

Do Video Games Enhance Competencies and Skills? A Study Case on Civil Engineering Students

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Abstract: The following article is a text that shows the relevance of including video games as part of an academic technique that promotes coexistence, communication, teamwork, develop some skills, competencies, and creativity among members of the university community -professors and students-. The objective of this research is to show the results obtained in a dynamic organized by the Civil Engineering department of a private university in Puebla, Mexico. The idea is to hold a private session and play "Call of Duty: Warzone II". It should be noted that with this activity the students can learn a specific content, in this case, the analysis of a hydraulic press, how it is built and how it works. In addition, the activity carried on, helped to create a better bond between teachers and students, but above all, showed the possibilities to generate greater interest in learning and to get the students actively involved in one topic. The theoretical framework on which this research lies in the following topics: Game-Based Learning -GBL-, innovative education focused on video games as community generators, and the importance of the development of certain skills among college students. The methodology that this study has, is quantitative. Particularly, a questionnaire -Likert scale-, is carried out to the students who participated in this dynamic. The main results show that the people who were in the virtual session are excited to interact under another type of scenarios that goes beyond the classroom, and that "breaking" the barrier between teacher and alumni becomes a differentiating and innovative element. In educational matters, they consider that the learning obtained from a video game is something that they had not contemplated; Added to this, the students ensure that working as a team, communicating their needs and doubts between peers, and getting involved in this kind of forums helps generate greater interest in engineering and acquire new knowledge. Finally, it can be concluded that video games nowadays are an indispensable tool not only to foster an online community but to take the teaching and learning process to another level.

Keywords: Game-Based Learning, Video Games, Higher Education, Educational Innovation, Students, Skills

1. Introduction

Educational contexts are characterized by being unpredictable and full of situations that help to reflect on the work of teachers. This leads to an increase in the challenges in the classroom and, therefore, teachers spend a little more time planning the sessions. In this sense, one of the pedagogical tools and techniques that has been incorporated is GBL; where games are used to promote certain learning. Huizinga (2019) describes that every playful experience has spatial limits, which separate the world of play from the outside world. Whoever decides to play must voluntarily enter this circle, where there are rules to comply with and that are very different from the conventional ones (Cornella, Estebanell & Brusi, 2020).

It is important to note that within the GBL there is a special category that focuses on video games, which, although they are not usually based on educational issues, present many problems that psychologists analyse when studying thinking and learning; These include active and critical learning, engagement, self-learning, and the principle of in-process learning (Gee, 2006).

As for their educational aspect, recent analyses show that the fact that these games present challenges with progressively increasing difficulty, challenges with solutions, the possibility of pausing or saving the game, etc., generates the possibility of being able to progress whenever you try and surpass yourself. For this reason, the game model works because it motivates students by helping them to develop greater commitment and encouraging the spirit of improvement. In addition to this, it should be mentioned that there is a clear link between games and emotions, this makes it an interesting way to promote learning, since memory works best when there is an emotional or experiential link with what you want to remember (Pacheco y Causado, 2018).

Considering the above, the objective of this article is to show the results of a methodology carried out with Civil Engineering students in which the GBL was used as a tool for the development of disciplinary and transversal

competencies. The idea of this dynamic is to play "Call of Duty: War Zone II" collaboratively so that students strengthen skills such as leadership or teamwork. Specifically, it was decided to use the video game because it encourages healthy competition, strategy, and group tactics to achieve certain goals. In addition to this, "Call of Duty: War Zone II" has graphics, animations and usability of great technology and the latest generation; as well as a long tradition and acceptance over the years.

2. Theory Approach

The incorporation of technology based on video games or E-Learning as an educational resource is one of the many mechanisms that teachers can use with their students to develop skills, competencies, foster another style of teaching, generate community and exercise new roles; among them, that students can reason more effectively, be more autonomous and with a more open mind to the knowledge they are taught, where their ability to create and understand is better every day (Villacís, et al, 2022). In this way, and considering that there are various aspects that encompass the GBL, the following are the essential points at the theoretical level that serve as the basis for the realization of this project

2.1 Game-Based Learning

Although this concept has a few characteristics, for this analysis it refers to learning with video games to support and improve teaching and learning processes. It is considered as an effective style to motivate the student in active educational experiences. From this, habit changes can be promoted in both students and teachers. These actions make the student a more active actor in the academic process. Given this comment, the GBL is used when incorporating and applying games in the contents of the syllabi of each subject (Cornella, Estebanell y Brusi, 2020). Therefore, when used in higher education, playtime becomes a time for serious work; In this sense, there is a relationship between work inside or outside the classroom and the acquisition of knowledge through effort, performance and productivity (Trujillo, 2017).

