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Integration of Gamification to Assist Literacy in Children with Special Educational Needs

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Abstract— Nowadays, the use of mobile applications is gaining popularity among people, spreading to different areas. Specifically, the use of mobile applications has boomed in the field of education, with the increasing variety of applications in the application stores (PlayStore, AppStore, etc) that address specific problems of stories becoming increasingly common in the market like: problems of reading, writing, mathematics and other topics.

On the other hand, the special education is an area of attention to children with special educational needs such as attention deficit, intellectual disability, speech problems, among other problems. Specifically, children who have problems in literacy with special educational need, face a challenge during their learning process of reading and writing. Because of this, special education has begun to incorporate the use of technology through the use of mobile applications in the classroom. In this context, we believe that teaching strategies can be adapted to the development of competences, both specific and transversal, in special education students, while at the same time they can increase students motivation during their learning process. These elements are known as gamification techniques. There is a series of gamification techniques that can be incorporated into the learning process in children with special educational needs.

The present work exposes the gamification techniques incorporated in a playful way in mobile applications, as well as a methodological proposal for the integration of these techniques in special education environments, making a case study in conjunction with teachers and special education children. First section of the article consists of a brief introduction to the reader on the subject of the gamification techniques, in which they are found and some examples of gamification techniques used. Section II exposes the problem that can be solved in this work, section III presents the methodology used for the preparation of this work, describing each of the stages by which it is composed. Section IV presents the case study that was conducted in conjunction with special education children and finally section V discusses the results and conclusions that were obtained from the work done.

Keywords— gamification techniques, ludic interactive applications, reading competence, special education, writing competency.

I. INTRODUCTION

Gamification is a learning technique that moves the mechanics of games to the field of education in order to achieve better results. The technique consists of systematizing a procedure,

guiding students in the acquisition of knowledge through new ways that can provide them with more meaningful learning. Specifically, create learning situations that allow them to obtain certain skills and knowledge, based on the idea of applying concepts and dynamics of game design that stimulate and make more attractive the student's interaction with the learning process [1].

The gamification is based on the way in which human beings learn. According to studies carried out, it is demonstrated that with the use of verbal stimulation a 10% recall rate is obtained after 72 hours. However, if we use images, the recall rate at 72 hours is 90% (figure 1). Therefore, one of the most commonly used techniques is to perform activities through the game to achieve greater retention of knowledge. The game is a compendium of behaviors that, both, in the human being and in any young mammal, prepare them and mold the necessary skills for many of the vital activities that are carried out throughout life[2].

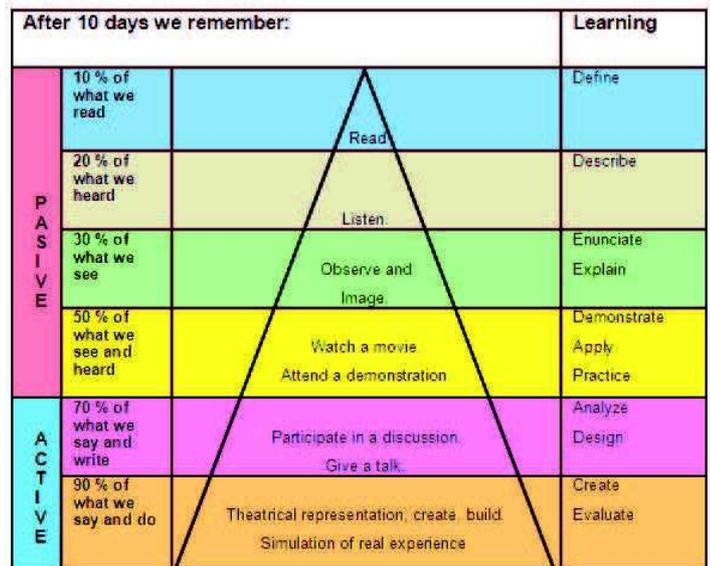


Fig. 1. Edgar Dale's learning pyramid.

Figure 1 shows the learning pyramid proposed by Edgar Dale in which exposes each one of the actions (reading, writing, defining, etc) incorporated in the different types of learning, and their corresponding recall rate after 10 days. This shows that using representations or simulations stimulates the child to acquire knowledge in a better way than if we use only read or listen.

