Proposal for a gamification strategy applied to remote learning

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Abstract With the rapid and drastic evolution of the COVID-19 pandemic at the end of 2019, interventions in the social interaction of the world population were necessary. Despite the distance from socializing, people's routines needed to remain normal as far as possible, and this includes student learning. Thus, the solution for educational institutions was to migrate activities to the remote teaching format as an emergency. As expected, some obstacles were encountered, and others were accentuated and requiring strategies to help mitigate such problems. Several studies point to demotivation as one of the main elements that affect students in terms of low academic performance and, consequently, culminating in low learning achievement, high failure rates, and dropout rates. The objective of this study is to propose, for Emergency Remote Teaching (ERT) activities, a simple gamification strategy aimed at student engagement. An exploratory literature review was carried out to identify potentially key points that could be adopted, which could influence student motivation. Based on this, the primary motivational activators for the gamification strategy were listed in Framework Octalysis. As a way of validating the technique, two not mandatory classes were taught in a remote format containing the same course content (Introductory to the Internet of Things (IoT)), differentiating between the control group (without interventions) and the group with the application of the proposed strategy of gamification. The expected result was the perception of greater engagement in the class with the application of the gamification strategy against the control class, but it was not achieved as expected. The research found that students had low participation and engagement in both traditional and gamified classes, even after intervention. This could be due to factors such as course duration, lack of collaboration, and teacher involvement. Both classes had the same completion and dropout rate (2 completions and 13 dropouts). As future works, the authors suggest interviewing students to understand the causes of demotivation and using Design Thinking, plan to investigate the root causes of low participation and develop actions for the "Ownership and Possession" motivational activator, apply improvements to larger classes, introduce a student/monitor role, and compare gamification in regular and non-mandatory classes.

Keywords: gamification, remote learning, distance education, motivation

1 Introduction

Dating back to 2600 BC, the first competitions and games were recorded in human culture and became universal and present in people's daily lives. Games and competitions are generally used for recreational purposes, benefiting the most diverse areas, such as education and health. In addition to recreational purposes, there is a growing interest in the application of so-called "serious games", in which other objectives are pursued, such as therapeutics and training. Through the development of various practical skills and competencies, games generate cognitive stimuli and can have an educational role. Several studies and experiments show that both students and educators agree that the use of entertainment games can promote learning [Flach and Ferreira, 2020]. With the beginning of the COVID-19 pandemics in 2019, a large part of the world population had to change the format of their face-to-face activities to remote (online) mode. The sudden need for a change in routine meant that a large part of the world population had to change their study habits and face-to-face work to develop these activities at home, using computers,

cell phones, and tablets, for example. Several ongoing studies seek to understand the potential impacts of this isolation on various psychological, social and emotional aspects that arise or are accentuated. These impacts sometimes impair people's engagement and motivation, configuring themselves as a serious problem concerning the proper execution of activities.

The application of gamification techniques, in this context, demonstrates the potential to act as a driver for people's commitment and motivation. Different contexts make use of these techniques, demonstrating as positive points the gain in cognitive skills, the possibility of greater flexibility in learning, and the gain in performance [Flach and Ferreira, 2020]. For Computer Science and Information Technology students, for example, curricula that apply purposeful games to specialize in programming learning, found positive effects on students as well as Ater-Kranov *et al.* [2010] outcomes.

In this context, the objective of this work is to propose the application of a gamified solution strategy that aims to increase the participation and engagement of students in the context of remote learning [Kay, 2020], based on the motivational activators proposed in the Framework Octalysis. The

use of mechanics, dynamics, and game elements to promote learning and engagement can be inserted as a strategy in this learning context [Da Silva *et al.*, 2018a].

In this way, we intend to answer the following research question: *"Could the application of gamification strategies increase student engagement when applied in an emergency remote learning format?"*. Therefore, the hypothesis put forward is that students in a class with gamification strategies perform better in the discipline than other students in classes without being gamified.

The work was developed in 3 stages, the first one being an exploratory literature review and diagnosis, the second stage planning and developing the proposed gamification strategy, focusing on high school and technical students, in a remote teaching context [Hamilton *et al.*, 2020]. The third stage consisted of the application and evaluation of the solution.

During the reporting stage, this paper extended the research discussion to bring improvements to the literature review to be able to insert other bibliographic sources and advances in the analysis of research results, especially in the discussion of possible reasons for the results obtained, and advances in better developments for future work.

The work is structured as follows. In section 2, related work are described. In section 3, the theoretical framework on the subject is presented. In section 4, a gamification solution is proposed in the context of remote teaching, and the strategy used is presented. In sections 5 and 6, the details of experimentation and the results are respectively exposed. Finally, the conclusion and future work are presented.

2　Related Work

In this section, the main related work identified in the exploratory literature review will be presented. Many of these works present a proposal for the use of digital educational games, applications, and free software to aid in the learning of children, young people, and adults. In addition to these programs used, works were also identified that present classes and even complete courses with the use of gamification techniques.

In Ferreira Filho *et al.* [2020], the application of a gamified solution called Pac-Mana is proposed, aimed at reducing the dropout rate in Programming Logic subjects in short-term courses (FIC) in the context of remote teaching. Similar to this work, the solution proposed by the authors is based on Framework Octalysis. However, the adopted strategy is based on peer instruction techniques.

A gamified solution was also proposed by Da Silva *et al.* [2018a], which included the application of a C programming language learning course for young people aged 13 to 15 years with a game approach combined with storytelling, in which the students were inserted into a fictional world and had to carry out missions (fixation exercises) to be able to advance in the level (modules) and earn points to gain classification in the ranking.

The work of Da Silva *et al.* [2018b] presents an analysis of the national scene in the use of games aimed at teaching and learning to compute. Through this analysis, it was possible to observe the benefits and effectiveness of using games during the learning process. Many studies have shown that this new approach has met objectives such as increasing student motivation and engagement, improving knowledge regarding the content and concepts covered, and facilitating learning through error, among others.

