

# Gamification Patterns: A Catalog to Enhance the Learning Motivation

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**Abstract**— Currently, the gamification has been a tool used in many contexts, in order to improve the user experiences, playability, among others. However, it just not has been focused in entertainment, but also this knowledge area has been applied from other perspectives like health, tourism and education. In fact, the traditional teaching methodology does not generate enough motivation in students to approach their learning and training objectives, that is why in this work we provide a patterns catalog of gamification that increase student motivation through its implementation in activities both inside and outside of classroom with the support of mobile devices and game applications. Besides, we show the outcomes of an experiment done with different student groups in an education institution in Colombia to evaluate its impact on the student motivation.

**Keywords**—*Gamification Patterns; Mobile devices; Game; Education; Mobile applications*

## I. INTRODUCTION

The education context in Colombia can be comprised of the teaching-learning process; there is a little bit of effort to improve the education quality. It is the cause of decreasing of motivation in student [1]. According to a strategic objective of “Decenal” plain of education [2], the inclusion of training in Sciences, Technology, Innovation, and use of Information and Communication Technologies (ICT) is fundamental for education activities enhancement in Colombia. However, it has been implemented in others countries of Latin-American without present significant results [3].

In the educational environment, there are research’s focused on discovering the impact of technological skills on the use of ICT with the aim of increasing the motivation for students. The Colombian government through the ministry of national education (MEN) have been promoting the use of ICT tools – MEN give to schools 74266 electronics tablets – to improve the educational quality. It allows to schools support the processes of production, innovation, and creativity in students. [4]; Many teachers are afraid of devices because they do not know how it works. They think that devices do not help their classes, on the contrary, they want to teach with traditional methods like they learned many years ago. Several teachers confess their fear of using new technologies because their students know more about those than they [5].

For this, it could be that for many students the school is boring. However, several others teachers think different, and they consider the technology advances like an opportunity to do the educational process easier. Usually, they are looking for new methods to enhance the motivation of their students in the classroom. Thus other problems like compliance with commitments can be solved too [6].

It gives rise to changing in traditional teaching process in a methodological perspective. Besides, the student's attitude also changes with the evolution of educational dynamics provided by ITC implementation. These changes are transcendental that

affect the educational environment, from the institutional management models until pedagogical activities and evaluation systems regarding both teachers and students [7][4].

Technology gives students the option of accessing information both inside and outside of educational institutions. But, in these schools, the teachers lead the use of technological devices, and they have to center the attention of students in their classes. Even though, social networks, chat applications, and others products always are a distraction focus. These restrictions over the use of mobiles devices and social networks decrease the motivation and interest of the student in the class, it generates problems of conduct in students and affecting the educational performance directly. A lot of research's present as a conclusion the importance of increase the motivation in students because without motivation there is not learning [8]. Specifically, in Colombia is necessary to improve the skills in students to strengthen their knowledge. Thus the educational system is also improved [7].

In the processes of learning, games and their elements are a fundamental part to achieve a significant increase in motivation, individual participation, social involvement and learning outcomes in different areas and contexts [9]. Taking into account the benefits of games in the learning process, teachers could use game elements to incorporate it into their classes or non-game areas; it is defined like gamification [10]. This strategy consists of creating playful activities that are attractive to people, these events naturally are not engaging, but with gamification elements, it can become. It is demonstrated is some researches like [11].

In this line, gamification has been a tool to improve the motivation in people through game elements; it allows to get fun from a regular activity. Besides, gamification aims to a change in education process achieving that people learn easier of a playful and fun way [12].

In this paper, we proposed a catalog of gamification patterns to support the aim of gamification. The document sections are structured as follows. Below, in section 2 we present the related works in each research field. Next, section 3 shows the execution of the experiment. In section 4 the analysis of results is shown. Finally, in section 4 are present the conclusions and future work.

## II. RELATED WORKS

There are a lot of examples of the application of gamification in different fields, following we present an analysis of their features and how they work.

In [13] was created an e-learning platform based on some elements of gamification. They created a gamified experience in a university through that platform. It consisted on create optional questions designed to improve the student skills to do the final exams – that originally were available in PDF files –; It was possible through the development of a plugin with gamified mechanics like rewards and competition in additional tasks. The impact of that platform was checked through surveys



and tests in itself. Thus, researchers could measure the motivation expressed by the students with the new way to study.