This learning technique gains ground in training methodologies due to its playful nature, facilitating the internalization of knowledge in a more fun way, generating in the child a positive learning experience. The gamification techniques in a game are a series of rules that try to generate games that can be enjoyed, that generate a certain addiction and commitment on the part of the users, by giving them challenges and a path through which to travel, either in a video game, or in any type of application [3]. While, there are many gamification techniques in video games, here we will only describe the most important:

Collection: Possibility of giving the player the ability to collect objects as it is staggered in the progress of the game. This element serves as a motivator for the child to continue carrying out the activities.

Points: Feedback that the game provides the user instantaneously for the performance of a certain activity. This element offers many advantages: it gives the user freedom to use the points earned for other elements; how to unlock levels, serves as a motivator in the game, allows to build rankings and comparisons and offers the child a clearer picture of the current state in which it is.

Classifiers: Element that promotes competitiveness in children when making comparisons; shown as a list, showing the users with the highest score in certain activities. This element is an incentive since it motivates the student to want to improve his score.

Feedback: Technique that allows the student to know if the activities performed or not met the objectives expected by the video game. Feedback, is very important because it is the element that allows the child to generate knowledge.

Levels: Technique that allows managing the progress of the child in the game, usually by modules; that the student must overcome to advance to the next level.

Challenges: A crucial element in video games, which has an important psychological burden on children and whose main purpose is to influence student behavior.

The social component is also important, since it allows the student to collaborate and compare achievements [4].

II. PROBLEM OUTLINE

The gamification techniques have been increasingly spread in areas as diverse as: marketing, human resources, training senior managers, among other things. In the field of education, it has also been incorporated using games to improve the learning process of children [5].

As a first problem, in special education the use of these techniques is barely beginning to be incorporated, making use of playful applications. Special education, is an instance of

regular education that is the responsible for providing care to students with special educational needs, with or without disabilities. Teachers, are responsible for providing guidance to teachers and parents, in addition to covering educational needs presented by each of the children [6].

The educational needs vary depending on two factors: learning problems or type of disability; presented by the child.

According to the National Institute of Neurological Disorders and Stroke, a learning problem is a disorder that affects the ability to understand, or use spoken or written language, perform mathematical operations, coordinate movements or direct attention [7]. On the other hand, disability is a general term that covers deficiencies, limitations of activity and restrictions on participation in a person. The deficiencies; are problems that affect a body structure or function; the limitations of the activity; are difficulties to execute actions or tasks, and the restrictions of the participation; are problems to participate in vital situations [8]. To deal with this problem, we propose the incorporation of gamification techniques, using playful applications that incorporate these techniques in their games.

As a second problem, we have that special education teachers do not have adequate training for the handling of mobile applications in the classroom, this represents a drawback, since, although teachers have a wide range of interactive applications that make use of Gamification techniques, can't get the most out of them if they're not trained to use them. The proposed methodology presents a process of adoption of interactive applications that incorporate gamification techniques within their game didactics, so, both teachers and students benefit from the use of these.

In this way it can be said that the problem basically focuses on:

- Lack of knowledge on the part of teachers of interactive applications that incorporate gamification techniques in their game dynamics.
- Special education teachers do not use interactive applications as support in the teaching-learning process.
- Lack of a clear methodology, that describes the process of acquisition of interactive applications that incorporate gamification techniques; both for teachers and for students.

III. METHODOLOGY

The methodology proposed to incorporate the gamification techniques is shown in figure 2. In this methodology, the process of integrating gamification techniques from a software engineering point of view is considered, in which the teaching-learning process is posed as a process. [9] Within this methodology, diverse actors interact such as: technologists, pedagogues, teachers and special education students.

The methodology is composed of several steps:

- A. Selection of a pilot group: In this step, the children are identified with whom they will be working throughout the process, the selected children can be classified according to the educational needs they have or according to a specific disability.
- B. Identification and proposal of educational applications by technologists: In this phase, technological educational applications that incorporate gamification techniques in their game dynamics are identified. It is based on the needs of the pilot group; defined in the previous step, a search is made of applications that address these problems, and that incorporate within their game dynamics some of the gamification techniques mentioned in previous sections (collection, points, levels, etc). A catalog of these applications is prepared, classifying them according to the needs towards which they are oriented, the disability they attend and the knowledge that the student is expected to acquire once the process is finished.

During this stage the child is guided by the technologist and the teacher always.