In another perspective of the use of games, we have in Alves and Santos [2018] the suggestion of an evaluation model that can better evidence the contributions of educational digital games. This new proposed model demonstrates some important aspects that must be taken into account in digital educational games, such as immediate and constructive feedback, clear and well-defined learning objectives, levels of increasing challenges, level of interactivity, integration of concepts learned, narrative, transmedia, balanced game learning curve, situations that require collaborative and cooperative practices.

As in the works cited above, this article will bring experiences such as the use of elements of Framework Octalysis, which, similarly to the work of Ferreira Filho *et al.* [2020], uses an approach through the influence of motivational activators. In addition, the use of gamified platforms will be addressed in order to simulate games and provide a different and characteristic online environment for the student, as proposed in the work of Da Silva *et al.* [2018a]. Finally, other elements adopted in this work, similarly to the work of Da Silva *et al.* [2018b] and Alves and Santos [2018], were the approaches of immediate feedbacks, through small games that represent activities, which bring errors and fixes once completed.

With a similar objective to this work, Teixeira and Jucá [2021] aimed to minimize school dropouts, especially in exact science courses in higher education. The authors proposed the creation of a gamification framework aimed at increasing student engagement and participation in subjects and in order to be adaptable by different teacher profiles for different types of subjects. Differently from this work, the authors used the framework defined by Werbach and Hunter [2012] as a basis. The evaluation strategy was similar to the one used in this work, when defining a discipline in which the gamification strategy would be applied and a class without the application of the gamification strategy, to be used as a control. As a result, the authors identify that gamification brought benefits in relation to student performance, reflected in attendance and grades.

The work by Araújo and Carvalho [2017], similarly to the present work, aims to facilitate the use of gamification by teachers who do not have depth in the area and relates the use with the Framework Octalysis. For this, it presents a training workshop, implemented with the aim of training teachers to integrate gamification into their practices. In addition, it presents a collection of digital tools aimed at facilitating the application of gamification techniques by teachers.

3　Theoretical Reference

3.1　Distance Education and Emergency Remote Teaching

A priori, it is necessary to define and differentiate two terms widely used in the literature, which can generate confusion

when dealing with online classes. Our object of study classes in the context of Emergency Remote Teaching (ERT) which differs from Distance Education (DE). This difference is due to the formats addressed in each of the distance learning models. Distance Education has been studied for some decades and through research, models, evaluations, among other methods, course designs were identified that bring a significant quality of teaching, due to the time that allowed an effective model of education to be elaborated teaching [Hodges *et al*., 2020b]. In an ERT situation, this past planning experience is not taken into account, due to the short period that is available for a teaching model to be put into practice, which will often be temporary and alternative, due to the current crisis time. In these circumstances, the main objective is not to develop a robust teaching model, but a quick solution, of an emergency nature, which will provide temporary access to certain content [Hodges *et al*., 2020b].

Distance Education has specific characteristics such as well-defined legislative issues, long-term planning, experiences designed to be online, investments in structure, and also in training the team of teachers for the use of digital educational technologies, in addition to having as starting point the quality of student learning [Joye *et al*., 2020].

Emergency Remote Teaching, on the other hand, brings a teaching modality adopted temporarily, as an alternative to face-to-face due to some crisis, in the case of COVID-19, a health crisis. This model brings a fully remote solution, with temporary access to support and educational content quickly and easily, during the emergency period. In this case, the creation of a robust educational system is not the objective, since, with the improvement of the crisis in question, face-to-face teaching tends to return [Hodges *et al*., 2020a].

With regard to remote learning, dropout occurs, in fact, often in institutions that use open distance learning methods. It is a fact that student dropouts occur quite often in institutions providing education using open and distance learning methods [Eisenberg and Dowsett, 1990].

3.2   Gamification

Even in the context of a traditional classroom environment, motivating and engaging students has been a growing challenge for educators [Lee and Hammer, 2011]. In this way, it is necessary to identify and report strategies and methodologies that help in the process of motivating students in a simple and effectively applicable way. In this sense, several works have demonstrated the potential of using gamification as a way to increase student motivation and engagement, for example Ferreira Filho *et al*. [2020] and Buckley and Doyle [2016]. In this way, gamification refers to the art of applying, in productive activities in the real world, elements with a high capacity to engage and have fun that is typically found in Chou [2019] games.

Thus, gamification presents itself as a way to motivate, engage, promote learning and solve problems through mechanics, aesthetics, and the way of thinking about games. This makes it possible to expand the concept to a wide range of possibilities for the improvement of work and/or study routines. Engagement generated by gamification intensifies user involvement in activities, also enhancing their effectiveness

and efficiency [Kapp, 2012].

In this work, the techniques related to gamification will be applied in the context of Emergency Remote Teaching, which adapts in an emergency way based on aspects previously developed in the field of Distance Education. Distance Education is an educational modality in which the didactic-pedagogical mediation process has subjects in different places and times, using information and communication means and technologies to monitor and evaluate activities [Brasil, 2017].

In this study, the authors conduct an analysis of research on the implementation of gamification in the high school teaching-learning process. The authors employed the Systematic Litecature Review (SLR) method and found that there are studies that demonstrate the effectiveness of gamification in high school education using various techniques, all of which have reported a positive impact on students learning and have been well-received by teachers [Alves *et al*., 2022].

3.3   Design Thinking

Design Thinking (DT) can be defined as an analytical and creative process in which a person experiments, creates, and prototypes models and thus manages to redesign what is being developed based on quick feedbacks, in addition to demanding from this person several expected characteristics of a good design thinker such as visualization and creativity [Razzouk and Shute, 2012]. Generally speaking, DT refers to an approach that allows design principles to be adopted by people in a variety of professional areas [Mesquita, 2017].

This work used several DT elements in the design and development stages, with the objective of maintaining the development of the human-centered gamification strategy.