Also, in [14] researchers identified some patterns of gamification that allow to enterprises of e-commerce comprise the which process they could to enhance. This kind of gamification is focused on user experience in the e-commerce platform through a playful searcher giving an additional worth to users. Patterns were implemented on a web site for its evaluation. From that moment, the sales have been increasing day by day until 70% according to the old platform.

Researchers in [15] present a gamified solution to the problem found in a video game development team. Through these patterns, the developers can share knowledge about architecture model, to learn a new design model, overcome difficulties, among other situations presents in a development video-game team. Even though, this problem arises when new members are integrated into a team, the patterns are focused on them.

Seven different systems have been evaluated in [16], in that project was proposed a semi-formal description of rules games in gamification related with business information. The analyzed applications had common attributes: user-centered design, user experience interaction, game rules, classification score, among others. They described the patterns in three points of view: 1. How does the pattern work? 2. Situations where the pattern could be used. 3. Consequences of using the pattern.

Therefore, another research [17] shows a gamification spectrum frame, it was developed and patented to organize the existent tools associated to gamification. Main patterns in this frame are used patterns like scores, positions table, and insignias. Employing these patterns were identified two important properties about gamification tools: sustainability and scalability. In each activity of the company is necessary to identify the objective (one of the two properties). Thus, the patterns are selected.

Finally, even though there are many others, we present a set of educational and innovator strategies [18] that arise from an educational context: Game-Based Learning (GBL) and the gamification of teaching-learning processes taking advantage of mechanisms of video games. These strategies aim to implement video games elements into a teaching-learning activity to encourage participation of students. GBL consists in the use of video games to improve the educational process. In this case, the gamification could be a good way to enhance the motivation through activities that encourage to students to take decisions, establish goals and to define how to achieve them.

To sum up, the research mentioned above are a sample of application fields of gamification, and how its patterns can be used for different purposes. That is why we want to give a proposal of patterns catalog. The main difference between our research and others is that those projects are incorporating gamification elements in existents tools to improve their processes. But, we present a classification of patterns to apply them in the educational process to increase the motivation of students, and thus they have better results in their school grades.

Besides, as will become apparent later, we group patterns according to mechanics, dynamics, and game elements to contribute to the motivation in students.

### III. EXPERIMENT

#### A. Diagnostic Survey

At the beginning of our research was necessary to identify the initial state of students about the motivation to learn with traditional methods. For that reason, we designed a survey that allowed us to know some information about them. Among that data are: interests about mobile devices applications, difficulty with subjects, among others. To achieve this objective were used phases of the collection data and evaluation of results, these stages were adapted from [19] to our needs.

The survey was composed of ten questions; the first two question were associated to how much time the students spend playing on their mobile devices? And, what do they like to play? The next three questions allow us to know about most used applications for students. The following question was related to the reason why do they feel engaging in a game? Continuing, three questions mores were asked about willingness to learn supported by technological methods and mobile devices. Finally, the last question was related to the subjects with most difficulty for each student from a motivational perspective.

This survey was carried out in the Colombian school "Educational Institution Cesar Negret Velasco" located in Popayán. The age range of asked students was between 10 and 15 years old. The diagnostic give us results to have a base for comparison with final results. Also, these results supported the selection and categorization of gamification patterns that finally we presented in the catalog.

For example, in figure 1, we present the main elements that a game should have fundamentally for a good engagement according to student's opinion. The results show that challenges were the most popular element, followed by gain experience and awards.

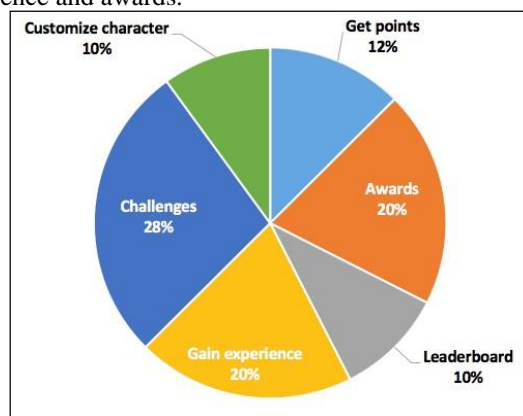


Fig. 1. Game elements that give motivation to students to keep playing - Men.

The results that are shown in figure 1 corresponding to answers provided by students of the masculine genre. Whereas the answer given by women students were different. It is very

important because the pleasures and way to think are different in each genre. Although in this case the most popular element was the same (challenges), in women case, the second place was the possibility to customize the characters.