- E. Evaluation of usability and user experience: In this stage, two parameters are measured: the quality of the experience; obtained by the teachers and by the students when interacting with the mobile application, that is, if the evaluated application was intuitive, easy to use, comfortable, etc. And the second parameter, the user experience, that is; if the application covered the expected learning objectives; if the interaction was good, etc.
- F. Results and search for continuous improvement: The results obtained from the surveys are identified to search where it can be improved or if the applications evaluated are those expected by the users.
- G. Teacher training: This step interacts in conjunction with steps two, three, four and five since the teacher must receive training in each of these phases so that in the future he can make use of interactive applications, look for applications in the stores (PlayStore, AppStore, etc). In this phase, another specific process is included to train teachers, figure 3, shows this method.

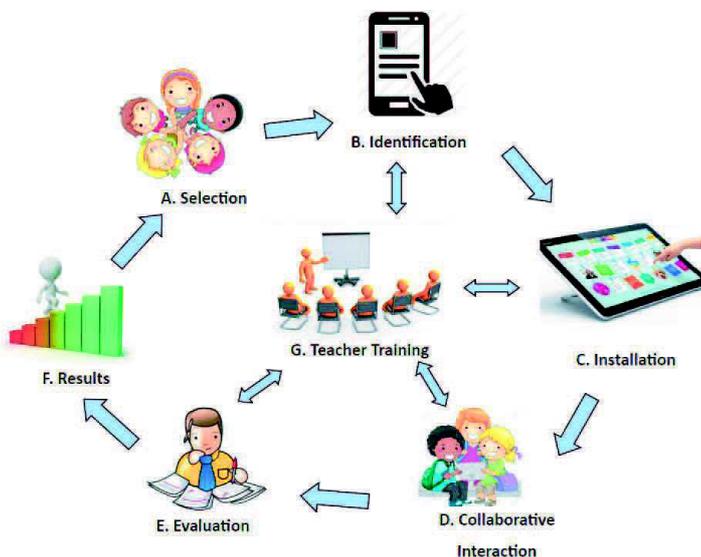


Fig. 2. Methodology considering gamification techniques.

- C. Installation of applications in mobile devices: Here, takes place the installation of the applications that complied with the incorporation of gamification techniques, in their game dynamics, and that have been approved by the teachers and pedagogues that cover the didactic objectives is carried out.
- D. Collaborative interaction with mobile applications: This stage is of utmost importance in the proposed methodology. In this stage we work together with the teachers and students of special education, the technologist presents the child with the applications selected in step two, so that, the child makes use of them and see how the child's response using them.



Fig. 3. Steps for training educational teachers.

The method is composed by 3 steps. The first step, is to establish the objectives of the training; here are defined the goals that should be reached once the training is completed, the number of sessions needed to achieve these objectives, the number of people who will attend, the educational needs or disability towards which the training will be oriented. The step two, includes: preparing the necessary support material to carry out the training; in this phase they include the use of presentations, electronic resources, human resources, didactic material. It also includes the preparation of the content of the training based on the objectives established in the previous

phase. Finally, we have the training realization phase in which the materials selected in the previous phase are exposed and we intend to achieve the training objectives defined at the beginning of the process. During this phase, there is an exchange between the trainers and the special education teachers, performing a feedback process to improve the learning experience on the use of interactive applications, towards special education teachers.

IV. CASE OF STUDY

In this stage, the case study that was carried out to integrate the gamification techniques in special education. The case study is divided into different phases. Phase 1 describes in detail the design of the case study; It exposes the context, the purpose, the reflection questions that help consolidate the case study, and a brief context, also describes the place where the case study was carried out. Phase 2 includes the compilation of the information necessary to carry out the case study, the video games used for the case and the information pertinent to the case study in general. Phase 3 corresponds to the classification of the information, in this phase it is explained under what criteria the information collected in the previous step is categorized. Finally, phase 4 describes in detail the results for the case study, as well as the experiences collected.

A. Phase 1: Design the case of Study

1) Background

The case study proposed here takes place in the USAER program (Support Unit for Regular Education) of the state of Aguascalientes. The USAER unit, is an initiative, specifically focused on giving attention to special education. Special education, is defined as education designed for students with special educational needs due to intellectual giftedness, mental, physical or sensory disabilities [10]. This unit, operates technically-operatively and administratively giving support and attention to students with special educational needs with or without disabilities. USAER units are integrated into basic education schools, provide guidance to regular education teaching staff and parents. These services promote links with schools, supporting the elimination of barriers that impede students' participation and learning, based on flexible management and organization work and guidance for teachers, the family and the community in general.

