

Digital Gamification: Benefits and Challenges in Education

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Abstract—This study explores the benefits and challenges of digital gamification as a pedagogical tool in the educational context. Through a systematic review and a practical case study carried out in a public school. The article examines the impact of gamification on student engagement, motivation, and performance. In the case study, students interacted with a role-playing game based on narrative elements, promoting collaborative and immersive learning. The systematic review revealed evidence pointing to the effectiveness of gamification compared to traditional teaching methods, but also identified challenges such as the lack of technological resources and the need for adequate training for educators. The article concludes that although gamification brings promising results, its implementation must be well planned, and more research is needed to overcome the limitations found.

Keywords—gamification, education, digital teaching, motivation, challenges, educational technologies

I. INTRODUCTION

Video games are strongly embedded in contemporary culture and were initially considered a resource aimed exclusively at entertainment. The origins of video games date back to 1947 when American physicists Thomas Goldsmith Jr. and Estle Ray Mann created an innovative system based on cathode ray tubes. This discovery has evolved over the decades, and contributed to the development of a global gaming industry which by 2024, is expected to surpass the 3,3 billion players mark, generating revenues of 188 billion dollars, according to market estimates. These figures reflect the continued growth of the industry, which has now surpassed even the film sector in terms of turnover. In Brazil, access to digital games is greatly facilitated by mobile devices. According to the Game Brazil 2024 Survey, developed by the Sioux Group and Go Gamers, in partnership with Blend New Research and ESPM, 73.9 per cent of Brazilians said they play video games, a significant increase on the previous year. This scenario reinforces the role of electronic games as a central part of the lives of a larger part of the population, especially young people.

With the growing impact of games, their motivational elements such as engaging narratives, reward systems, and competition have aroused interest not only for entertainment but also for use in other areas such as education. According to studies [1], gamification has been shown to significantly improve learning performance and educational outcomes in students, reinforcing its role as an effective pedagogical tool in various educational contexts. This impact is not limited to the educational environment; gamification is also transforming areas such as healthcare and the corporate

environment, where it has proved to be an effective tool. According to studies [2], the application of gamification elements in educational environments can be analyzed through an existing taxonomy, allowing for a structured understanding of how these elements influence learning.

Gamification as an educational strategy began to gain prominence around 2010, when Jane McGonigal questioned why we don't use game strategies to solve real-world problems. A systematic evaluation [3] found that gamification has a moderate positive effect on academic performance and student motivation, with competitive elements acting as a key driver of engagement in learning. From this reflection, gamification was gradually incorporated into the educational context, with the aim of promoting greater student motivation and involvement in the learning process.

While gamification uses game elements such as scores and challenges in conventional activities, game-based learning involves the creation of complete, structured games for educational purposes.

According to a study [4], the use of gamified interactive e-books in a flipped classroom model has been shown to have positive effects on students' motivation and learning achievements compared to traditional teaching methods. Research indicates that gamification, particularly through the use of points and badges, enhances students' intrinsic motivation; however, its effectiveness is influenced by cultural and contextual learning factors [5]. Although the study did not provide a specific percentage increase in content retention, the results indicate that gamified environments can facilitate better knowledge retention and student engagement. In another scientific study, according to [6], students who were taught using gamification increased their performance by up to 89.45 per cent compared to those who only received lectures.

Klock, Santana and Hamari [7] also suggest that research in the field of gamification should focus on developing practical guidelines that mitigate negative impacts and maximize benefits. While gamification is widely recognized as an effective tool, studies emphasize the need to assess its impact systematically to ensure that its application remains both meaningful and effective [8]. This includes establishing clear indicators of success, conducting long-term studies to evaluate the effects of gamification and engaging stakeholders (such as teachers, students and parents) in the development and implementation process. This collaborative approach can ensure that gamification meets pedagogical objectives in an ethical and responsible way. Given the growing disconnection between traditional pedagogical

methods and the interests of the digital generation, investigating the effectiveness of gamification on engagement and academic performance becomes crucial to ensuring more relevant and inclusive learning.

In the context of digital transformation, gamification has emerged as an essential tool for modernising teaching practices and aligning the education system with the demands of the 21st century, promoting more inclusive and efficient educational governance.

This study therefore sets out to investigate the benefits and challenges of digital gamification in the teaching-learning process. The study starts by questioning whether gamification is capable of providing better results than traditional teaching methodologies and seeks to analyse the challenges involved in its implementation, such as the lack of technological resources in schools and the training of teachers to manage interactive classes using technology.

II. LITERATURE REVIEW

A. Evolution of Games and Gamification

With increasing popularity of digital games, their elements have been increasingly explored in different contexts. These components are essential for creation of gamified educational activities that can engage students in a similar way to digital games.