Brull (2016), comments that Game-Based learning allows learners to participate and create a learning community, enjoy the freedom to experiment and make mistakes in a more enjoyable environment; in addition to the fact that students can interact with other types of sensations; In fact, there is evidence that students involved in this kind of pedagogical practices improve their learning.

It should be noted that this technique is still criticized, there is a myth that learning and playing cannot go hand in hand; However, one of the points in favour is that the dynamics adapt to the demands of new generations, which are in constant interaction with Information and Communication Technologies -ICT- (Hernández, Monroy y Jiménez, 2018).

Thus, the GBL becomes a tool to generate motivation in students and relate acquired knowledge; In addition, as mentioned above, by combining play with strategy, a motivating environment is created. It is worth mentioning that they normally generate physical or mental stimulation, help acquire practical skills, serve as exercise, have an educational role and can contribute to development and psychological balance (Jadán y Ramos, 2018).

It is necessary to recognize the advantages that video games can bring to training processes, since they invite the students to become an active part of the process. In addition, practicing in simulated situations helps them develop skills and gain self-confidence. Therefore, play as an educational strategy helps to solve many problems that are often mentioned in the classroom; Finally, we must add the capacity for engagement that makes the GBL technique even more relevant as a pedagogical tool.

2.2 Video Games in Education

Education has undergone important changes ranging from new methodologies to transformations in the way knowledge is constructed and transmitted; therefore, it can be said that education is an essential and permanent element in everyday life at both the individual and social levels (Ortiz & Cardona, 2020). In this sense, although video games have their origin in leisure, they have now become a tool for educational innovation, which responds to personalized and meaningful learning (Garbanzo, et al., 2017). The proliferation of these kind of games and the online multiplayer mode has generated communities among which experiences are shared, help is requested, and problems are sought or to invite matches between teams and stay informed of important news in the field (Marcano, 2012).

Likewise, video games have a socio-affective and an educational dimension; the first helps to dynamize group relationships, enhances participatory and collaborative work and induces reflection; the second because it helps the development of skills and abilities or the development of competencies. Specifically, war video games, are based on a sensory and psychosocial environment that generates emotional states that motivate different behaviors (Marcano, 2014). If this type of video game needs to be used as a playful technique, it must be accompanied by didactics in accordance with the objectives to be achieved; Therefore, the teaching methodology that fits best is problem-based learning and leadership development since its objective is to confront the student with fictitious problem situations. In addition to the above, these types of games promote the development of competencies (Mirama, 2019).

In conclusion, the use of video games in the classroom can be an innovative strategy, so its application will depend on everything from the teacher's attitude to renounce their traditional methodology, to the tools they have at their disposal to execute it. In this way, the essential elements by which video games can help create more active learning dynamics are covered; And although more can be written, for the purposes of this article, it is fair to talk about the skills or competencies that students can acquire during undergraduate education.

2.3 Development of College Skills

The competency-based education focuses on what a student is expected to know and be able to do by the end of the course; that is, when the student has demonstrated mastery of these skills, whether transversal or disciplinary. This type of teaching emphasizes the mastery of concepts, knowledge and skills, regardless of time (Díaz & Gallardo, 2019). In the same way, it proposes a series of changes and transformations in education, some of these are (Aria & Lombrillo, 2019):

- Analysis of conceptual and factual knowledge towards a focus on comprehensive performance in the face of activities and problems.
- Education must contextualize knowledge in the local, regional and international context; In addition, there must be a dynamic of search, selection, comprehension, systematization, critique, creation, application and transfer.
- It implies that learning is at the centre of education.

This means that it is now necessary to establish what learning students come with, what their expectations are, what they have learned and what they have not, what the learning styles are, and how they can actively engage in their own learning. From this, a change in teaching can be appreciated; which is not only to make knowledge more practical or to integrate theory with practice or to orient education towards employability; With this teaching, based on the development of competencies, it is intended to guide the training of human beings towards the ideal performance in the various cultural and social contexts (Aria y Lombrillo, 2019).