3.4   Framework Octalysis

Framework Octalysis refers to a set of elements for gamification design based on successful games proposed by Chou [2019]. The Framework Octalysis is organized in an octagon shape so that the main elements that focus on creativity, self-expression, and dynamics are arranged on the right side of the octagon and are called right brain core drives. Core drives that are most commonly associated with logic, analytical thinking, and ownership are graphically represented on the left side of the octagon. This octagon is composed of 8 vertices that represent the 8 core drives. Yu-kai Chou's research suggests that if there are none of these core drives (associated with the 8 motivational triggers) behind the desired action, there will be no motivation or behavior in place.

3.5   Gamification and Blended Learning

Hybrid teaching promises to bring the best possible teaching experience to the student when it comes to the mixture of remote and traditional teaching. As Horn and Staker [2017] said, blended learning is any formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace.

The proposed gamified model, depending on the strategy that was adopted, has similarities with hybrid teaching models,

especially the flipped classroom model. Flipped classroom model is one of the known classifications of hybrid education. According to Horn and Staker [2017], in flipped classrooms students consume online lessons independently where they are. Time in the classroom, previously reserved for teacher instruction, is instead spent on tasks in which the student becomes the protagonist, with teachers providing assistance as needed.

4   Gamification proposal in the context of remote learning

The methodology for developing the proposed solution was carried out in 3 stages described as follows:

- **Stage 1** - Diagnosis of the main aspects related to the context and motivation of the actors involved in Emergency Remote Teaching;
- **Stage 2** - Planning and development of the gamification strategy to be applied;
- **Stage 3** - Brief evaluation of the application of the gamified solution proposed.

4.1   Diagnostic

The diagnostic stage was carried out in order to better understand the main elements possibly influencing the motivation of the actors directly participating in the teaching-learning process in the remote context (students and teachers). For this purpose, dynamics associated with the Immersion/Empathy stage typical of Design Thinking (DT) were conducted. In this stage, we tried to identify the main elements of demotivation of students and teachers and possible root causes of demotivation by collecting data through a questionnaire form presented in Table 1.

The collection was carried out as a way to measure aspects of motivation, aiming to create a baseline of reference regarding motivation, developed through key questions created associated with each of the core drives proposed in the Framework Octalysis. The diagnosis was performed only with the gamified class and the results (on a scale of 1 to 10) are presented in Table 2.

Figure 1 displays the octagon generated based on the diagnostic stage of the gamified class, before the intervention. To create this octagon, a previously mentioned collection form was generated, in which each question inserted was associated with each vertex. Each question could be answered on a scale from 0 to 10, where 10 represented the maximum value of each vertex, that is when this core drive would be ideal and 0 the minimum value, that is, the core drive would be at the worst possible motivation value. Each vertex was generated based on the average of values obtained in the form.

4.2   Gamification strategy

The planning and development of the gamification strategy were carried out based on the actions presented below.

Table 1. Diagnostic Questionnaire Form.

Feedback on Motivation in this course	Scale
On a scale of 1 to 10, how much do you feel this course will contribute to your knowledge of the Internet of Things?	1 to 10
On a scale of 1 to 10, how do you currently rate your interest in overcoming your own obstacles and developing Internet of Things skills in order to acquire knowledge and recognition?	1 to 10
On a scale of 1 to 10, how do you rate your level of curiosity about the Internet of Things content?	1 to 10
On a scale of 1 to 10, how motivated/motivated do you feel when you want to own something?	1 to 10
On a scale of 1 to 10, how much social interaction do you usually have with the other participants in this course? Whether in activities (collaborative or competitive).	1 to 10
On a scale of 1 to 10, how important is it to you to acquire a certificate/digital badge?	1 to 10
On a scale of 1 to 10, how curious have you felt about each chapter of the course, regarding the next chapter?	1 to 10
On a scale of 1 to 10, how important do you consider completing this course?	1 to 10
Please feel free if you want to suggest something	Open question

Table 2. Diagnosis of pre-intervention core drives.

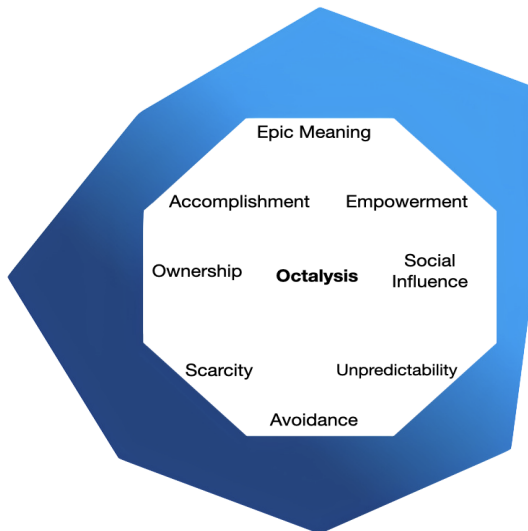| Core drive	Score
Epic meaning and call	9
Development and realization	6
Empowering creativity and feedback	9
Ownership and possession	10
Social influence and affinity	3
Scarcity and impatience	8
Unpredictability and curiosity	7
Loss and Evasion	8

Figure 1. Octalysis shape from pre-intervention diagnosis.

4.2.1 The experience

The first emotion (climate) transmitted in the gamified class occurs after the intervention in an asynchronous format, in which the expected climate to be invoked is relaxation when using a platform called Gather Town (`http://gather.town/`). Unlike the usual videoconference interaction platforms, on this platform students can choose avatars similar to game characters. Students can then navigate in the virtual environment (which simulates in two dimensions a classroom environment on the screen, with tables, chairs, and a whiteboard) and thus interact with each other through voice and text in the chat.

The Figure 2 illustrates the virtual environment adopted for synchronous meetings. Note that the playful format, alluding to games, had the role of facilitating students and arousing their interest.

4.2.2 Course Flow

The student starts the course by accessing the Virtual Learning Environment (VLE). The first challenge is to understand the elements of interaction and functioning of the environment. As a condition for completing the course, the student needs to participate in the course, read the material (above 50%), and take the final theoretical exam, the two feedback evaluations of the course (one in the middle of the course and another at the end of the course).

The Figure 3 represents the vision of the virtual learning environment adopted for the activities, provision of texts and asynchronous resources. This view of the virtual environment is from the student's point of view.