The use of characters in games allows students to identify with fictional figures, which increases emotional involvement with the activity and motivates learning. Competition, meanwhile, is one of the central elements in games and serves as a powerful motivator for students to try harder and concentrate on tasks. Clear rules, meanwhile, help to establish a framework within which educational activities are carried out, guiding students as to what is expected of them.

B. Game-Based Learning and Gamification in Education

Game-based learning and gamification have established themselves as innovative strategies in the educational field, promoting greater engagement, motivation and content retention. Although they share similar elements, these approaches differ in their objectives and forms of application.

Gamification incorporates gaming elements, such as scores and challenges, into non-game contexts to make traditional tasks more engaging. For example, platforms like Kahoot create interactive environments that promote healthy competition among students.

Game-based learning, on the other hand, uses structured games as the main tools for teaching specific concepts. In this model, the game itself is the means by which students learn, integrating educational objectives directly into the game's activities. Game-based learning, exemplified by Minecraft Education Edition, integrates concepts like geometry into immersive and collaborative challenges. This approach offers an immersive, hands-on experience in which students apply theoretical concepts directly to game situations, stimulating skills such as critical thinking, problem-solving and collaboration.

Both approaches have shown significant impacts on student performance. A study [4] demonstrated that the use of gamified interactive e-books in a flipped classroom model

resulted in greater motivation and academic achievement compared to traditional methods. Similarly, a study [6] revealed that students exposed to game-based strategies showed an increase of up to 89.45 per cent in their academic performance when compared to those who only attended lectures.

However, each approach has different benefits. Gamification is ideal for creating a continuous and motivating learning environment, with immediate feedback, i.e. instant feedback on their actions, allowing them to correct mistakes or confirm successes quickly. Game-based learning, on the other hand, offers a deeper, more practical learning experience, allowing students to develop specific skills through interactive scenarios. Both strategies can be complementary, creating a richer and more diverse educational environment."

Despite their benefits, implementing these approaches also presents challenges, such as the need for teacher training, access to appropriate technologies and, in some cases, initial resistance from educators and students to new methodologies. Even so, both gamification and game-based learning have the potential to transform the educational environment, making it more dynamic, interactive and in line with the demands of the digital age.

By exploring the intersection between these strategies, educators can create more effective pedagogical practices that not only engage students, but also promote critical skills for the 21st century, such as critical thinking, creativity and collaborative work. In such manner, gamification and game-based learning represent a significant evolution in the field of education, paving the way for more inclusive and student-centred teaching models.

C. Benefits of Gamification in Education

The systematic review carried out in this study aimed to identify the main benefits of gamification in education, comparing it with traditional teaching methods. According to study [9], gamification proved to be an interesting field of research since its strength as a predictor of improved performance has been automatically assumed by practitioners from almost every field. Among the questions explored were: "How does gamification compare with traditional methods in terms of effectiveness in education?" and "What are the main challenges and limitations encountered in implementing gamification in schools?"

The case study conducted at Olavo Bilac State School demonstrated concrete benefits of gamification. Students showed increased engagement and motivation during activities involving narrative text interpretation, a skill traditionally challenging in classroom settings. By incorporating gamified elements, such as levels, challenges, and collaborative tasks, the study created a more dynamic and participatory environment. Additionally, the collaborative dynamics encouraged peer interaction and mutual support, particularly benefiting students with initial difficulties in textual interpretation.

In contrast, the systematic review revealed broader trends in the application of gamification across various educational contexts. According to study [10], the application of gamification in education is beneficial for students,

stimulating social behaviors and improving performance, engagement, and physical and social interactions. Several studies highlighted gamification's ability to promote engagement, motivation, and improved academic performance when compared to traditional teaching methodologies. For example, a study [11] emphasized the importance of factors such as usefulness, enjoyment, and knowledge improvement in students' preference for gamified tools. Their findings showed that tools like Didactic City effectively increased student engagement in virtual learning environments.

A study [12] conducted a meta-analysis on gamification in programming education and observed that gamified elements like levels had a significant positive impact on student performance. However, the study also noted that the relationship between motivation and learning outcomes is not linear, suggesting a need for deeper investigation into the mechanisms driving these effects. Similarly, a study [7] found that gamified elements, such as collaborative competition and fictional narratives, significantly increased engagement in programming courses over a 14-week period. Although the "novelty effect" initially impacted participation, students' familiarity with the gamified elements sustained long-term engagement and improved performance.

Together, these findings indicate that gamification offers more than just increased student motivation. The case study provided specific insights into its immediate effects in a classroom setting, while the systematic review highlighted its broader potential to foster motivation, collaboration, and academic achievement in diverse educational contexts. These insights underscore the importance of integrating gamification strategically to enhance learning environments, aligning engagement, pedagogical innovation, and academic outcomes.