Regarding subjects and the difficulties that students have in each one, we present the Table I. There are three subjects in the top of percentages, History 39%, English language 22%, and Mathematics 17%. Apparently, the students had not problems with others subject like geometry, chemistry, and statistics. And just 2% had no problem with none subject.

TABLE I. PERCENTAGE OF DIFFICULTY BY SUBJECT

Subject	Percentage
Spanish Language	6%
History	39%
Statistics	8%
English language	22%
Mathematics	17%
Chemistry	3%
Geography	3%
None	2%

### B. Generating the patterns catalog

To select the gamification patterns, first, we searched situations and common features in existents gamification processes such as [20],[21],[14],[16],[22],[23]. Next, with these features identified, and based on them, we choose the groups to classify the patterns. In Table II are presented a summary (4) of total gamification patterns in the study (41). Each pattern in the table has and identifier, name, description, and applicability field.

TABLE II. PERCENTAGE OF DIFFICULTY BY SUBJECT

N°	Name	Description	Applicability
1	Training / Tutorials	It helps to people to know the tools through guidelines.	It can be applied in a context where the user does not know how the system works. In this way is not necessary to have user manuals.
2	Signaling	It consists in to indicate the next actions that a user have to do. Thus the process is done quickly.	It is used in an unknown context, where the user does not know where to go.
3	Progress	It is a feedback that the application shows to the user in real time. The user can see him/her advances constantly.	Progress is useful when the user wants to know him/her state of the tool, and how much is missing to get the goal.
4	Topic	Give a topic to gamification and being sure that users can understand it.	It is useful when the user wants to give a custom appearance to the graphic interface of the application.

Later, we analyzed the table II, we considered several features of these patterns, and we applied some filters to them. After conducting a comprehensive and depth study for each pattern in different papers and specialized websites, we define that some patterns are similar – Not to say the same – in description and applicability. Whereas others patterns are not focused in our research field (educational), for that reason, we delete them from the list. Finally, 26 patterns were selected to be part of our catalog. They can see in Table III.

TABLE III. PERCENTAGE OF DIFFICULTY BY SUBJECT

N°	Pattern name	N°	Pattern Name
1	Training / Tutorials	14	Challenges
2	Signaling	15	Learning / New kills
3	Aversion to loss	16	Mission
4	Topic	17	Levels / Progress
5	Narrative	18	Collecting
6	Against time	19	Sharing gifts
7	Shortage	20	Rewards
8	Social network	21	Scores
9	Social status	22	Virtual economy
10	Competition	23	Social feedback
11	Exploration	24	Share achievements
12	Creativity tools	25	Advanced user roles
13	Customization	26	Gain points

Subsequently, we searched and chose some applications that had incorporated several patterns of the catalog. We decide just take applications that run on Android based on [24]. We applied filters to found applications, and finally, we choose five of them. See Table IV.

TABLE IV. APPLICATIONS THAT MEET WITH CATALOG PATTERNS

N°	Name	Topic	Patterns
1	Cálculo Mental	Education / Mathematics	22, 17, 6, 20, 21, 1.
2	Piano Tiles 2	Arcade game	17, 26, 20, 19, 14, 1, 3, 7, 18, 24.
3	DuoLingo	Learning	1, 3, 9, 13, 14, 1, 15, 17, 20, 22, 23, 26.
4	Geometry Dash World	Adventures	1, 16, 20, 19, 24, 2, 13, 22, 3.
5	Trivial Historia	Education	6, 10, 14, 17, 20, 21

Also, we choose others applications with the same application field, but these applications had not incorporated gamification patterns.

*Comscore* [25] and *Kantar Ibope* have shown the results of research about technology consumption habits in 2016 in Colombia. Relevant data support our research when they affirm that youngsters access to the internet between five and ten hours per day. Also, 66.8% of them do it through a smartphone.

### C. Experiment execution 1)

#### Guideline and survey

A guideline was allowed to do the experiment. A new survey was done while the experiment was running – first part, during the experiment, the other part at final of experimental process – This survey had 12 questions related with initial motivation level, individual and collective work, and students interest in a specific group of subjects. Each question had to be answered at a certain point in the experiment.

In order to have a point of comparison additional according to initial diagnostic, we select two different groups, the first one named analysis group, and second one control group.

#### 2) Pre-experimental phase

Taking into account what was proposed in [26], we propound a pre-experimental phase to identify the current motivation to learn in students of both groups (analysis and control). This getting information was defined as moment one.



Fig. 2. Analysis (left) and control (right) groups answering the survey.