4.2.3 Relationship between mechanics and core drives proposed by Octalysis

Next, the actions implemented in the gamification strategy will be described, aimed at influencing each of the core drives based on Framework Octalysis.

- **Epic Meaning and Calling** - The Epic Meaning and Calling core drive, in this context, refers to the aspect of the student feeling that he has a greater purpose in the

development of that activity, a motivation. To seek to influence this core drive, the action is taken in order to demonstrate to students that they would be participating in a motivation experiment that can motivate other students in the context of remote learning, since the lessons learned in the execution of this class would be shared as a set of good practices to be adopted by interested teachers. Thus, they are expected to feel that they are doing something meaningful, greater than themselves.

- **Development and Accomplishment** - The Development and Accomplishment core drive refers to students' willingness to be better at what they do. Usually, Points, Medals, and Rankings are used in this context. To influence this, we defined that whoever manages to complete the course would win a digital badge that can be shared via social networks. The Figure 4 shows the digital badges issued to those approved in the course. The digital badge works similarly to a course completion certificate and was issued by the Cisco company, through the Cisco Networking Academy. Each badge is integrated with metadata so that through the Cisco Networking Academy portal digital badges can be verified. On the digital badge it is possible to verify the skills needed to complete this course.

- **Empowerment of Creativity and Feedback** - The Empowerment of Creativity core drive refers to allowing the person to discover new things and perform different combinations to reach a result. To influence this trigger, we defined that students would take tests with immediate feedback.

- **Ownership and Possession** - This is the core drive where users are motivated because they feel like they own something. However, no actions associated with this core drive have been defined, due to limited time for protocol development.

- **Social Influence and Affinity** - The Social Influence and Affinity core driver refers to companionship, acceptance, horizontal relationship, and mentoring, for example. To influence this drive, we created a group on whatsapp aimed at allowing networking and a more horizontal relationship between students and lecturers.

- **Scarcity and Impatience** - The Scarcity and Impatience core drive refers to the perspective that rare things are more valuable. Thus, to influence this drive, we defined that the participation of students in the synchronous meeting will result in each one receiving a gift. The proposed gifts were simple items such as books and key chains. These items would be revealed during the synchronous activity and in response to active participation during the meeting and students who got certain challenge questions right.

- **Unpredictability and Curiosity** - The Unpredictability and Curiosity core drive refers to the perspective that what is to come and we still don't know can engage more than a reward that we already know what it will
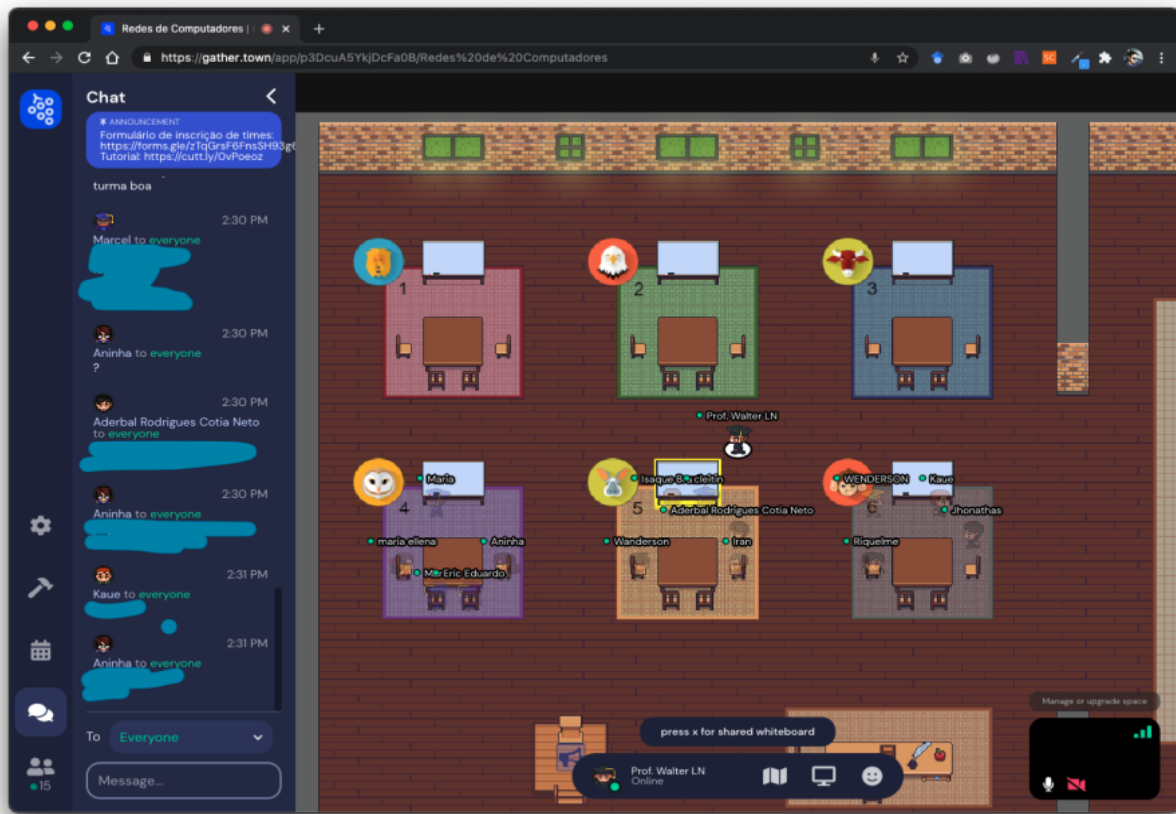
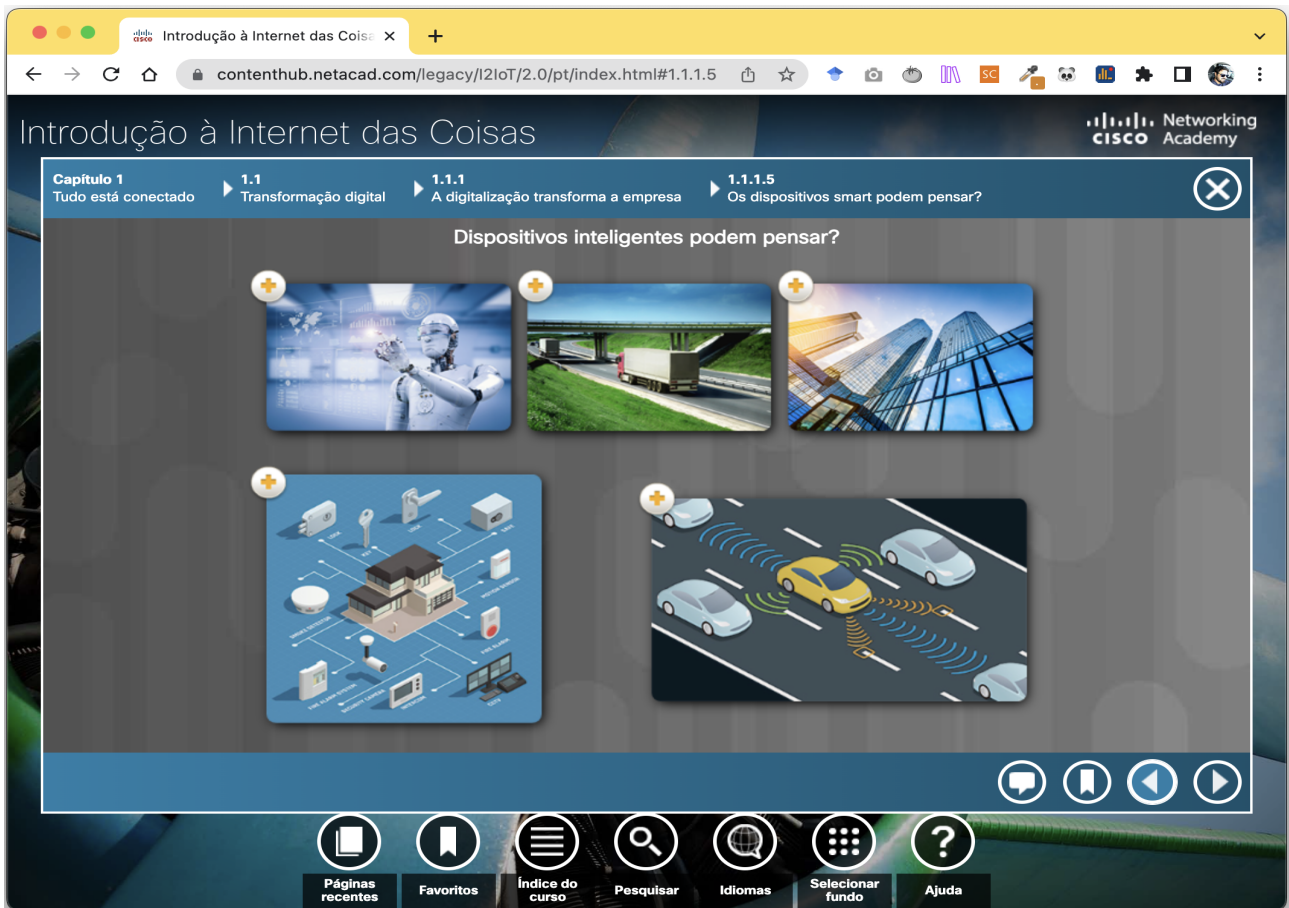**Figure 2.** Virtual Learning Environment - Gather Town platform.