To have a more specific context, it should be mentioned that competencies are emergent characteristics of the person's encounter with their qualities, experiences and interests and with the demands of an activity to be carried out (Corral, 2021). They are also known as dynamic combinations of personal resources, complex systems of understanding and action that include "knowing how to think, how to do." It is constituted as an approach or proposal to train students because it aims to achieve a complex and ideal performance; In general, it looks for a relationship between what the student learns and the challenges of post-university life (Cuadra, Castro y Juliá, 2018).

3. Methodology

This study was conducted under a quantitative methodology. This approach is decided because it best suits the needs of the analysis presented, in addition, it helps to obtain the data more accurately for subsequent interpretation. It should be noted that the quantitative study corresponds to a constituent element of the statistical method to: collect, organize, summarize, present and analyse data required by the scientific method; and to obtain inferences from a volume of data when only a part of it is observed, thus being able to reduce uncertainty with respect to a research problem; In this way, valid conclusions can be drawn and reasonable decisions can be made based on this analysis (Zúñiga y Adame, 2020).

Specifically, a questionnaire with a Likert -Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree-, scale is carried out which included five dimensions to which certain characteristics were assigned: 1) Graphics/Gameplay: includes emotion, graphics, gameplay, and realism; 2) Social interaction/comprising: group work, supportive relationship, coordination of tasks to be carried out, friendly relationships and opportunity to

interact; 3) Learning: emotional learning and competency development; 4) Challenge/Overcoming: confluence of variables: motivations and learning and resolution of the challenge posed; 5) Activity/game: war games helps not only as playtime, but also as an educative tool; and, 6) Competency development: execution of the tasks to acquire and/or develop the necessary skills declared for this session.

These dimensions help to encompass the reagents so as not to have too extensive measuring instruments, and from this classification, it is possible to make the instrument to obtain the appropriate information. The instrument, which prior to its execution had a series of pilot tests as well as some modifications to improve its comprehensibility, was as follows:

1. This game has the ideal quality in images and sounds to be able to carry out an educational activity.
2. With this activity focused on the GBL method, I had more interaction between my classmates and teachers.
3. The sustained dynamic allowed me to obtain meaningful learning outside the classroom.
4. The challenge proposed by the dynamics of this video game fulfilled my expectations.
5. This educational dynamic is a fun tool to achieve several goals.
6. I was able to identify and develop the competencies declared for this activity.

It must be clarified that only the students answered this questionnaire. There was a universe of 30 people (20 men, 10 women); everyone was part of the course: "Hydraulic Works"; The number corresponds to the total of students enrolled in that course. The students were in the 9th semester, and on average they were 23 years old.

3.1 Activity Development

To get a clearer idea of how this activity was developed, a figure is presented with the steps that followed.