This case of was possible thanks to the existing agreement between the Autonomous University of Aguascalientes (UAA) and the USAER, in this agreement it was agreed to carry out a training to teachers of special education, by researchers of the UAA, with the purpose of training USAER teachers to handle mobile applications as a means of support in the teaching-learning process, in addition to exposing the gamification techniques that are incorporated in interactive applications.

2) Purpose

The case study is multipurpose, since it is intended:

- The case study is focused on reading and writing problems.
- Train the members of USAER in the management of interactive applications that incorporate gamification techniques in the state of Aguascalientes.
- Resolve doubts that special education teachers have regarding the topics of: handling of tablets in classrooms, gamification techniques, management of educational applications and other doubts regarding technology.
- Identify educational mobile applications that are useful as support in the teaching-learning process in special education children and that meet the didactic objectives established by the education system.
- Present to the teachers a catalog of applications, classified according to several criteria that incorporate gamification techniques in their game methods.
- Carry out an exchange of information between USAER teachers and UAA researchers, so that both parties can benefit from each other's knowledge.

3) Reflection questions

A series of questions to answer was established, based on the experience obtained from the case of study.

What are the main obstacles that USAER teachers present when they want to incorporate the use of technology in the classroom?

How does USAER teachers benefit from the use of interactive applications that incorporate gamification techniques to assist the student's teaching-learning process?

How does the use of interactive applications that incorporate gamification techniques for special education children benefit?

4) Unit to analyze

The unit to be analyzed during the case study will be the USAER number 23 of the state of Aguascalientes.

5) Methods and instruments for gathering information

Qualitative methods were used during the case study to understand the different perspectives that USAER teachers have regarding technology, such as: interviews and surveys. Observation, will also be used to detect behaviors of interest in students and special education teachers, during training and collaborative interaction.

Likewise, to propose the catalog of applications, reference will be made to the topics that should be covered according to the specified needs and based on the gamification techniques exposed in previous modules.

To carry out the training, the necessary material was prepared, such as the classroom, computers, tablets, preparing the support material, planning the training, etc.

B. Phase 2: Information gathering

The information collected to carry out the case study was as follows:

- Profile of children who participated in the case study.
- Gamification techniques
- Main concerns regarding the use of technology and the management of mobile applications.
- Consultation of pertinent bibliography that could be of help to the team of researchers when implementing the training.
- Necessary skills to be covered depending on the level of reading (presyllabic, syllabic, syllabic-literate, literate).
- Information obtained from conducting sessions together with children and special education teachers.
- Preparation of surveys on usability and user experience in order to register how well the applications presented during the training had been received.

C. Phase 3: Analysis of the information

In this phase, the information collected in the previous section was categorized. The information on the children's profile was synthesized. The cataloged of applications that gave support to the teaching-learning process was categorized by the gamification techniques incorporated in each of these. The catalog was made considering the following classifications:

- Reading level (presyllabic, syllabic, syllabic-alphabetic, alphabetic) [11]
- Name of the application
- Icon
- General description
- Expected knowledge, that is, the knowledge that the child is expected to master using the application
- Gamification techniques used in the videogames

D. Phase 4: Development of the case study report

Considerations of the case study: During the development of the case study all children members of the pilot group made use the same applications. The applications used involved gamification techniques in their game methodology, the techniques were:

Collection, use of points, classifiers, feedback, levels and changes. The case of study is presented by listing each of the phases that make up the methodology and explaining what was done in each of the phases.

Phase A. In this phase the students who participated during the entire study case were selected, a total of 10 students was selected. The selected students were children who presented some problems related to literacy that involves reading or writing competence. For each student member of the pilot group, a profile of the student was elaborated that contained data such as: name, age, school grade, disability, learning problem, among others. In addition, a drawing was made that contained the skills of each student on a scale of 1 to 5. This was done to have a comparative result and being able to determine the use of gamification techniques is advantageous for environments of special education.

Phase B. Here, taking based on the information collected in the profiles of the students, who has a search for applications that incorporate gamification techniques in their teaching procedures (collection, points, challenges, classifiers, feedback, levels) and that responds to the educational needs of each of the children in the pilot group. Figure 4 shows an example of interactive applications that incorporate gamification techniques, applications are new from the application store: PlayStore.