D. Challenges and Limitations

Although gamification offers significant benefits, it also presents challenges that need to be considered. According to study [13], gamification can have a positive impact on student motivation, promoting a more engaging and stimulating learning environment, especially in contexts with limited resources. One of the main obstacles is teachers' unfamiliarity with technology and gamified resources. Not all educators have the necessary training to implement gamification in their classes, either due to a lack of adequate training or resistance to new methodologies.

In addition, many schools face infrastructure limitations, such as the lack of adequate technological resources. A study [14] revealed that the effectiveness of gamification varies across disciplines, showing greater impact in education-related courses compared to fields like engineering and business. The lack of sufficient equipment and a quality internet can make it difficult to apply gamification widely and consistently.

Another point highlighted in the systematic review is the need to adapt gamification to different school contexts. What works in a well-equipped school may not be as successful in schools with fewer resources. It is therefore essential to make adjustments to the application of gamification according to the specific conditions of each environment.

In the review, just as benefits were observed, challenges were also addressed. According to the study [11], gamification previously suggested improvements in the teaching-learning process, however they identified that there are significant challenges in its implementation. The authors highlighted the need to measure the acceptance of gamified tools, since lack of motivation and inadequate pedagogical design can limit the effectiveness of these strategies. In addition, the research acknowledged that the exploratory nature of the study and confirmation bias are limitations that can impact the generalisability of the results, which is directly related to the aim of this study, which seeks to understand how to overcome these challenges in order to optimise the application of gamification in education.

Also in another study [12, 15–17], several challenges in implementing gamification strategies in education, including the variability in effectiveness results between different contexts and the lack of consistent data supporting the long-term effectiveness of gamified approaches. The research also pointed out that the 'novelty effect' can lead to a decrease in engagement after the first few weeks of use, which suggests that gamification must be carefully planned and adapted to maintain students' interest over time. These challenges are crucial to my study, which seeks to understand how to overcome barriers to the adoption of gamification in programming learning environments.

Therefore, overcoming these barriers requires the development of gamified tools that are well-designed, aligned with clear pedagogical objectives and supported by solid empirical data. In addition, it is essential to invest in teacher training and the creation of methodologies that take into account the limitations and specific contexts of application. In this way, gamification can not only transform teaching-learning environments but also promote a more inclusive and dynamic education.

III. MATERIALS AND METHODS

A. Case Study Description

This case study adopts a qualitative approach, with the aim of understanding the perceptions and impacts of gamification on the teaching-learning process.

The qualitative method was chosen in this study because of its suitability for exploring and understanding the perceptions, experiences and impacts of gamification in the educational context. This method allows for an in-depth analysis of how gamified elements were perceived and used by students and teachers in the school environment.

The study seeks to investigate not only the objective results of gamification, but also subjective aspects such as engagement, motivation and collaboration between participants. These dimensions are best captured by qualitative methods, which provide a rich and detailed understanding of the interactions and behavioral changes that occur during the use of gamified strategies.

By using questionnaires and direct observations, qualitative research also makes it possible to identify trends, opinions and barriers related to the implementation of gamification. This is essential for understanding the challenges faced in specific school contexts, such as limited

technological infrastructure and teacher training, which can impact the effectiveness of gamification.

The Portuguese language teacher at the Olavo Bilac State School, in the municipality of Sucupira, Tocantins, planned a lesson using gamification for her tutoring class. To this end, she teamed up with Alexandre Tolentino, Language Curriculum Advisor at the Gurupi Regional Superintendence of Education.

It was agreed that Alexandre Tolentino would create a pedagogical game that dealt with narrative elements. The teacher applied the game in class 117.01 Extended Day of Primary School - Final Years, for the 12 students present.

