Gamification as a strategy for promoting child involvement: A study on spatial orientation in the 1st CEB

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Abstract— We' are living in an era of strong change that misaligns offerings, processes and interests. In the field of education, it is urgent to find strategies that foster the revitalization of energies capable of triggering student involvement and thus improving efforts, skills and behaviours facing the challenge. Within the scope of initial teacher education, more specifically in Supervised Teaching Practice, this study was carried out with the purpose of evaluating gamification as a positive impact driver design in the involvement of children in a spatial orientation class, with effects on school outcomes. It was based on the Gamification Framework [7]. With a mixed methodological approach and a study case, we used disparate data collection instruments: participant observation of the trainee teacher who performed the pre-test, the post-test and the multimodal narratives, sustained in dialogues and interactions of the children recorded during the sessions, an interview with the teacher and, for a better understanding of the results, an interview with two specialists, one being an Internet Risk specialist and the other an Educational Technology expert. The project involved 21 1st grade children from a 1st CEB School. Among other results, there was an improvement in student involvement. Regarding spatial orientation, the promotion of lateralization ability and the ability to locate spaces were stood out, taking into consideration reference points and to identify the position of figures present in a grid through their coordinates. The analysis of the results raises some questions concerning the humanist paradigm.
Keywords— Gamification, Information and Communication Technologies, Motivation.

I. INTRODUCTION

Answering to the statement in the Student Profile of Leaving Compulsory School presupposes the development of essential competences to the construction of a coherent and rewarding personal and social path [33, [41], capable of promoting a sense of self-fulfilment, a height of human needs [21].

In this context and knowing that every individual has the right to education [40], it should be focused on the person and their holistic formation[25, [37]. Thus, the teacher, as facilitator of learning environments [31], should promote learning to learn [24], through a humanistic view of the curriculum, as decreed by [43], which focuses on the person as a natural potential for learning, as self-awareness makes him / her responsible in the learning process. This makes the act more meaningful and therefore more lasting and comprehensive learning [31]. In this scenario, the teacher who facilitates learning, adopts attitudes of authenticity, acceptance, trust and understanding [30], but also assumes great responsibility in the process, as it defines learning objectives and finds the means to respond to the student and society. In this

endeavour, it should also provide the involvement of students in the process of defining their own goals so that it finds meaning in learning. It is in action that activity takes effect. Thus, the student involvement in the educational process should stimulate emotions and intellect, and, respecting the studies conducted by [6] regarding the dependent relationship between the presence of involvement and development, is defined involvement as "quality of human activity" [27, p. 25], observable through various indicators, such as concentration and persistence, motivation, energy expenditure, satisfaction and interest [27]. When the teacher emerges in an educational context strongly marked by the students' lack of involvement in their own learning process (absence of the above mentioned indicators), they may resort to active methodologies and resources more familiar to this digital generation [28].

This same reality was felt by the trainee teacher when she entered the educational context of the 1st CEB. Given the uniqueness of the class, particularly as regards interpersonal relationships and compliance with rules, students aspired for a teaching focused on personality [25].

It was these ideas that served as the motto for the research project - *Gamification as a strategy for promoting child involvement: a study on spatial orientation in the 1st CEB*, supported by a gamification approach, as a driving force for children's involvement when addressing promotion of spatial orientation.

In this scenario, and regarding the gamification approach, it assumes different definitions in the literature. However, it should be noted the providing by [10], which briefly defines it as the use of elements of games in non-gaming situations. In fact, one of the initial questions concerns with the distinction between the terms gamification and game. Although the "root" word gamification is based on an Anglo-Saxon foreignism - *game* -, adopted for practical reasons [14], these same concepts do not have a synonymous relationship, namely by the first idea highlighted: gamification occurs in non-game situations [10], although it resorts to certain elements of games: "mechanics, strategies, thoughts" [11, p. 1]. Not presenting itself as a specific methodology of education, it is possible to recognize, in this same area, great potentialities, such as the ability to provide playful, engaging and captivating learning environments. More intrinsically, it is able to assist in problem solving and to foster their own learning in an active way [11]. These potentialities occur, in large scale, simply because the approach is directed to the human being, namely at anthropological, sociological and psychological level, as emphasized by[12]. In this scenario, and given the magnitude that gamification increasingly acquires, there are several models that allow the design and evaluation of a gamified strategy [12]. For this project, we highlight the *Gamification Framework*, also known as *Octalysis*, developed by[7], pioneer and expert of the methodology in question. As a reference in the application of gamification in pedagogical practice, the *Gamification Framework* is composed by eight axes: *Core Drives* that should compose any gamified activity:

1. *Epic Meaning & Calling*, referring to the meaning that the activity may trigger in the student. For this same Core Drive, the plot is highlighted, while driving all the activity and its challenges;
2. *Development & Accomplishment*, where the core notion goes through the satisfaction that the subject feels when performing the activity;
3. *Empowerment of Creativity & Feedback*, which aims to promote creativity and feedback, ideally immediately provided;
4. *Ownership & Possession*, where it is defined that gamified activity should foster a sense of ownership. Creating an avatar illustrates this *Core Drive*, as the student / group admits the avatar as their own, as it is

designed through the tastes and preferences of the student (s);
5. *Social Influence & Relatedness*, which addresses the social component. Upon entering a gamified activity, the child also emerges in a need to communicate and interact;
6. *Scarcity & Impatience*, once motivated and predisposed to learn, a sense of impatience arouses in the student, whether in the face of rewards or in terms of the following challenges;
7. *Unpredictability & Curiosity*, which presupposes a gradual process of discovery of the activity, allowing to highlight its unpredictability;
8. *Loss & Avoidance*, since as in everyday life, you do not always win, and sometimes it is necessary to work more and more incessantly to achieve the goals [7], [12].

Thus, it is reinforced that gamification assumes innumerable and significant repercussions, not being associated, in education, to the act of playing[29]. Gamification is not meant to be fun, but rather a playful and active way of learning, sustained by real and contextualized goals, which makes sense in our project.

Regarding to spatial orientation, understood as spatial capacity [22], developed gradually and sequentially in space and with space, in body and body, it is a curriculum content to be developed in primary education, as stated in the Environment Study program, block 4 "Discovering the interrelationships between spaces", which can be articulated with the area of Mathematics, which is constant in the domain of Geometry and Measurement, given that the location and spatial orientation are assumed as the cornerstone of the geometry study. It is from the correct mobilization of their own vocabulary and language expressions that the child can communicate and perceive the world [4].

Trying to define the spatial orientation, one rescues a broader term: the spatial sense, also connoted as spatial capacity or spatial thinking. From the perspective of several authors, it occurs as the union of three components: spatial orientation, spatial visualization and geometric figures [4]. Being fostered from birth, spatial sense is responsible for the ability to respond to various daily tasks[26]. As mentioned by [15], spatial orientation and spatial visualization assumes a thin border with each other, since, to perform a spatial orientation task, it is often necessary to mobilize spatial visualization capabilities. Differentiating the two visual capacities, since they have a thin but existing boundary, spatial visualization refers to the individual's ability to understand their surroundings, occurring a mental movement of the object through the observer [15]. Regarding spatial orientation, it stands out as responsible for the appropriation of the "relative position of shapes and objects as well as the relativity of

their sizes" [5, p. 10],not requiring a mental movement of the object [36]. Thus, spatial orientation refers to the reading and construction of maps, plans and itineraries, as well as their reflection. At the same time, it allows the interrelation with geometric notions associated with coordinates, direction, distance and relative position [5].

In this study, we highlight a gradual and sequential course, namely from the use of terms that emerge from the stories selected by the teacher and the appropriation of notions of orientation (eg. right and left) [23]and also the concepts lateralization and laterality, given that lateralization corresponds to a preference for a body part, while laterality represents an advancement of this same ability, allowing to emphasize the notions of orientation according to the selected reference object [32]. In the age group in question, the relative position of a subject or object can be described from relative and subjective terms, namely regarding distance [5]. There may also be situations where the relative and subjective terms are not presented as sufficient solutions, requiring the use of coordinate systems and reference systems [5]. Thus, and as advocated in the Mathematics and Environmental Studies programs and highlighted in the present study, the promotion of spatial orientation occurs gradually, according to various concrete and practical experiences [34].Thus, the investigative project assumed, as its central objective, the investigation of the influence of gamification as a propelling methodology of the positive impact on the involvement of children. Defined specific objectives: a) Identify children's knowledge regarding spatial orientation; b) Promote learning regarding spatial orientation; c) Identify the impact of the didactic proposal on learning; e) Foster children's involvement; f) Approach the proposed work with the work performed. In this sense, two research questions and their objectives were traced: 1) In what way is gamification suitable for working on spatial orientation? 2) What contributions can gamification bring to student involvement in learning?