Both groups were formed by ten students between sixth grade and eighth grade. The students were evenly distributed according to their grade, age, and academic performance to obtain more reliable results – in this process was fundamental the teacher and his knowledge about students –. Each student answered the survey individually to avoid the collective influence. The process can be detailed in figure 2.

#### 3) Experimental phase

The primary objective of this phase was to know the motivation level of students while they used mobile devices and selected applications (see Table IV) for different areas. As it is shown below, we worked with each group separately.

First, we gave to analysis group a set of tablets with gamified applications installed. They interacted with devices about 60 minutes under the guidance of us. During this time, in minute 20 and 40, we ask them some questions of the survey defined in the point 1. These answers gave us a comparison point with initial diagnostic.

The process defined above was repeated with the control group. This activity gave us information for moments two and three. In figure 3 are shown the groups interacting with mobile devices.



Fig. 3. Analysis (left) and control (right) groups interacting with mobile devices and applications.

#### 4) Post-experimental phase

Aiming to obtain more reliable data, immediately, when the activities finished, we applied the last survey to measure the motivation for each group. At this instant, we had the moment four with recent information.

As of this data, we did an analysis comparing the different moments, and results are presented in next section.

## IV. ANALYSIS OF RESULTS

During experimental phases, we got information about motivation in both student groups. Analyzing this information, we found interesting results that are presented below.

First, we want to present the initial diagnostic data, in Table V are exposed percentages according to each level for each aspect asked in the initial survey. There are conclusions like a lower interest in autonomous and collective work by own initiative. It was directly related to activities and distraction in the classroom.

TABLE V. RESULTS OF INITIAL DIAGNOSTIC

Aspects	Levels				
	1	2	3	4	5
Autonomous work	3%	22%	53%	7%	15%
Collective work	3%	23%	43%	17%	13%
Classroom activities	2%	22%	50%	20%	7%
Distraction in classroom	35%	45%	12%	5%	3%

On the other hand, during the experimental process where students in both groups were interested in a learning process through mobile devices and their applications. In figure 4 are presented results about exciting level of students according to learning activities supported by mobile applications. Most students were captivated in top levels to try with this proposal. Close 83% were a real interest.

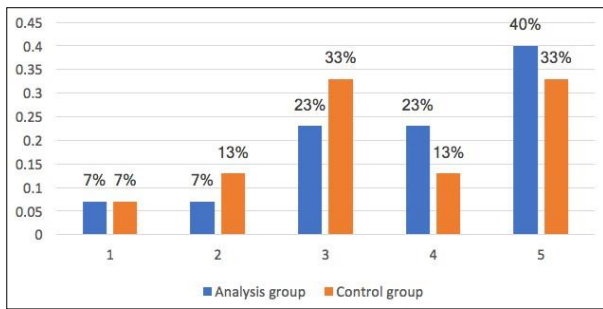


Fig. 4. The interest level of learning through mobile applications in both groups.

Related with applications, students considered that applications with gamification patterns were more attractive than others applications without those patterns. Even though analysis group had funny and educational applications, the difference between their acceptance level was short (figure 5). Conversely, in control group, the difference was a lot (figure 6).

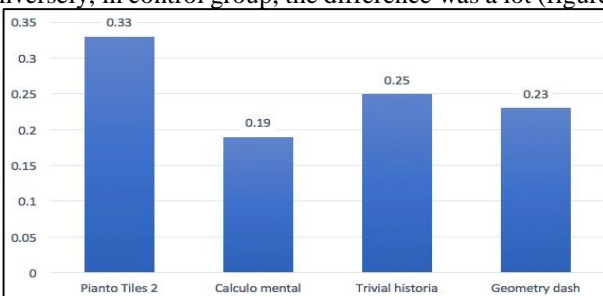


Fig. 5. The interest level of learning through mobile applications in analysis group.

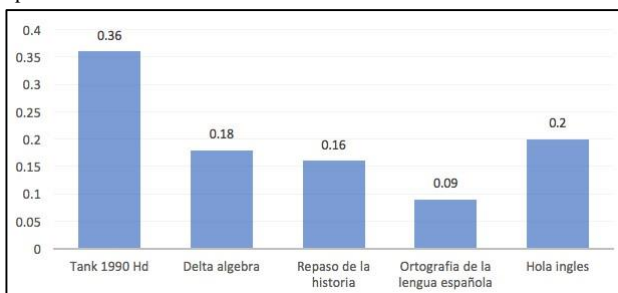


Fig. 6. The interest level of learning through mobile applications in control group.