Curriculum Advisor Alexandre Tolentino developed the game 'The House of Terror' on the Genially platform as a narrative RPG, in which students had to help a ghost to be freed from a curse, going through different challenges related to narrative elements. Genially was chosen for its intuitive interface and immediate feedback, allowing students to visualise their progress in real time. Next, we detail the mechanics of the game, highlighting how its elements have been organized to promote student learning and engage them in the gamified narrative. The game "The House of Terror" is an immersive gamification experience based on narrative elements, which combines narrative, interactive challenges and immediate feedback to promote the learning of narrative texts. The game's design explores various mechanics to engage students and facilitate the development of specific skills related to textual interpretation. The structure of the game is organized into three main phases, each representing a room in the haunted house. Players interact with the environment through buttons, quizzes and clickable elements, with the aim of exploring the narrative, solving challenges and completing the inventory with key items. The mechanics include immediate feedback, which refers to the instantaneous return provided to the player after answering a quiz question; for example, if the player answers incorrectly, they receive a message such as "Not right" and are directed back to the same question to try again. This mechanism reinforces learning by allowing for immediate correction and helps avoid frustration. In addition, there is a skill-based progression, meaning that advancement to the next stage of the game is contingent upon the player demonstrating specific abilities, such as collecting key items like a magnifying glass or musical notes. These items are essential to unlocking new stages, creating a sense of accomplishment and rewarding the player's skills. Another important mechanic is the integration of memorization and physical interaction, such as challenges that require remembering a sequence of musical notes and finding hidden numbers with the aid of a magnifying glass, stimulating multiple cognitive skills. The game was designed to align its mechanics with the pedagogical objectives of developing the interpretation of narrative texts. Each stage requires players to read extracts from the narrative and answer questions that test their understanding of narrative elements such as characters, setting and conflict. In addition, the challenges applied require players to apply critical skills, such as identifying relevant information in the text and solving problems based on the narrative, as well as developing skills such as memorization and attention to detail, which are reinforced by interactive challenges.

An example of this integration occurs in the first phase of the game, in which players must answer a narrative quiz as they climb the stairs. By getting the answers right, players progress through the narrative and unlock new challenges. Another example occurs in the second phase, in which, after completing a quiz, players receive a note with musical notes, which they must memorize. They then use a virtual piano to play the notes in the correct sequence, consolidating their memory skills. In the last phase, the player uses the magnifying glass to identify a numerical code hidden in pictures and inserts the code into an old typewriter to unlock the next challenge.

The combination of narrative, interaction and gamified challenges in the game "The House of Terror" demonstrates how gamification can transform learning into an engaging and meaningful experience. By integrating mechanics of immediate feedback, progression and practical application of knowledge, the game connects educational objectives with playful elements, promoting greater retention and involvement on the part of students.

The proposal aimed to provide a playful and immersive experience in which students could consolidate their knowledge in an interactive way. The activity took place in the school's computer lab, using Chromebooks. The students, organised in pairs, interacted with the game, answering questions that involved interpreting narrative texts. In more detail, the game consisted of the cover "The House of Horror" with a dark setting and an image of a macabre house and lightning effects in a dark environment and the start button.

To start the game, students press the start button and are presented with the introduction to the story, a brief explanation of the curse of an imprisoned ghost and, at the same time, the reader's attention as the protagonist with the mission of passing all the knowledge tests related to knowledge of narrative text elements, which enables them to save the ghost from the house's prison. To do this, you have to explore the house and get items for your inventory, so that you have the skills to save the ghost. To do this, you have to answer the questions correctly; if you get it wrong, you have to try again. As well as answering questions, you have to find the key among the various objects in order to open the door and move on to the next step in the game. Next, the student must answer other questions with the aim of obtaining musical notes and memorising them so that they can play the piano correctly and thus obtain a magnifying glass. With this magnifying glass, they have to look for numbers on various objects and type them into the typewriter so that they can continue to the next step: answering more questions about narrative elements. When you finish these last questions, a folder will appear that you have to open and inside will be various photos of the ghost's memory, which is necessary for the ghost to be able to rest in peace and for the player to leave the house safely.

According to teacher Miraci Ataídes Tavares, the gamified experience aroused great interest in the students, who remained focused and motivated throughout the activity. The sound effects related to the horror theme increased the students' immersion, encouraging them to interact with the text and apply the knowledge acquired in previous lessons.

After applying the game, the students answered a Forms

form with 12 questions about their classroom experience with digital gamification. This structured approach follows specific stages, including planning, development, implementation, student engagement, and data analysis (Fig. 1), ensuring a comprehensive understanding of gamification's impact on the learning process.

Each question contains 4 objective alternatives, in which they should mark the answer according to the degree of satisfaction with the experience gained in the class. The class was held on 22 May 2024.

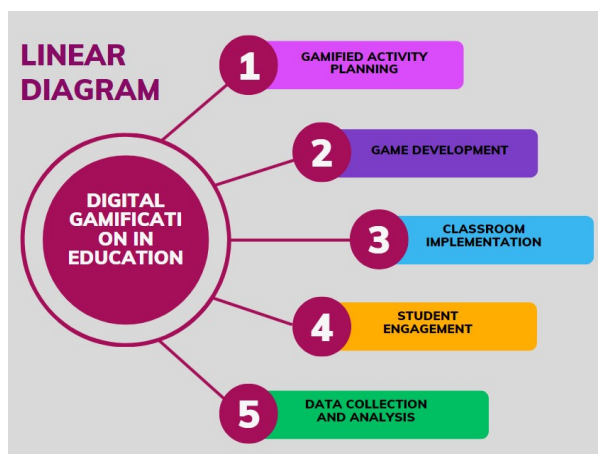


Fig. 1. Stages of digital gamification in teaching: A case study in Portuguese language.