II. METHODOLOGY AND SAMPLE

Enhancing gamified educational activities presupposes the conception and development of a dynamic process by the teacher, able to respond to the singularities and needs of the context under analysis [16; 21;43], as well as the objectives listed. Given this same premise, was developed an investigation that followed the mixed methodological approach and a case study. Regarding the case study, it was decidedto develop a short, time-centred and fully situational investigations [3]. Additionally, we sought to approach the Research - Action, assuming its phases towards the transformation of educational practice and professional improvement: observation, planning, action and reflection. Although the project was not again applied in the context under analysis, it served as a learning ground for future applications. Regarding to the mixed methodological approach, this emerged from the confluence of the use of quantitative and qualitative method techniques and strategies [1]. This approach, by mirroring reality [35], allows redirecting research to a full understanding of the case [9].

In this way, the data were collected through: (i) participant observation, which allowed the interaction between the trainee teacher and the students, as well as the collection of empirical data regarding their behaviors, interests and signs of involvement. It was used The Child Involvement Scale, developed by Laevers[27]. Although intended for preschool education, the same scale was used in order to ascertain the level of involvement of students when implementing the sessions scheduled to carry out the project. However, the scale implemented was adapted, as it changed from the original. Two of the most important changes were due to the number of existing levels, which decreased from five to four, so as not to influence the trainee teacher to fill in the middle column. Another change was based on focusing on only two signs of involvement: (a) concentration and (b) facial expression and posture. With these changes, the description of each level was adapted, as shown in Table 1.

Table 1. Description of each level of the adapted Child Engagement Scale

Levels	Description (concentration / facial expression and posture)
1*Absence of activity*	- Distracts himself with space and peers. Does not exhibit any interest in the activity - Has an absent look and a passive attitude
2*Frequently interrupted activity*	- Distracts himself with space and peers. Exercises activity, but without great concentration - Evidence of a disinterested posture
3*More or less continuous activity*	- Distracts himself with some external stimuli. Concentrated and motivated in the activity - Committed attitude most of the time
4*Continuous activity with intense moments*	- Hardly distracted. Very focused and involved in your activity - Posture and facial expression fully focused on activity

Regarding semi-structured interviews with the class teacher, an interview was conducted prior to the implementation of the project, in order to get to know the context in depth, and another subsequently, in order to ascertain the perspectives from the teacher regarding the repercussions of the project. For data collection, were performed categorical content analyzes[2]. In the final part of the project, in order to try to answer the questions raised regarding the analysis of the results, a semi-structured interview was conducted with Dr. Tito de Morais, founder of the MiudosSegurosNa.Net project, and with Professor Manuel Area -Moreira, Full Professor at the University of La Laguna, located in the Canary Islands, Spain, together with a content analysis. These experts were used because they are actively working in this area;

The dynamics of all sessions were organized and systematized into multimodal narratives that presented with "important epistemological value"[20, p. 28]and allowed to preserve their globality[8].

Our analysis was careful to triangulate the data.

In addition, the case study consisted of twenty-one 6-year-old students from the 23 who were part of the class because they were absent during the pre-test and post-test implementation sessions.

The project ran from February to May and was based on three major phases (Table 2).

Table 2. Research Project Schedule

Study Phases	Assignments
Cross to various tasks	1st Participating Observation
Early Stage	2nd Presentation of authorized consents: School Board and EE
	3rd Pilot test performance
	4th Conducting of EPT1
Implementation stage	5th pre-test application
	6th Groups formation
	7th Implementation of sessions and extensions
	8th Post-Test Application
Final stage	9th Conducting of EPT2
	10th Conducting the Expert Interview

Regarding the gamification approach, we retrieve the various *Core Drives*[7] and their presence in the project:

1. *Epic Meaning & Calling,* with the plot created and the cross poster posted in the room;

2. *Development &* Accomplishment, through gradually challenging levels and punctuation;

3. *Empowerment of Creativity & Feedback*, with motivating challenges framed by various iconic places to visit, group-designed avatars, multi-session extensions and immediate feedback;

4. *Ownership & Possession*, from the individual monsters in ClassDojo and the recurring rewards;

5. *Social Influence &Relatedness*/ 6. *Scarcity & Impatience*, through award-winning collaborative work, successive exchange of representatives in groups, and the ability to visit places with families from Thinglink;

7. *Unpredictability & Curiosity*, based on curiosity about the following challenges;

8. *Loss & Avoidance*, with the extra challenges.