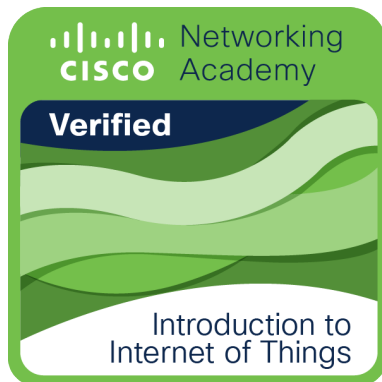**Figure 3.** Virtual Learning Environment - Internet of Things course.

Figure 4. Internet of Things Digital Badge.

be. So, to influence this drive in the same way of the Scarcity and Impatience drive, we propose a raffle of surprise simple gifts (such as books, key chains, and pens), which would be revealed during the synchronous activity, being delivered to the first students to complete a given challenge.

- **Loss and Avoidance** - The Loss and Avoidance core drive refers to the perspective that human beings naturally seek to avoid losing something they have already achieved. For example, avoid wasting work already done, time and effort already applied, money, and so on. Thus, to influence this drive, we use a message identifying time already applied in the course versus what is missing for successful completion.

5 Experiment Details

Aiming to evaluate the application of the proposed gamification strategy, a short-term Internet of Things (IoT) course was taught in Emergency Remote Teaching format as a guiding element for the application and evaluation of the proposed strategy. This is a course of Introduction to the Internet of Things course, offered by the Cisco Networking Academy in several languages and without pre-requisites in terms of of technical knowledge in the area of Information Technology, with an estimated total workload of 20 hours. More details about the course can be obtained via the URL: (`https://www.netacad.com/pt-br/courses/iot/introduction-iot`).

In this sense, an invitation to register for those interested in taking the Introduction to IoT course was released through social media. A total of 30 applications for registration were made before registration was closed.

The course was offered free of charge to students and its completion was not part of any mandatory requirement, such as being an evaluation criterion for completing a technical or undergraduate course.

Among the 30 enrolled students, two groups of 15 participants were formed based on a lottery. The draw was carried out to minimize the possible bias concerning the choice of participants based on the academic profile for each class. One of the classes was designated as a control class (without intervention), to act as a basis for comparison with the gamified class. In this class, there would be no application of the gamification strategy. At the same time, a second group was created,

with the remaining 15 participants. In this class, however, the gamification strategy suggested in this study was applied.

Before the beginning of classes, preparation of the two courses and pre-and post-intervention stages was carried out. During the execution of the course, the intervention stage was carried out.