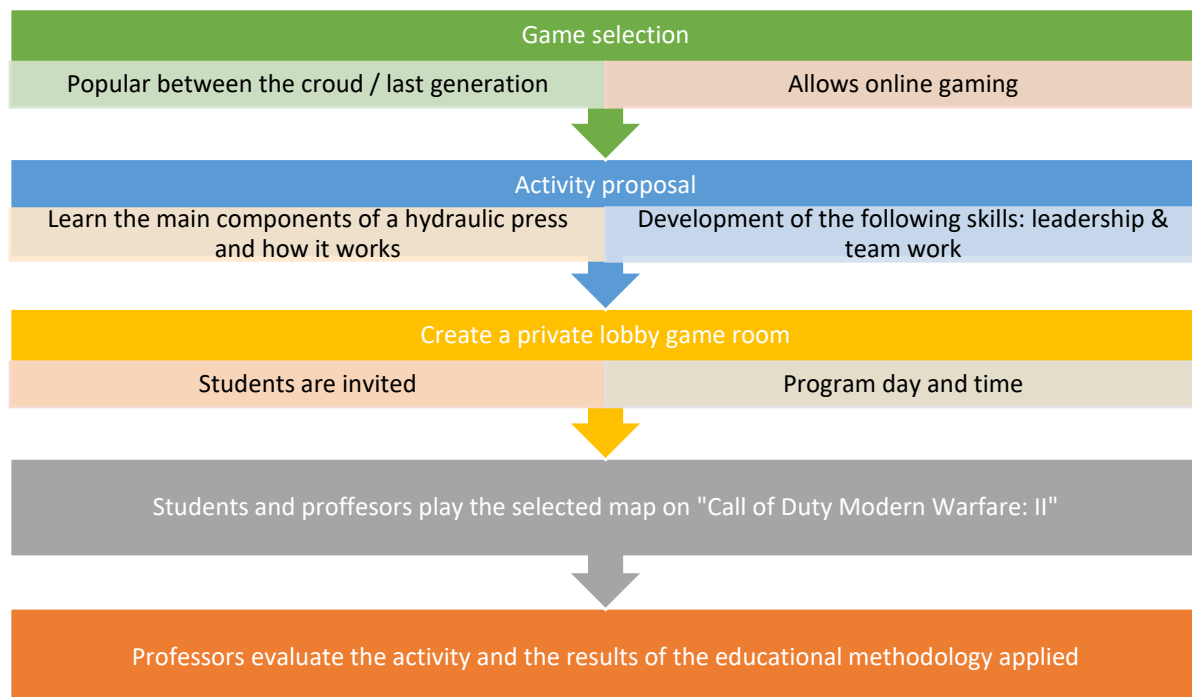


Figure 1: Step by step of the pedagogic activity

In this way, not only the methodological approach is established, but as can be seen in this image, the design process of the activity includes everything from the selection of the game to the evaluation of the pedagogical activity developed. To clarify the image presented, the process by which the activity is carried out is described below:

1. The teacher presents a topic in class
2. The professor asks who has the game "Call of Duty: Modern Warfare II"
3. In this case, all the students have played and own the game
4. The teacher tells them that he will open a private room in "Call of Duty: Modern Warfare II" and share the PIN to increase the knowledge about hydraulic Dams.

5. Time and day are shared, in this case, and according to the course length, teacher and students will be online in the game will be for 2 hours.
6. Students join the game created
7. First, a campaign is played between the participants, teams are assigned, and the game proceeds according to the rules, this means that the students enjoy the game, and literally play.
8. Once the playtime is over, the moment for the teaching and learning process is on, the teacher tells them where on the map they must go and everyone, arrives to the checkpoint mark.
9. Once in the agreed area, they talk about the construction of the hydraulic dam, how it works, main characteristics, and specific issues of this building
10. Doubts are resolved and the teacher makes a link between what is explained in class and the dam they just studied
11. The game closes.
12. The next class students answer the quiz

Once the experience was over, it was possible to verify that the dynamics used had a positive impact on the students, and this could be verified with the interaction that was had in the subsequent classes; In fact, students request that this type of experience be carried out again not only in this course; but in others to make the teaching-learning process more dynamic.

3.2 About the Video Game

The context of the game used in this activity is important, especially because one of the reasons why this video game is used is because it became the fastest-selling game in this franchise of all time. The game earned \$800 million in physical sales in its first three days of release, surpassing the previous record for the series. In the UK, it became the best-selling in the week of release, in Japan, the PlayStation 4 version sold 24,371 physical copies in its first week of release. The PlayStation 5 version sold 17,710 physical copies in the same country.

Currently, "Call of Duty: Modern Warfare II" has surpassed \$1 billion in sales worldwide, making it the first title in the saga to surpass this figure. As for the essential features, it is described as a first-person shooter video game developed by Infinity Ward and published by Activision. It can be played on PlayStation 4, PlayStation 5, Xbox -One, Series X/S-, and Microsoft Windows. It is the nineteenth instalment in the series of the same name. It was on sale since October 28, 2022. Finally, this game offers a set of gameplay and graphics innovations that elevate the saga to new heights, such as:

- An advanced and redesigned AI system
- Enhanced rendering and photogrammetry technology
- A new gunsmith system that allows for more customization than before.
- Pioneering innovations that set the trend in next-gen gameplay

Once the methodology, the activity applied in the session and the general principles of the game with which this practice is carried out are explained, it is possible to give rise to the results that were reached.

4. Results

The following lines present the interpretation of the questions that are asked in the measurement instrument; To make their understanding clearer, it is decided to create a graph for each of the questions and their subsequent interpretation. The findings are as follows:

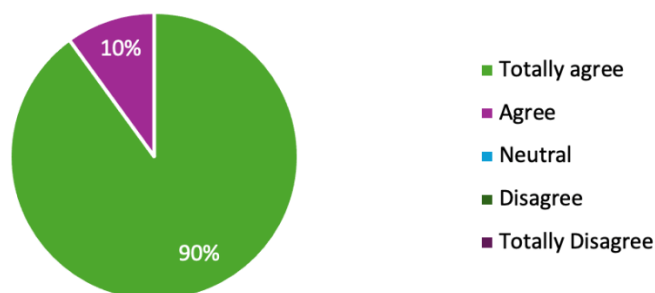


Figure 2: Question 1. With this activity focused on the GBL method, I had more interaction between my classmates and teachers.