Presentation and discussion of results

For a better understanding of the results, Table 3 presents the spatial orientation capacities attended and the way they interrelated with the gamification approach, more specifically with the *Core Drives* [7].

Table 3. Path built during sessions

Sessions	Skills	Place to visit	Issue	Challenge	Extension
Session 1st	-Develop lateralization and laterality -Mobilize proper vocabulary of position relations of two objects	Avenida dos Aliados / Aliados Avenue	What indications can you give to overtake the maze without touching it?	-Motor coordination game -Overpassing a maze, adapted from the electric maze game, with the structure of the Porto City Hall (cf. Appendices 23.2. And 23.3.)	Online game based on questions prepared by the trainee teacher (see appendix 23.7)
2nd Session:	-Mobilize proper vocabulary of position relations of two objects -Represent, describe and compare itineraries linking the same points	São Bento Station	What indications can you give to overtake the maze without touching it?	-Construction, interpretation, description and comparison of several itineraries that connect two points (tourist and train) in grid and with several pieces constructed using magnetic paper. (see appendices 24.1 and 24.2)	Online games regarding the capacity in analysis (see appendix 24.6)
Sessions 3rd and 4th	- Identify the position of figures present in a grid with their coordinates -Locate spaces relative to a reference point	Bolhão Temporary Market	Which stand to choose and what information to give about its location?	- Selecting a branch by identifying the coordinates in a grid (see Appendix 25.1.) - Choose from a market stand to place the selected branch. - Creation of an avatar, through the Voki website,[1] recording the necessary indications in order to the other groups can locate the stand	Question-answer game using a digital resource developed by the trainee teacher (see Appendix 26.4)

It should be noted that the simple appropriation of various game elements in educational practices does not itself influence student involvement and self-realization. In contrast, a path was designed in order to meet the needs and motivations of the class [21], the educational objectives to be listed and the resources available. It was intended to involve students in the process by stimulating connections that give meaning to what they learn. These preparation moments are fundamental in the application of game elements and the development of gamified activities [16]. In addition, we highlight the fact that each session was composed of several moments, as shown in Figure 1.
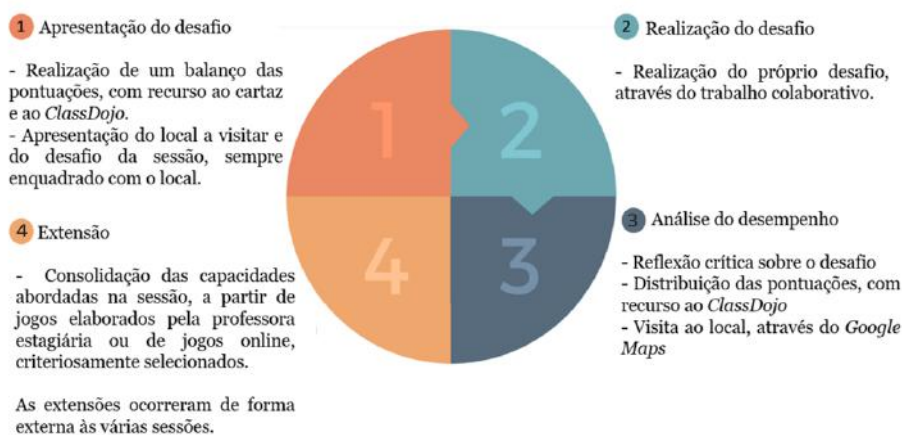

Fig.1: Session moments

Given this, in the present study several resources were mobilized to promote student involvement. An example, is the poster posted in the room (cf. Figure 2), allusive to the various levels (sessions), scores, final reward and observations made throughout the project, according to the *ClassDojo* parameters (cf. Figure 3) and the performance of each group.