IV. RESULT

A. Case Study Findings

The application of gamification in the class resulted in a more dynamic and engaging learning environment. The students showed a high level of engagement and interaction with the game 'The House of Terror,' as reported by the teacher Miraci Ataídes Tavares. The immersive narrative, coupled with the challenges proposed, meant that the students not only engaged with the content, but also collaborated with each other. The need to interpret the narrative texts in order to progress in the game was a crucial element in the success of the activity.

The teacher's reports indicate that gamification provided a meaningful learning experience, as the students, motivated by the narrative and the healthy competition generated by the game, endeavoured to apply the concepts of narrative elements correctly. At the end of the activity, most of the students managed to complete the proposed phases, which reinforces the success of the strategy used to consolidate learning.

The use of the computer lab and the Chromebooks were also highly rated by the students and the teacher, even though they had to share the devices in pairs, which ended up encouraging collaboration between classmates. The teacher observed that students who had more difficulty interpreting narrative texts benefited from the help of more advanced classmates, creating an atmosphere of co-operation.

To measure the experience of the students, the data presented in the questionnaire was favourable. According to study [18], the implementation of gamification and game-based learning can be an effective tool for teaching reading skills, resulting in better academic scores in courses

related to reading and writing. It reflects the motivation aroused by students when developing activities with gamified resources compared to traditional methods. The question comparing the gamified lesson with the traditional one, as shown in Fig. 2 below, showed that 83.3% considered the gamified lesson to be much more interesting than the traditional one, followed by 8.3% who considered it to be somewhat interesting. Significant figures that suggest the importance of working with games centred on pedagogy in order to motivate students and consequently improve learning.

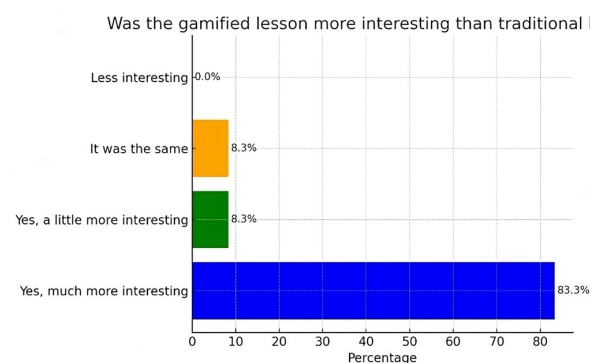


Fig. 2. Students' perception of the gamified lesson compared to traditional lessons.

According to Fig. 3, 75 per cent of students said that the gamified lesson helped a lot in understanding the content on narrative elements, while 25 per cent said it helped a little. This data reinforces the effectiveness of gamification in learning. By presenting a different model to the traditional one, it arouses motivation and this is preponderant. It arouses interest on the part of the students and results in greater concentration. This allows them to understand the content of the lesson.

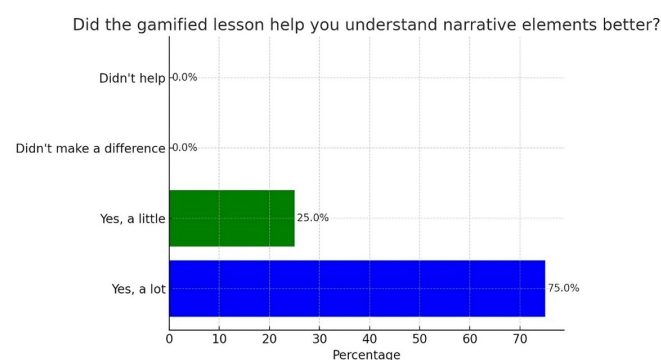


Fig. 3. Students' perception of the gamified lesson's effectiveness in understanding narrative elements.

The students were so interested that, in another question, they answered: 'Do you think activities like this (gamification) should be used more often in class?' According to study [19], gamification can improve student engagement and potentially increase academic performance, creating a more enjoyable learning experience. In Fig. 4 below, 91% of the students answered 'yes, definitely,' which shows their interest. Understanding the current scenario in which students do not have routine access to gamification in class. The teacher took the initiative on her own. It's interesting to point this out, because gamification is not part of the school's PPP, in other words, it's not institutionalised. It is not a recurring practice in

the school that is developed by all the teachers in the school. The figures therefore suggest a reflection on current teaching models. Inserting technology into the teaching process means realising that it goes hand in hand with the reality of the students of this generation, who are constantly connected to the digital universe.