This graph shows that 90% of respondents are in total agreement with the proposed reagent; They assure that "Call of Duty: Monder Warfare II" contains the necessary technical elements so that the educational activity carried out has the quality that is expected. In addition, they mention that when playing a state-of-the-art game, the sharpness of the graphics, the quality of the images and the realistic sound help to get even more involved with the environment. It should be noted that no one is unhappy with the visual features that the video game presents; an aspect that ensures its acceptance.

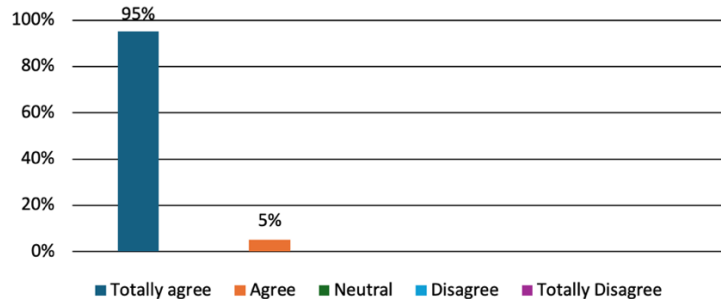


Figure 3: Question 2. With this activity focused on the GBL method, I had more interaction between my classmates and teachers.

The results of this graph show that the majority (95%) of the study subjects are in total agreement regarding the change in interaction between peers and with teachers as a result of this activity; They say that it is better, more dynamic and at times forgets the hierarchical aspect that can be presented in the room. Respondents agree that these kinds of forums are open and encourage feedback, exchange of ideas and even greater motivation to learn new things; It should be noted that 5% of respondents agree with this item.

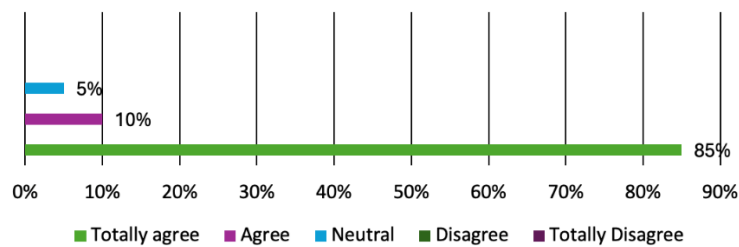


Figure 4: Question 3. The sustained dynamic allowed me to obtain meaningful learning outside the classroom.

The third question focuses on understanding how enriching learning outside the classroom was from the GBL, in this sense, 85% of those surveyed say they totally agree with this teaching style; They consider that there is a more informal forum but that it is also interesting, and they consider that the play space becomes a work environment where another type of knowledge is acquired under an innovative modality. 10% say they are totally disagreed, which also indicates that not all the group has the same skills and intention to carry out this type of activity.

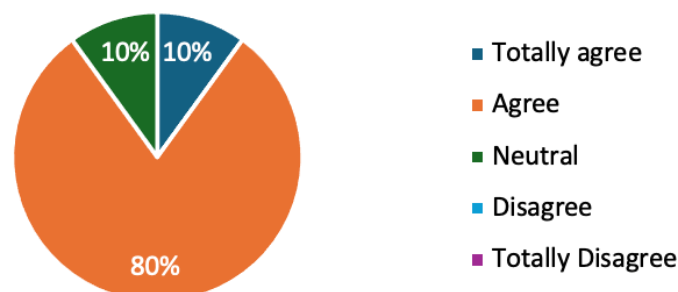


Figure 5: Question 4. The challenge proposed by the dynamics of this video game fulfilled my expectations.

For the fourth question, we seek to analyse if the challenge established when playing "Call of Duty Modern Warfare II" is adequate according to the characteristics of the game and the course taught. In this sense, 80% say they agree, while 10% are totally in agreement. It should be noted that 10% were neutral about the challenge

and the way to solve it under the GBL modality; This means that there are still people who have a percentage of resistance to this kind of educational innovations, which although they do not disagree, do not show the same level of interest as the others.