Figure 1. Project poster

Fig.2. Selected ClassDojo Parameters

It has been found that students' visualization of the learning process makes it clear, decreases anxiety, and increases intrinsic synergies that are essential to learning. Although with simple bur encouraging observations, given the age group, students resort to the poster when they needed to know what to do to improve or remember their score and level. Moreover, such an event allowed some autonomy to be stimulated, freeing the trainee teacher for other tasks. It was also found that it triggered the inclusion of digital resources (*ClassDojo*, *Google Maps*(https://www.google.com/maps/@41.2609476,-8.7154688,15z), *Thinglink*, *Voki)*, which, associated with games, expanded the sessions and made the moments more playful, fostered the conception of learning how to learn through active, constructive and collaborative work [13]. It is noteworthy that the use of editing and display of graphic presentations allowed, in partnership with the visit diary, that students were motivated and assumed the various sessions as a continuum. Already in the second session all students recognized the tour guide (avatar) and were impatient to know what question the guide was going to ask and where they would take them (cf. Figure 4.)


Fig.4. PowerPoint slide

In the Child Engagement Scale it was found that students only reached level 3, which means that they were compromised most of the time, but reveal some distraction from external stimuli. Respecting the analysed signals - concentration and facial expression and posture - the obtained data was not analysed by session, but by moments. The time reserved for extensions is not present as it occurred externally. Figure 5 illustrates the level of student engagement. The shown values were converted to relative frequency, as a percentage rounded to units.
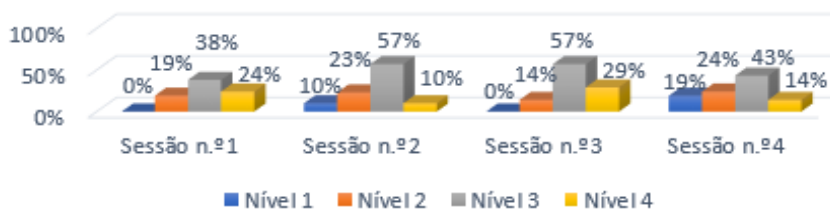
Fig.5: Comparison of involvement levels at various session times

Note: The first moment did not occur in session no. 4, just as the third moment did not occur in session no. 3, which meant that they didn't appear in the referred graphs.

To complement the information gathered from the graphs, we sought to highlight the voice of the full professor through the interviews provided (EPT1 and EPT2). Tables 4 and 5 show analyses of the EPT1 and EPT2, although Table 4 illustrates an excerpt. The purposes of each interview were the basis for the stipulation of analysis categories.

Table 4. EPT1 Review Excerpt

Category	Sub-category	Recording unit	Unit of context	Enumeration
Characterization of the class group	Behaviour	Serious emotional and behavioural problems	*There are children who have severe emotional and behavioural problems*	4
	Engagement	Interest in learning	*generally they show interest in learning*	1
	Attention Period	Difficulty staying motivated and diligent	*... Have a hard time staying motivated and diligent*	2
	Ability to deal with feelings of frustration and difficulties	Difficulty in feelings of frustration and difficulties	*(...) Have a hard time dealing with the frustration and difficulties founded*	1
	Interests	Practical, playful and exploratory activities;	*They are more interested in practical, playful and exploratory activities*	3
Classroom Mediation	Gamification as a strategy	Beneficial	*Would be beneficial*	2
	Programmatic Topic: Spatial orientation - Fullness	Crucial; Individual growth	*(...) Is central to individual growth*	1
	Programmatic topic: Spatial orientation - Difficulties a) Notions of orientation b) Capacity of distance, direction and position in space	a) Yes b) No	*[a] Yes. [b] In general not*	1

The analysis of Table 4 shows that the full professor characterized the class as interested in learning, especially when presenting practical and playful activities, although ephemerally and with behavioural and emotional weaknesses. Given the problems and interests of the class, he considered the gamification approach a beneficial strategy.