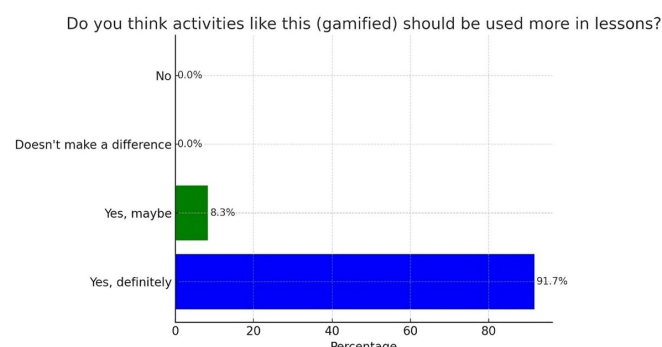


Fig. 4. Students' opinion on increasing the use of gamified activities in lessons.

The results showed that the use of immediate feedback, present in the game, was essential for students to correct mistakes and improve their understanding of the concepts without the need for direct intervention by the teacher. The researchers pointed to this factor as one of the great benefits of gamification, as it promoted autonomy in the learning process. According to a study [20], the games showed that learning can take place in fun and engaging environments, promoting improvements in academic results and student

motivation. The results therefore show that gamification, represented by the game "The House of Horror", provided a dynamic and motivating learning environment, promoting engagement, collaboration and better understanding of the content by the students. Data such as the 83.3 per cent who found the class much more interesting than traditional ones and the 91 per cent who want more gamified activities reinforce the effectiveness of the approach. In addition, the immediate feedback and interaction between students demonstrated the potential of gamification to promote autonomy and co-operation. However, the lack of institutionalization of this practice in the school points to the need for greater investment in technology and teacher training, aligning teaching and learning to a more effective approach and teacher training, aligning teaching with students' digital reality.

B. Results of the Systematic Review

We searched the Scopus database using the string 'gamification AND education AND elements AND games', which returned 528 articles.

After applying the exclusion criteria, including non-primary articles, articles outside the educational context and articles of limited relevance to basic education, we refined the study to 13 articles that directly investigated the use of gamification in the classroom as described in Table 1 below.

Table 1. Selected studies on gamification in education and their classifications

Nº	Study title	Author(s)	ISSN	Qualis classification	Key findings
1	Students' preference for the use of gamification in virtual learning environments	Acosta-Medina, J.K., Torres-Barreto, M.L., Cárdenas-Parra, A.F.	14495554	A1	Students' preference for gamified tools improves engagement, motivation and perception of learning in virtual environments
2	The study on the effects of gamified interactive e-books on students' learning achievements and motivation in a Chinese character learning flipped classroom	Chen, C., Jiamjit, N., Ma, Y.	16641078	A1	Gamified interactive e-books in flipped classrooms improved students' learning achievements and motivation, highlighting the effectiveness of gamification in education.
3	Using game concepts to improve programming learning: A multi-level meta-analysis	Costa, J.M.	10613773	A1	Gamification improves programming learning by increasing student motivation and engagement. However, its effect can diminish over time, indicating the need for strategies to maintain interest. Effectiveness varies according to the context and characteristics of the students, suggesting the importance of personalized approaches
4	Gamified learning in three university contexts: Unleashing the power of the Quizizz app to increase self-efficacy, intrinsic motivation, satisfaction and performance	Hernan, V., Latorre-Cosculluela, C., Suárez, C., Lanchares-Sancho, E., <i>et al.</i>	13605237	A1	The use of Quizizz improved students' motivation, self-efficacy and satisfaction, with the results varying according to the area of study. Gamification was more effective in Education than in Management and Engineering, promoting a more interactive and engaging learning environment
5	A systematic evaluation of game elements effects on students' motivation	Leitão, R., Maguire, M., Turner, S., Guimarães, A.F.	10486871	A1	The study showed that gamification increased students' intrinsic motivation, with PBL being the most effective. Cultural differences influenced responses between students from Portugal and the UK, and motivation varied according to the gamification elements used