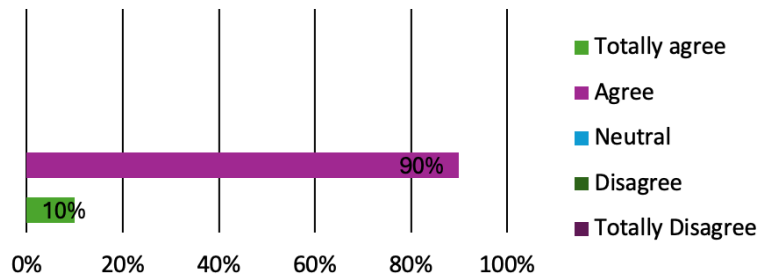


Figure 6: Question 5. This educational dynamic is a fun tool to achieve several goals.

The graph presented shows whether students find a correlation between play and academic activity. That is, if they find the link between fun and GBL. Faced with this, the answers are almost unanimous, on the one hand 90% agree and the remaining 10% are totally agree; This reflects that the pedagogical technique has the expected success, but above all, that the subjects of study -students-, understand that a video game can be used for didactic purposes and not only as a leisure space.

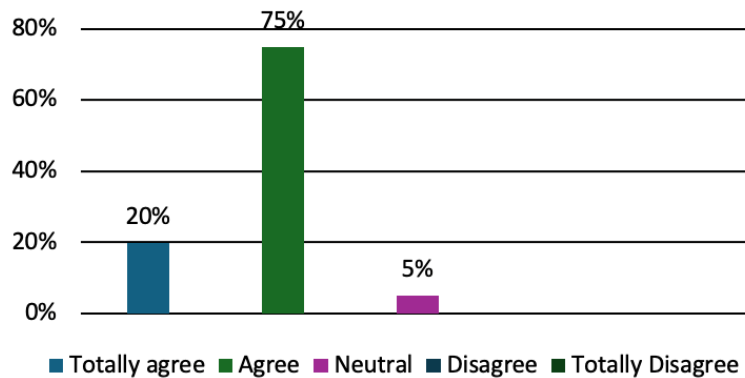


Figure 7: Question 6. I was able to identify and develop the competencies declared for this activity.

The last question refers to the way in which students develop or achieve competencies based on this pedagogical technique based on the GBL. Once again, the answers confirm the success of the dynamics carried out; This, because 75% say they agree, while 20% confirm that they are totally agree, although 5% answered neutral in terms of the identification of competencies.

In this way, the results of this study are formed, which, as can be seen, show that the activity developed is configured as a successful technique and that it is well received by the students of the Civil Engineering career; In addition, it can be corroborated that playing "Call of Duty: Modern Warfare II" becomes a space in which learning, entrepreneurship, communication and other aspects converge thanks to the fact that this game is of the latest generation. This confirms that the GBL is an effective technique to encourage learning, teaching processes and emphasize the new role that both students and teachers have within higher education.

5. Conclusions

It is a fact that for some years now, the use of games in educational environments has become one of the didactic methodologies that has provoked the greatest interest among teachers and students, especially because it creates great expectations due to the ability to surprise and contrast with other types of more conventional techniques. As a learning alternative, it allows students to have more active learning processes, establish links with their peers and teachers, as well as signify the way they acquire new knowledge since games provide holistic, problem-based environments.

In this way, once the study is completed, it can be concluded that the objective of this activity is achieved; In this sense, the Civil Engineering students who participated in the dynamic developed some competencies such as

leadership, teamwork and problem solving. This could be verified with subsequent exercises where the way of addressing and seeking solutions to different academic problems could have better results.

In addition, it can be assured that "Call of Duty: War Zone II" is a game that not only entertains, but also helps both teachers and students to have a more active role in the teaching and learning process, relate under other types of schemes and in unusual forums and find points of interest; In addition to this, it can be seen that video games can have an educational purpose and not just entertainment. In this sense, it is here where the GBL finds a meeting point with educational innovation and the disruption that teachers must have when planning their sessions.

Finally, it should be mentioned that for these teaching proposals to have the impact that is required, it is important that, on the one hand, the teacher not only knows the games they intend to use, but also requires constant teacher updating. The idea of connecting with students and making educational processes more interesting not only requires technology, but also a sense of educational innovation that manages to go beyond the classroom, and if an educative institution wants to use GBL, it must have the necessary tools to be able to carry it out. Always, thinking that digital technology is a tool and not the objective, that is, the teaching staff must rely on it and not depend on it.

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