The pre-intervention stage consisted of the following activities:

- APRE1: Publication of the course (free of charge) with registration request form (limited to the first 30 students);
- APRE2: Creation of two identical classes, with the material from the Introduction to IoT course, in a virtual learning environment;
- APRE3: Division of the 30 enrolled into 2 equal groups of 15 students each (based on a draw);
- APRE4: Creation of an instant messaging group with the teacher, facilitators, and the 15 students of the gamified class;
- APRE5: Initial guidance email sent to both classes. The email presented the course rules, how to access and how to ask questions;
- APRE6: Concealment of half of the chapters of the material for the gamified class, to make it possible for these elements to be revealed progressively according to the student's development.

The intervention stage consisted of the following activities:

- AI1: After one week of starting the course, a diagnosis form was sent with 8 questions that referred to the motivational activators;
- AI2: At the beginning of the second half of the course time of the gamified class, synchronous meetings were proposed through the platform (Gather Town), in which participants could get to know the environment, open discussions, schedule a study time with a shared board, among other tools;
- AI3: As a third intervention activity, a synchronous meeting with the gamified class was proposed, to apply a practical challenge of skills integration, dividing the participants into collaborative groups that would compete with each other;
- AI4: The same initial diagnosis form was sent at the end of the course as a way to identify the effective changes during the application of the technique that gamification.

The post-intervention stage consisted of the following activities:

- APOS1: Motivation diagnosis form with students;
- APOS2: Evaluation of the implemented strategy.

The course was composed of 6 study chapters, which were formed by short videos, texts, interactive fixation exercises, among others. The basic composition of the course consists in the initial student orientation content, in order to insert the student in the technology environment, device integration and connections. In addition, the student is presented with financial opportunities and process transformations that are provided by the IoT field. Upon completion of the course, and if the student scores above 7 in the assessment, he/she

receives a digital badge. The idea of the badge is that it can minimally represents the dedication and recognition to the student about the knowledge acquired.

In the control class, all chapters were accessible to those enrolled from the beginning to the end of the course. In the gamified class, only 3 chapters (half of the course) were left accessible and the other 3 following chapters remained hidden in order to be released gradually, according to the predicted interferences.

As for enrollment, a web form was initially generated and forwarded to various media (social networks, for example) to collect basic information from interested students (such as personal data and area of expertise). There were a total of 30 entries. After enrollment, an email with initial guidelines was sent to both groups (gamified class and control class). The control group started normally and each student should carry out the study in a self-taught way, following the material available in the virtual learning environment and performing the fixation and evaluation activities in their own time, being stimulated only by their self-motivation and interest in the content offered. At the end, after completing the minimum achievement requirements (defined as 70% of achievement in the final assessment), the student received a digital badge.

Unlike the control class, the gamified class started with only 3 chapters available to the student (half of the course). The first intervention took place after one week (determined among the authors who judged it sufficient to complete this first stage). The group was then used in an instant messaging application to facilitate interaction between participants. In this group, a form was sent with 8 questions that referred to core drives and, in this way, primary answers about students' motivation were summarized in the Table 2. From the second half of the course of the gamified class, synchronous meetings were proposed at Gather Town to carry out fixation dynamics, in which participants could get to know the environment, open discussions, schedule a study time with a shared board, among other tools. At the end of the course, the same diagnostic form was sent as a way to identify the effective changes during the application of the proposed gamification technique and to verify if the objectives were achieved.

Despite attempt to administering the survey after the intervention phase, it was observed that the students did not provide their feedback on post-intervention. This phenomenon may be indicative of a larger underlying problem—student disengagement with the course material or a sense of disinterest in the learning process. Identifying the reasons behind this non-response is crucial for educators to tailor the next interventions more effectively. Further research is needed to explore the potential factors contributing to this lack of motivation, such as instructional methodologies, curriculum relevance, or individual learning preferences, to devise targeted strategies aiming to increase the enthusiasm of the students.

The 2 main motivations for carrying out the diagnosis and intervention in the gamified class one week after the start of the course was: i) as a way of verifying whether there would be a possible similarity in the behavior of the class having the gamification strategy applied and the control class and; ii) as a way of verifying whether there would be some change in behavior in the gamified class before and after the interventions.

As a way of favoring the reproducibility of the strategy, the Table 3 presents the protocol adopted to materialize the proposed gamification solution.

6   Results - Strategy evaluation

The main metric designed to identify whether the proposed game strategy was successfully applied consisted in the success rate of the course by students in the gamified class, when compared to the students in the control class.

The first interaction with both classes was carried out in the same way, through a welcome email to the course with initial guidelines for accessing the online platform, contacting the teacher, and details of the schedule and course activities. During the execution of the experiment, we noticed that there was no effective participation in the activities, questionnaires, and evaluations in the control group. At the end of the term, the course was closed without any interactions on the part of the students and with two approvals. The number of students completing the gamified class was small compared to works like Ferreira Filho *et al.* [2020]. A possible cause hypothesis for this low number of graduates, comparing the two surveys, may have been the duration of the course and the fact that it was non-mandatory.

Regarding to the gamified class, the students demonstrated behavior similar to that of the control class during the first half of the course (without intervention). Only one of the 15 students took one of the optional assessments (fixation assessments) during this time. After the intervention in the gamified class, part of the students (4) performed interactions via instant messenger. The students showed no interest in participating in the synchronous moment proposed by the teacher and the facilitators and, in the end, only 2 students successfully completed the course in the gamified class.

As mentioned in the previous section, at the end of this course the diagnostic form of the Table 1 was applied to seek information about the students to qualify and quantify the self profile of each one (if they considered themselves curious, resilient, and interested people, for example). So, it is important to highlight that, due to the emergency issue of virtual classes, there are points that need to be evaluated and will be presented in more detailed as follow:

1. The standard format of face-to-face classes is different from remote classes. With the abrupt change, a growing line of learning is needed for the student to get used to the "freedom" to organize his time and a certain resilience so that he does not give up in case of any obstacle;
2. The real importance of certificates, course content, and knowledge of this topic for the student's life. This will also be a determining factor for completing the course, since the student is not really interested in the content, there will be no main reason for him to continue;
3. We must always remember that the pandemic moment was a tense and complicated moment for everyone who have had this experience. Thus, being motivated may not be so easy for the student. Being psychologically well is of fundamental importance for motivation, curiosity, and interest.