Table 5 EPT2 analysis

Category	Sub-category	Recording unit	Unit of context	Enumeration
Perspectives on project repercussions	Adopted strategies	Positive ; New methodology	*Experience was very positive (...) the adopted strategies allowed them to get in touch with a new methodology*	1

Behaviour	Agitation and restlessness; Collaboration and interest	*(...) It is natural that there was more agitation and restlessness, but they were always collaborating and interested.*	2
Attention periods	Improvement; Good levels of interest and motivation	*(...) the students have improved in this aspect, showing good levels of interest and motivation.*	2
Ability to deal with feelings of frustration and difficulties	Awareness of the success stages; Do not give up; In some children, it remained	*(...) encouraged them to comply with their demands, being aware that success is achieved in stages and that there should be an effort to achieve it (...) in children with very low levels of attention (...) the feeling of frustration over the difficulties remained*	1
Interests	Arousing of the curiosity and interest	*aroused curiosity and interest in the challenges presented in some students*	2
Engagement - Child Engagement Scale	3 students at level 1; 3 students level 2; 7 students at level 3; 10 students at level 4	*(...) For level 1, I identify three students. (...) Level 2, I identify three students. (...) Level three I identify 7 students (...) level four I identify 10 students.*	1

The analysis of Table 5 supports the perspectives on the project's repercussions on the class and emphasizes that these, extrapolated student engagement. According to the teacher, significant improvements were felt in the dimensions: periods of attention, curiosity, interest, but also in the ability to deal with feelings of frustration and difficulties in most students. This result allows us to state that the gamification approach has effects mainly on the person who assimilates the process of change. When this occurs, according to [30] it can become threatening and individuals tend to resist, unless the experience reduces this threat, so gamification promotes a playful environment that does not shrink the student. In contrast, it incites you into action, involving you in the learning process. Thus, it also contributes to self-realization, the basis of personal growth, as stated by[21].

After this analysis and with regard to involvement it can be recognized that all data collection instruments point to an improvement. However and as shown in Figure 5, student engagement focused on level 3 - *More or Less Continuous Activity*. Thereby, was asked a question regarding the reason that did not allow most students to be at level 4- *Continuous activity with intense moments*. Given this question, and through a triangulation of data it

was possible to verify that, as referenced in EPT2 the sessions took place in the afternoon which, a priori, conditioned the results. However, at session no. 3, regarding the creation of an avatar, using a tablet / computer, the trainee teacher noted, in the observation field of the Child Engagement Scale, that "some students at the 2nd moment [achievement of the challenge] remained at a low level of involvement (level 2) as they intended to use tablets to play war games" (cf. Child Engagement Scale, session no. 2). Since it was assumed as a major underlying purpose of the project the implementation of a student-centred humanistic curriculum and its self-realization and integrity [38] plus a willingness of the future teacher to know his action sought to conduct an interview with Mr. Doctor Tito de Morais and Professor Doctor Manuel Area-Moreira. With this, it was intended to ascertain what would have been the best position to be adopted by the trainee teacher: to allow the use of war games, although selected according to the educational purposes or not? These interviews were also used to ask questions related to the theme. An analysis of the interviews was conducted, which focused on the question-doubt theme: the educational environment and war games, as shown in Table 6.

Table 6. Excerpt from the analysis of the interviews with Doctor Tito de Morais and Professor Doctor Manuel Area-Moreira

Category	Sub-category	Recording unit	Unit of context	Enumeration
The educational environment and war games	Use of war games in pedagogical practices responding to the interests of some children	Mr. Doctor Tito de Morais Don't do all the wills	*Raising a child is not to do everything for her*	2
		PhD Professor Manuel Area -Moreira Not really	*In principle, I think that shouldn't be used*	1
	Justifiable situations for the use of war games	Mr. Doctor Tito de Morais Related topics	*The only situation that I see that this can be justified will be on the use of such games - carefully chosen - to teach subjects related to the theme*	2
		PhD Professor Manuel Area -Moreira Game Critical Analysis	*Only if we use these games to make the student perform a critical analysis of the games*	1
	Learning disability and attention	Mr. Doctor Tito de Morais Gamification Strategy	*would recommend adopting a gamification strategy*	1
		PhD Professor Manuel Area -Moreira Interesting and technical quality game for the student	*game that has both audio-visual and graphic technical quality, which offers a straightforward challenge to the student*	1

Studying the analysis of the interviews allows us to recognize that the project was effective because it used a good strategy to intervene in a context / class with the behaviors and interests already explained. In fact, the results prove that gamification acted on the person, with effects on involvement and results, even if they did not reach the highest level, because the professional attitude of the trainee teacher also worked on the child's education.