	Motivations of Elementary School Students: An Action Research Field Experiment	Fatemah, A., Hassan, L.				leaderboards, increased the motivation and engagement of elementary school students, with no significant differences between the methods. The research emphasized the importance of connecting educational content to real-world experiences to increase students' perceived relevance
7	Gamification and SQL: An Empirical Study on Student Performance in a Database Course	Morales-Trujillo, M.E., García-Mireles, G.A.	14966226	A1		Research has shown that gamification improves student performance and motivation, but can cause anxiety and stress due to competition
8	Impact of a Gamification Learning System on the Academic Performance of Mechanical Engineering Students	Pamies-Vila, R., Fabregat-Sanjuan, A., Puig-Ortiz, J., Nebot, J., Fernández, A.H.	0949149X	A1		The research showed that gamification with Kahoot increased students' motivation and academic performance, albeit modestly. Competitiveness was seen as a positive stimulus, but the study had limitations, such as the lack of analysis of gender differences. The authors call for further research to validate the results in other educational contexts
9	Leaderboard design principles to enhance learning and motivation in a gamified educational environment: Development study	Park, S., Kim, S.	22919279	A1		The study shows that leaderboards increase student motivation. It proposes using macro and micro leaderboards together, including all the elements of achievement in micro leaderboards and applying them in a variety of contexts. Following these principles improves effectiveness and student satisfaction
10	Gamification suffers from the novelty effect but benefits from the familiarization effect: Findings from a longitudinal study	Rodrigues, L., Pereira, F.D., Toda, A.M., Palomino, P.T., Pessoa, M., Carvalho, L.G., Fernandes, D., Oliveira, E.H.L., Cristea, A.I., Isotani, S.	23659440	A1		Gamification in programming courses increased STEM students' engagement over 14 weeks by combining collaborative competition and fictional storytelling. The initial novelty effect was followed by familiarization that maintained interest, highlighting the importance of innovative design for effective learning outcomes
11	Who likes to learn new things? How Gamification User Types and satisfaction but not the frustration of basic psychological needs still explain the preference for learning new things	Rowicka, M., Postek, S.	16918	A2		Gamification increases student motivation and engagement, mediated by the satisfaction of psychological needs. Its effectiveness varies according to the context and characteristics of the students, and it is crucial to balance fun and learning. Adapting to the target audience is essential to maximize benefits
12	Effects of Gamification in a Teacher Education Program, 2010 to 2020	Michael Swanbenget and Daniel Bergl	2158240	A2		Gamification can increase motivation and academic performance, but its effectiveness varies according to the context and can be distracting for some students. Cultural factors, such as free education in Sweden, influence motivation, and the comparison with traditional methods was not addressed
13	A gamified approach for improving the learning performance of K-6 students using Easter eggs	Tabkiri, Y., Bastanfard, A., Amini, A.	13807501	A2		Gamification can increase motivation and academic performance, but its effectiveness varies according to the context and can be distracting for some students. Cultural factors, such as free education in Sweden, influence motivation, and the comparison with traditional methods was not addressed

The overall results of the review showed that, compared to traditional methodologies, gamification offers superior results in terms of student motivation, engagement and performance. Most of the reviewed studies indicated that gamification contributes to creating a more participatory learning environment, with students showing greater interest in the activities and, consequently, better academic results.

Among the benefits observed were:

- Greater engagement: Students were more willing to take

part in activities when these incorporated gamified elements such as challenges and rewards;

- Immediate feedback: Gamification allows students to receive feedback in real time, which makes it easier to correct mistakes and adjust learning strategies;
- Co-operation and healthy competition: In gamified activities, many students benefit from interacting with their peers, whether in collaborative activities or in contexts of friendly competition.

However, the review also pointed out some important challenges:

- Lack of technological resources: Many studies highlighted the need for adequate technological infrastructure to implement gamification, something that is not yet available in many schools, especially in public networks;
- Inadequate teacher training: Most teachers reported difficulties in adopting gamified strategies due to a lack of specific training and qualifications. Many educators still feel insecure or overwhelmed when trying to integrate new technologies into the classroom;
- Resistance to new methodologies: Another obstacle identified was resistance on the part of both teachers and students to adopting innovative methodologies such as gamification, especially in more traditional school environments.

V. DISCUSSION

The results found in both the case study and the systematic review corroborate the effectiveness of gamification as a pedagogical tool for primary and secondary education. The case study carried out at the Olavo Bilac State School in Sucupira-TO provided concrete evidence that the application of game elements can increase student involvement and performance in the learning process, especially in activities related to the interpretation of narrative texts.

The comparison of the data obtained in the case study with the conclusions of the systematic review indicates a clear trend that, in situations where technological infrastructure is adequate and teachers are prepared, gamification has the potential to promote more effective educational results than traditional approaches. In addition, the environment of collaboration and healthy competition created by the game dynamics provided more participatory and engaging learning. However, the challenges raised, especially related to teacher training and the availability of technological resources, cannot be ignored. The success of gamification depends not only on the implementation of the tool but also on the suitability of the school context and the ability of educators to conduct these activities.

The results obtained in the case study reinforce the effectiveness of gamification as a pedagogical tool, especially in terms of student engagement and motivation. As highlighted by a study [12], the use of gamified elements, such as levels and rewards, has a positive impact on motivation and academic performance. This relationship was also observed in the context of this study, where students showed greater interest and interaction during the gamified activity compared to traditional methodologies. Furthermore, gamification has proven to be a transformative educational tool when carefully planned and adapted, even in contexts with limited resources, as demonstrated in this case study.