Table 3. Protocol adopted to materialize the gamification solution.

Action code	Action
A1	The Experience: Invoking Course Atmosphere. Suggestion: A relaxed atmosphere when using a platform that reflects reality in students. For example http://gather.town/.
A2	Plan a course and associate different material and activities in a virtual learning environment. Define course flow as completion conditions in the course, which steps and paths students must follow.
A3	Publicize the course and enroll students in the most suitable virtual learning environment for teachers and students.
A3	Create instant messaging communication channel between students and teachers for frequent and more personalized interactions.
A4	Inform students of the course rules, approval rules, explaining how to perform the first access and how to ask for help.
A5	Carry out socialization activities between students and teacher. Seeking to understand the main characteristics of the students, especially those that can be more strongly influenced (associated with any of the motivational activators)
A6	Develop at least one mechanic to influence motivation that is associated with each of the motivational triggers.
A7	Explain to students that they would be participating in a motivation experiment that can help motivate other students in the context of remote learning.
A8	Use some Scoring, Awards, and Ranking mechanism. In this regard, it is suggested that, depending on the characteristics of the class, the public ranking is based on teams and that the score and individual ranking position can be consulted privately
A9	Implement the immediate feedback mechanism in discipline retention tests
A10	Apply motivation diagnostic tool (applied at the beginning of the course).
A11	Apply synchronous meeting through some interactive and playful platform, suggestion Gather Town.
A12	Apply synchronous meeting with the gamified class, in order to apply a practical challenge of skills integration, dividing participants into collaborative groups that would compete with each other.
A13	The same initial diagnosis form was sent at the end of the course as a way of identifying the effective changes during the application of the gamification technique.

We identified that possibly, one of the elements that may have had a strong influence for the non-involvement of students with the course, was the totally free nature and a non-mandatory requirement for evaluation or completion of any discipline. In this way, the drive of Scarcity and Impatience was not strongly influenced.

In this way, we understand that the experimental results were valuable in the researchers maturation process, since they reinforced the importance of exploring certain key elements in a real scenario, as presented in the literature as elements that are able to act in the sense of the core drives. As lessons learned, the aspects identified in this work will be fundamental for the evolution of the proposed gamification strategy in an interactive way for the future works.

In addition to evaluating the possible causes of students' demotivation, it is also important to observe the temporal context in which this experiment was applied. Considering that the course started in May 2021, and that in this period the Colleges and Universities in the region were usually at the end of the semester, we hypothesized that students needed to prioritize other activities to the detriment of the this course. An element that corroborates with this hypothesis was the answer of one of the students in the open question, in the diagnosis form. The answer given was: "I'm just not taking (the course) because I started college in Information Technology. If it is still available on my vacation, I could take it."

Another hypothesis raised by the researchers was that the total time of the course could be extended, in order to better accommodate this challenge of demotivation in the course by prioritizing other activities (as in the case of University activities). In this experimental execution, the course was carried out for 15 days. Although the course has an introductory nature and an expected workload of 20 hours, there is a need to read and interact with the activities on the online platform. These factors may have impacted both on the fact that students did not actually have time available for the course activities, and on the feeling that there would not be enough time to complete the course, causing dropouts. Thus, considering the entire temporal context, one should reflect on the total period of the course. For this, the following questions were raised to be considered as future work:

1. What is the impact on the diagnosis of motivation, if the experiment is carried out again, based on the same protocol identified in section 4, but with an extension of the course time for 1 month (twice the experiment of this research)?
2. What is the impact on the diagnosis of motivation, if the experiment is carried out again, based on the same protocol identified in section 4, including the same course period, but at a time of low academic demand for students?

Another point to be considered is that, although this activity was developed during a pandemic period (people were supposedly more available to take online courses), the high offer of courses that were offered and the excessive amount of information may have overloaded people.

In addition, there was, covertly, a great pressure for productivity, since people were at home and needed to keep their activities and routines as normal. In this time interval, there

were also different moments of tension in relation to waves of flexibility in the movement of people and also the intrinsic tension of the events, which can lead to dropouts, demotivation, or even oscillation of the study rhythm, disturbing the result of student.

Through the electronic form used for student registration (APRE1) detailed in section 5, basic contact information was collected from interested parties, such as name, telephone and e-mail. In addition, to register, each interested party answered the following two questions:

1. What is your level of knowledge in Information Technology?
2. What is your main area of activity (ex.: Technology Student, Law Professional, etc.)?

In this context, the answers were possible on a scale from 0 to 10, with 0 being considered no knowledge in the area and 10 being considered a professional in the area. As identified in Figure 5, it appears that the majority (28 of 30 respondents) of the grades were from 6 to 10, that is, most students identify themselves as having a medium to advanced domain in the area of technology. From these, 15% of the students are professionals in the area of Information Technology or related. With this, it was possible to identify that the majority of those interested in the course were taking some course at the undergraduate level. Furthermore, we were able to trace the simplified profile of the students participating in the course.

In a complementary way, another element to be discussed as a possible cause of low student motivation may have been the fact that the course is not mandatory. As the course did not have any specific obligation, as is the case with mandatory subjects in undergraduate courses, for example, when there is a need to prioritize between the non-compulsory course and mandatory activities, the hypothesis is that non-compulsory activities may be in the background.

7   Conclusions

In this research, we could observe that both in the control class and in the first half (without intervention) of the schedule of the gamified class, there was no participation or involvement of the students beyond the enrollment in the course. It was possible to notice that the students had low participation in terms of interaction and engagement, even after the intervention. This element possibly reinforces the need to address possible gaps that may have caused this low participation, such as the duration of the course, encouraging collaboration, greater use of collaboration tools, and the importance of the teacher and the facilitator participation in the process of engaging and motivating students.