After the four sessions implemented, the post-test was applied, which allowed to measure the promotion of spatial orientation compared to the pre-test initially applied. In Table 7 it is possible to recognize the results obtained between the two applied tests. The values are converted to relative frequency, as a percentage rounded to units and absolute frequency. The answers obtained were not exposed to scores, since the most important was the acquisition of knowledge. Thus, each challenge was analysed through a graded table, constructed based on the answers obtained at both application times. Each type of answer obtained is named according to a code (R1, R2, R3,…). Since these are gradual tables, the R1 code corresponds to the totally correct answer, followed by the remaining codes that have failed or unanswered answers.

Table 7. Synopsis of pre-test and post-test data for each challenge

Capacity under study	Challenge		Percentage …of answers with no failures (R1)	Absolute student frequency by answer code							Percentage …of…evaluations o *easy grade*
				R1	R2	R3	R4	R5	R6	R7	
Mobilization of proper vocabulary of position relations of two objects	1	Pre-test	43%	9	3	3	3	0	3	0	90%
		Post-test	57%	12	4	0	2	1	1	1	90%
Location of	2	Pre-test	29%	6	11	2	2	0			76%

spaces, relative to reference points		Post-test	62%	13	5	1	1	1		85%
Analysis of itineraries	3	Pre-test	62%	13	6	2	0			86%
		Post-test	86%	18	2	1	0			90%
Building of itineraries	4	Pre-test	66%	14	2	3	2	0		95%
		Post-test	80%	17	2	2	0	0		90%
Identification of the figures position in a grid through their coordinates	5	Pre-test	24%	5	8	2	5	1		76%
		Post-test	57%	12	4	3	2	0		95%

Note: Shaded cells represent answers not counted in the respective challenge.

Regarding the mobilization of gamification in the promotion of spatial orientation, it is possible to recognize its adaptation, given the felted degree of learning between the pre-test and the post-test, once the results improved. As for the percentage of students who rated each challenge as easy, it is also possible to recognize an evolution. Moreover, this same adaptation was not only felt in the results obtained in the two tests applied, but also during the sessions. With the appropriation of various elements of the games and the creation of a cross-sectional plot and a sequential path focused on the students and the educational context, it was found that the approach allowed the learning to take place in an active way and through a trial-error method and immediate feedback [16].

In addition, the multimodal narratives of the pre-test and post-test implementation sessions were intersected in order to focus on the evolution felt when presenting the challenges. In general, the analysis of the results allowed us to conclude that the gamification approach is suitable for the promotion of spatial orientation. However, and through a triangulation of data between the percentages of easy grade, extracted from the two tests, and the multimodal narratives of the test application sessions, it is necessary to recognize a poor credibility of these same data. Many students marked the challenges as easy, although they did not understand and accomplish them, "Once again, and moving around the room, it was found in the vast majority of students that they considered the task easy, regardless of whether or not they did it" (multimodal narrative of the pre-test application session).

III. CONCLUSION

The obtained results allow us to conclude that gamification is suitable to work the spatial orientation promoting moments of transdisciplinarity, so we highlight the eight axes *Core Drives*[7] and the strategies and resources used. We also concluded that gamification makes the classes more dynamic and that captivates the students, being involved with pleasure in the learning process. However, it was found that the use of digital games with educational intent is of interest to students, but not enough to engage with attention in the construction of knowledge, as it was found that some students were distracted by external stimuli. Trying to understand this result, it was found that some students preferred war games, so due to the educational game their attention level was not high. This dilemma raised the question of how the teacher should proceed. We conclude that, especially given the age group, it is necessary to educate to form critical and conscious and intervening citizens. Thus, we consider that gamification was the best pedagogical strategy to treat curricular content and to form according to the student profile for the 21st century.

In this follow-up, the gamification approach made it possible to understand, as a trainee teacher, that teaching to learn in contemporary times, in a pleasant environment that respects the student as a person and social being, brings to the teacher new postures, new knowledge and new processes from teaching to learning.

In short, this article, while presenting research limitations such as the short time frame in which it took place, recognizes the potential of gamification as a methodology for the positive impact on the involvement of children in Mathematics and Environmental Studies.

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