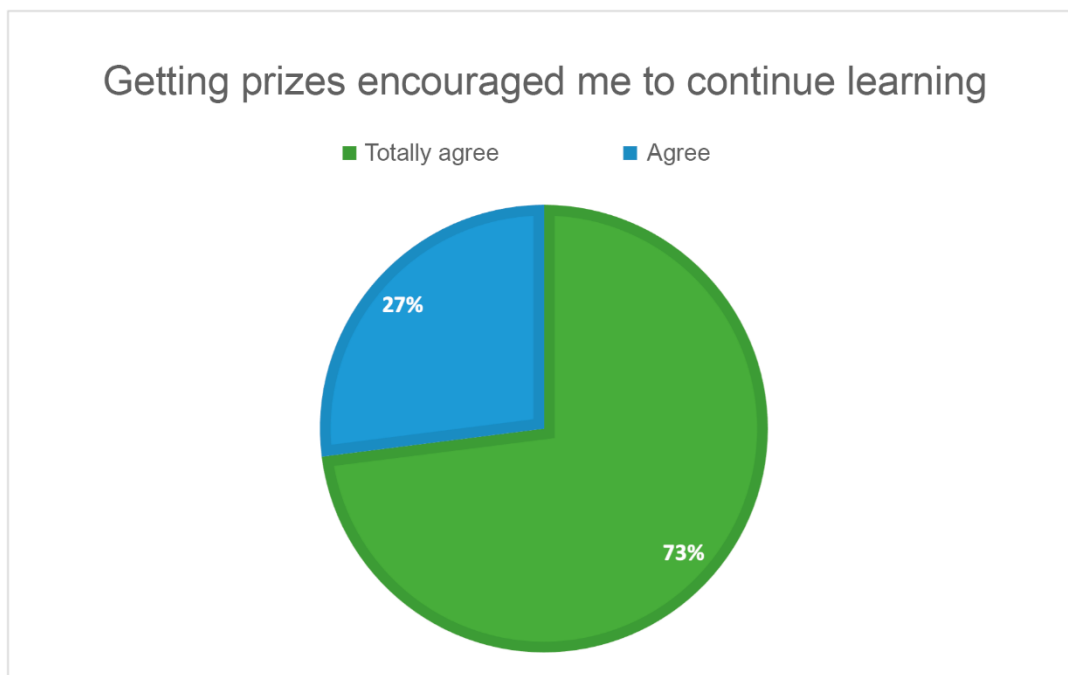
Figure 8. New challenges



Source: self made

Another aspect of gamification that encouraged students to continue learning was getting prizes. In this sense, the majority fully agree that this action really encourages them, while the rest of the percentage agrees (figure 9).

Figure 9. Prizes as incentives



Source: self made

In summary, students are generally satisfied with the use of gamification during their learning process; In addition, they show acceptance and taste for the different applied dynamics, as well as for the selected components. Regarding gamification, they consider that it is a learning method that manages to motivate them, encourage them and generate a real interest in their learning.

Discussion

Gamification has been used as a teaching-learning technique for a long time, mainly in primary and secondary schools. However, at higher levels, students can be affected by external factors beyond the control of the teacher and that decrease their motivation, interest and participation in learning. It is in these cases where gamification is an excellent option, since it helps students to feel that their activities are part of a game, challenge or dynamic, and not an obligation. In this way, learning is perceived as a fun task, which increases their willingness and ability to learn.

However, gamification is a technique that has various dynamics, which must be used correctly according to the characteristics of each student, since each of them has specific preferences, as well as particular motivation factors.

Even so, thanks to this research we can ensure that gamification helps to increase the motivation, interest and commitment of students regarding their learning. This agrees with what was expressed by Kapp (2012), who states that games intrinsically motivate players to participate through the challenge and reward for their efforts.

Indeed, motivation —as already mentioned— can make students actively participate in their learning and achieve better results. According to Landers and Landers (2014), games can provide a safe environment for skill practice, experimentation, and problem solving. Furthermore, this research showed that gamification benefits meaningful learning, since students are more involved and engaged in their learning process and in the development of skills and competencies.

On the other hand, it was found that constant feedback improves student performance, since in real time they can see their progress reflected in the different components, such as leaderboards and progress bars. Regarding personalization, according to Hamari et al. (2014), gamification can be adapted to the needs of each student, as they provide challenges and tasks that fit each one and provide unique learning experiences. Based on this principle, during this research gamification components were applied based on the type of player that most students preferred; this aspect, however, could also be further customized if components were applied in the AVEA according to the preferences of each student.

Regarding a possible deviation from the learning objectives, Landers and Landers (2014) mention that a careful alignment of the game elements is required so that they do not trivialize the academic content or divert attention from the learning objectives. However, during this investigation it was noticed that the students were completely focused on their activities and on the study topics.

On the other hand, it should be noted that there was a certain dependence of the students on the components of gamification to preserve their interest in the subject. In this regard, Deci and Ryan (1985) mention that when students get used to receiving rewards in their learning process, they can become dependent on them, which completely affects the motivation to participate. In the words of Przybylski et al. (2010), this extrinsic motivation can cause students to focus only on rewards, and not on the intrinsic satisfaction of doing an activity for their learning. Therefore, according to Werbach and Hunter (2015), if

gamification focuses mainly on components such as badges and points, there is a risk of diverting attention from learning objectives.

In short, gamification can be an effective technique to improve motivation and learning. However, to obtain its benefits it is important to design the activities, themes or subjects carefully to avoid creating a problematic situation, such as rivalry between students (Deterding et al., 2011). Furthermore, according to Werbach and Hunter (2015), another concern about gamification is that it can distract students from the actual content of the course, and promote superficial motivation based solely on external rewards.

Conclusion

At the beginning of this research, the students were observed during a partial period to identify the degree of their commitment, interest and motivation in the subject; In addition, attention was paid to their grades, attendance, and percentage of activities and tasks delivered in order to compare their performance after having implemented gamification in the same subject. In this sense, it can be affirmed that this strategy significantly improved the motivation of the students, since they agreed that gamification had a positive effect on their interest and participation. In addition, an increase in the percentage of homework and activities delivery was observed, since the students perceived these activities as a challenge or a game that allowed them to level up, receive rewards or climb in a ranking. In summary, it can be stated that gamification is an effective technique for teaching, especially when seeking to increase student motivation and interest.

However, the research project also faced some limitations. For example, the population in which the test was carried out could have altered the results, since the faculty where the experiment was carried out had no problems in the use of technologies. Another limitation was the change of students to take the tests, since the modality of the faculty is semester-long, which made it necessary to apply them in a control group during the same semester: first with a traditional teaching method and then with the implementation of gamification to compare the differences.

In addition, it is important that teachers understand how to design activities and themes effectively, and how to integrate learning objectives into the dynamics of the game to achieve the best results in academic performance and student motivation. In short, the implementation of gamification in virtual teaching-learning environments for higher

education can be an innovative and effective technique to improve the learning process, as long as it is done properly and with the necessary training for teachers. and students.

Future lines of research

As future work, it is proposed to develop effective metrics and evaluation tools to measure the impact of gamification in education, including the creation of validated measurement scales to evaluate user experience, satisfaction, learning effectiveness and other relevant aspects. as the emotional connection with the learning process. In this way, strategies and instructional design can be improved in virtual gamified teaching-learning environments. Likewise, examine the ethical aspects of gamification considering equity, accessibility and inclusion at all times.

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Investigación	Yazmín Lisset Medel San Elías
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Curación de datos	Yazmín Lisset Medel San Elías
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