In post-experimental phase, the most important result was obtained. With the question asked at that moment, we defined how much had enhance the student's motivation in learning process using mobile applications with gamification patterns of our catalog.

First, the analysis group had an important impact. They answered positively (80% considered that they had enhanced in motivation). On the other hand, control group presented increasing just 43%; these numbers are 37 points apart. For us, it was the most important point of the experimental process.

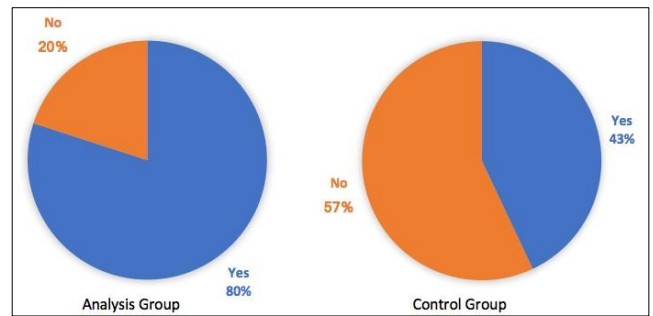


Fig. 7. Answers of both groups to question: Do you considered that this activity enhanced your motivation for learning?

The result above shown gave rise to ask students about the areas that they believed had greater impact through using mobile applications. Both groups agreed to choose the concentration as the central aspect. Complete results can see in figure 8.

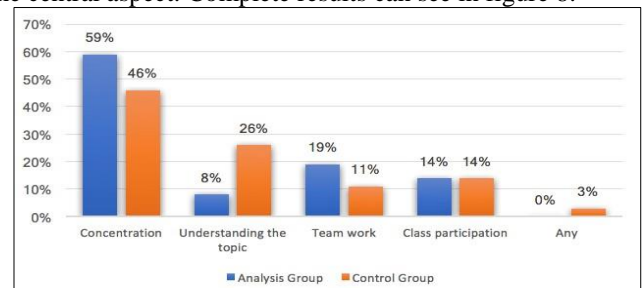


Fig. 8. Answers of both groups to question: Do you considered that this activity increased your motivation for learning?

Finally, we wanted to know the motivation level of students to attend classes related to activity topics, but this time without mobile devices. Results are expressed below in figure 9. It is evident that students of analysis group are more motivated than the control group, and our hypothesis is confirmed.

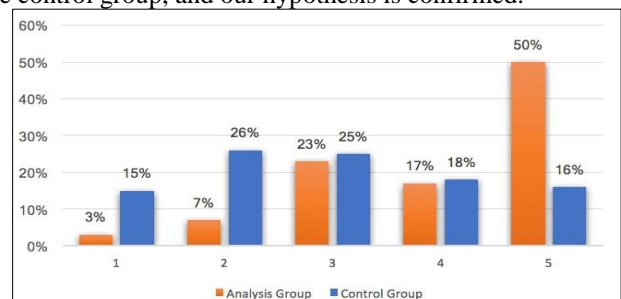


Fig. 9. Interest level to learn a topic in the classroom with traditional methods later of use mobile applications with gamification patterns.

## V. CONCLUSION AND FUTURE WORK

We presented a catalog of gamification patterns that could be incorporated in mobile applications aiming to increase the student motivation in a learning context. Moreover, we had an experiment with students of a Colombian school. It to validate our proposal of the catalog. We present the results of the experiment, which was successful and allowed us to validate our hypothesis.

Using mobile applications that incorporate gamification patterns exposed in our catalog is possible to generate in

students an increasing on learning motivation. Although, later in the class, they have not mobile devices with this kind of applications.

Catalog of gamification patterns gives to applications an additional worth over other applications without these patterns. Even though, it is evident that students of the control group also have an increase in their motivations, but, it was lower than rising in analysis group.

The initial diagnostic concluded that the most complicated subjects were History, English, and Mathematics. During experimental activities, surprisingly, in analysis group, the most used application was associated with History. Whereas, in control group, the application related with History subject did not have acceptance by the students. Based on that, we can conclude that is possible to increase the motivation for students when they use applications that include some elements exposed in the catalog of gamification patterns.

Furthermore, it was important the acceptance of students to use mobile devices. They demonstrated a height level of adaptation to these devices. It was an important point while the experimental process was developed.

As future work, we pretend to do an experiment with students of universities. it will be possible through appropriate applications for each area. Also, it is implemented this catalog inside the conceptual models ChildProgramming and YoungProgramming, which pose collaborative work through agile methodologies and cognitive practices.

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