Additionally, the findings of a study [7] on the effects of familiarization with gamification are relevant to interpreting the results of this study. While the initial “novelty effect” generated an increase in student participation, the continuity of gamified activities can sustain this engagement over time, provided they are well planned. In the case of the game “The

House of Terror,” the immersive narrative and interactive challenges were essential for keeping students’ attention, suggesting that repeating similar activities could further consolidate the benefits observed. The inclusion of elements such as immersive storytelling and immediate feedback has a significant impact on content retention and student autonomy, reinforcing gamification as a viable educational strategy.

Collaboration between students, stimulated by the need to share devices and solve joint challenges, is also in line with the findings of a study [11] which highlight the role of gamification in promoting collaborative learning environments. This interaction not only enhanced individual learning but also created a space for mutual support among peers, especially benefiting students with greater difficulty in textual interpretation.

However, the study also points to challenges already identified in the literature, such as the need for teacher training and adequate technological infrastructure [11, 12]. In the context of the Olavo Bilac State School, the scarcity of equipment and the shared use of Chromebooks limited the scope of the activity but also demonstrated that creative strategies, such as organizing in pairs, can partially mitigate these barriers. Recognizing these challenges, it is crucial to propose practical solutions to address them. The lack of adequate technological infrastructure, as seen in this study, can be mitigated by leveraging creative strategies, such as sharing resources between students or using low-cost digital tools adapted to local realities.

Ongoing teacher training programs are essential to equip educators with the necessary skills to design and implement gamified activities effectively. Without these measures, the potential of gamification may remain unrealized, particularly in under-resourced educational contexts. Additionally, expanding the use of gamification into hybrid teaching methodologies and analyzing its impact on different subjects could contribute to a broader understanding of its effectiveness across educational settings.

Finally, the literature suggests that the long-term impacts of gamification depend on planned and continuous integration into the school curriculum [7]. The lack of institutionalization of gamification observed in this study reflects a greater challenge in the educational scenario: the need to transform one-off practices into sustainable educational policies. This transition requires investment not only in technology but also in the professional development of teachers so that they can implement gamification consistently and in line with pedagogical objectives. Future research directions should explore longitudinal studies to track the sustainability of gamification’s impact on academic performance and socio-emotional skills. These studies will provide valuable insights into how gamification can be optimized to support continuous learning and skills development.

Furthermore, the potential of gamification goes beyond academic performance. By promoting collaboration, critical thinking, and problem-solving, gamified activities can prepare students for future challenges in academic and professional contexts. These effects, although more difficult to measure, highlight the transformative potential of gamification when used strategically and sustainably. Expanding the use of gamification [6] must consider both the

benefits observed in the short term and the strategies needed to overcome structural and contextual challenges. This study contributes to the discussion by demonstrating that, even in environments with limitations, gamification can offer a meaningful and motivating learning experience when well planned and adapted to local conditions.

The limitations of this study indicate the need for more longitudinal research to verify the effects of gamification over time. Different school realities, such as urban and rural or public and private schools, can have a direct impact on the feasibility and success of gamification, pointing to the need for a more contextualized analysis. Future research should explore how different gamification models can be integrated into a variety of educational settings and how they influence student outcomes in the long term.

VI. CONCLUSION

This study demonstrates that digital gamification offers a serie benefits for the educational process, particularly in terms of increasing student engagement, motivation and performance. Both the case study and the results of the systematic review indicate that gamification, when well implemented, can transform the learning environment, making it more dynamic and interactive. For example, 83.3 per cent of students found gamified lessons much more interesting than traditional ones, while 91 per cent expressed a desire to take part in more activities of this kind.

However, the implementation of gamification faces significant challenges, especially regarding teacher training and the availability with regard to teacher training and the availability of technological resources in schools. In order for gamification to be widely adopted, it is necessary to invest in ongoing training for educators, as well as ensuring that schools are equipped with the appropriate technological infrastructure.

These findings highlight the positive impact of gamification but point to challenges in maintaining engagement and adapting the tools to the educational context. In addition, the novelty effect observed suggests that gamification must be continually renewed to maintain student interest.

Future research should focus on the long-term analysis of gamification in different school contexts, exploring how the age of the students, the level of education and the geographical location can influence the results. In addition, it is essential to investigate how the use of digital games can be integrated with other teaching methodologies to create a more effective and inclusive pedagogical approach.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

APT and ESS conducted the research; SEGS translated the paper to the English version; all authors analyzed the data; APT wrote the paper; all authors had approved the final version.

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