Observing non-response to post-intervention survey suggests possible student disengagement or lack of interest in the course. Identifying reasons is vital for tailoring effective interventions; further research is required to explore factors like instructional methods, curriculum relevance, and individual learning preferences for devising targeted strategies to boost student enthusiasm.

Another factor that we can take into account so that the experiment did not occur as expected, is the fact that a single

course (extracurricular) of short duration, possibly does not bring a feeling of belonging to the student in that teaching environment. In this sense, the student can consider this type of course as a passing one and does not have a relevant impact on their academic life, differently from a regular, long-term course, which could provide a feeling of belonging. This, arising from their time of proximity with friends, teachers, and even with the educational institution, makes the feeling of belonging to the group much stronger, directly impacting their academic performance.

Another important aspect to be mentioned is that the Emergency Remote Learning course, due to its similar nature to Distance Learning, demands greater student participation as a proactive agent in the learning process. Traditional teaching (in which the teacher is seen as a source of knowledge to be transmitted to the student, who ends up adopting a passive posture) tends not to develop this competence in students and this, among others, is an element that is not solved only by gamification strategies alone. In this sense, this research reinforces that, although gamification strategies have the potential to help this type of challenge, reservations are needed since gamification should not be seen as an answer to what it is not capable of changing.

The use of a communication tool that was already familiar to the students (using the whatsapp tool, which already had a previous report of the possible use during the course enrollment period) proved to be an important ally for engaging students. This reinforces that, with the subtle and incremental changes in the aspects that affect the engagement and motivation that occur over the generations, it is necessary to review the mechanisms, theories, tools, and strategies adopted for these students. Traditional educational standards have shown themselves to be less and less able to maintain the interest and attention of new generations, which may signal a need to be revised.

However, it is noted that there is a need for further investigation to identify the possible root causes of both classes having presented similar behavior and low participation.

8   Future works

In this way, as future works, it is expected that part of the investigation will be related to an interview with the students, to individually investigate the causes of demotivation, trying to make the students feel part of the process and can contribute to the improvement of the proposed method, thus making the process more humanized. We can relate this part of the investigation to the use of Design Thinking, thought from the perspective of seeking answers effectively aligned with the existing problem and with the perspective of the people who experience it. Furthermore, an aspect to be considered as a limitation of this work is the small number of students in the gamified and control classes. In future work, we hope to investigate the possible root causes of low participation in this course format. In this sense, we identified a possible source of relevant information for this analysis: The Introduction to IoT course, used in this work as an element to have the gamification strategy applied, is a course widely offered by hundreds of partner academies of the Cisco Networking

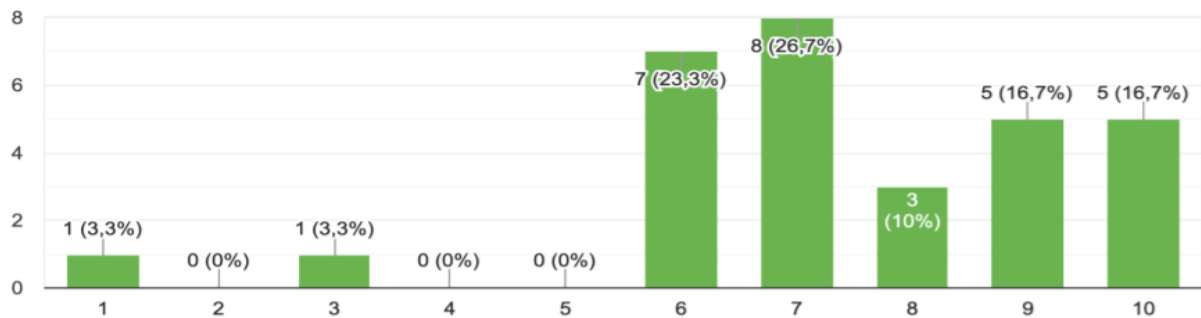## What is your level of knowledge in Information Technology?
30 respostas

Figure 5. Graph on the participants' degree of knowledge in Information Technology.

Academy program in Brazil and worldwide. During the application of the course, it is mandatory to complete a form to collect feedback data about the course. So, we hope to propose this analysis of statistical data with the Cisco Netacademy program in order to draw a panorama with a more significant volume of data and thus better understand the aspects that involved the evasion and successful completion of the course. We also hope to incorporate the improvements identified during the development of this work in the gamification strategy and apply the strategy in larger classes and with the intervention taking place from the first interaction of the teacher with the students. We also hope to develop and apply an experience-based scoring mechanism and we hope to share the lessons learned in the execution of these classes as a set of good practices to be adopted by interested teachers and evaluate this.

In this research, actions associated with each of the Framework Octalysis motivational activators were presented. These actions were implemented through the proposed gamification strategy. However, the only motivational activator to which there was no associated action was Ownership and Possession, due to limited time for protocol development. Thus, based on the Octalysis Framework, it is also suggested as a future work the development of an action associated with this activator. In this sense, a possible action to be taken would be that the development of the figure of the student/monitor. In this way, students who have presented better performance, participation and motivation in the continuous and partial assessments of the gamified class, have the possibility of changing their status to act as class monitors/teacher's assistants. Thus, it is expected that the student/monitor can develop a sense of belonging to being an influencer of the Ownership and Possession motivational activator. It is suggested that, based on the proposed gamification strategy, further research can identify more actions associated with each of the motivational activators and be evaluated, generating extensions of the Gamification Strategy. So, the strategy can evolve more and more, as it is applied to new classes and the feedback collected. Furthemore, we will evaluate the application of the strategy in regular/mandatory classes to allow a comparison with the application in non-mandatory classes, carried out in this work. In a complementary manner, aiming to compare the level of motivation of the gamified class with the control class and with the gamified class itself at the beginning of the course, the intervention in the gamified class was carried out one week after its beginning. A hypothesis that can be treated from this is that the application of gamification strategies from the beginning of the course could improve the students' sense of belonging. Thus, it will be expected to verify this hypothesis. Finally, we hope to compare aspects of gamification in short and long-term courses.

Declarations

9   Acknowledgements

10   Notes

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