From left to right and from top to bottom: 1) Collection gamification technique to allow the child to select an element for having completed a certain score in the video game, 2) Technique of scoring, representation of sweets that the student will obtain 3) Classification gamification technique, shows the user different rankings, 4) Level gamification technique, shows the student each of the levels by which the video game is composed and the percentage that has advanced in total, 5) Technique of feedback gamification, shows the user a message about his answer to the right one or not, 6) Challenge gamification technique, shows the user a certain exercise that he must complete.



Fig. 4. Interactive applications that incorporate gamification techniques in their teaching methods. Source: PlayStore

Phase C. During this phase the installation of the applications that were identified incorporated gamification techniques in their game techniques.

Phase D. The collaborative integration phase, was carried out during different visits to USAER units, in which they participated: the technologist, the teacher and the special education student. During these visits it was possible to observe the behavior of the child, when presenting him and his response to the use of interactive applications. The technologist recorded the observations that occurred during these sessions, as well as the opinion of the special education teacher regarding the interactive application. In general, the response of the children when using these applications was positive, in most of the children, interacting with the mobile application was a fun process in which they also learned reading or writing skills.

Figure 5 shows an example of the sessions that were carried out with special education children, as you can see, the child was presented with a Tablet along with previously installed applications. The technologist mentioned the instructions of what was to be done in the game or what was the objective. The special education teacher, gave support if at any time the child had any difficulty regarding the contents of the lesson or if something was not completely understood.



Fig. 5. Collaborative interaction carried out with USAER

Phase E and F. The evaluation phase of usability and user experience was carried out using usability and user experience questionnaires. The results according to the evaluations of the mobile applications, in our case of study most of the applications that were used received positive comments regarding its interface and ease of navigation and understanding; as well as the fulfillment of learning objectives.

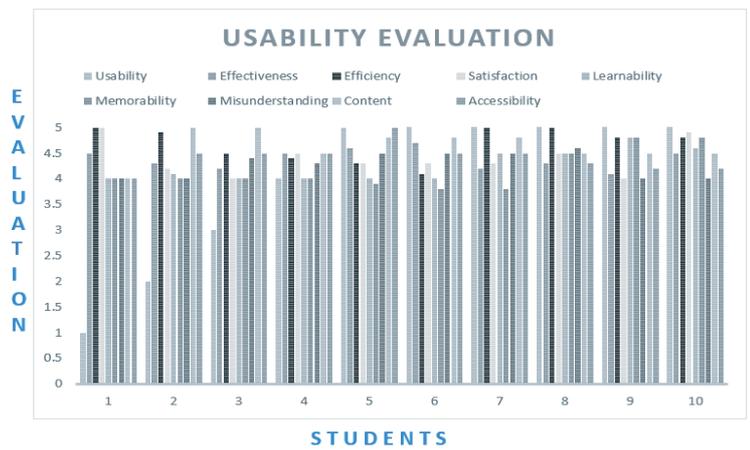


Fig. 6. Usability assessment graph applied to students

Figure 6, shows a graph with the results of the usability evaluation obtained by students' evaluations of mobile applications. The range for the evaluation was from 0 to 5, with 5 being the maximum score and 0 the lowest score.

Phase G. In the training phase for teachers, satisfactory experiences were also obtained, by making teachers accept the use of interactive applications, as a means of supporting the teaching process of special education children. In this case study the teachers were very collaborative, they expressed their doubts about basic notions of the use of tablets and the use of mobile applications. Similarly, at the end of the training the teachers were able to:

- Manage a tablet (turn on, turn off, navigate)
- Search mobile applications that respond to the specific needs of students
- Install applications on the tablet
- Interact with the application appropriately
- Evaluate interactive applications



Fig. 7. Training for USAER teachers.

Figure 7, shows the training that was carried out with special education teachers to incorporate into their teaching processes applications that incorporate gamification techniques.

V. RESULTS AND DISCUSSIONS

The gamification technique in the field of education is very favorable, since it allows to personalize the learning experience, depending on each one of the needs presented by the children. Specifically, in the field of special education it is even more favorable since special education children respond to more specific needs than children in regular education [12].

In this case of study, favorable results were obtained after incorporating applications that made use of gamification techniques in their teaching process. Figure 8, shows the evaluation of four children who participated in the case study. In blue you can see the first evaluation made, before using interactive applications with gamification techniques. In orange, the second evaluation is shown to the same students after having used the interactive applications with gamification techniques. As can be seen, in most of the students there were improvements after making use of gamification techniques.

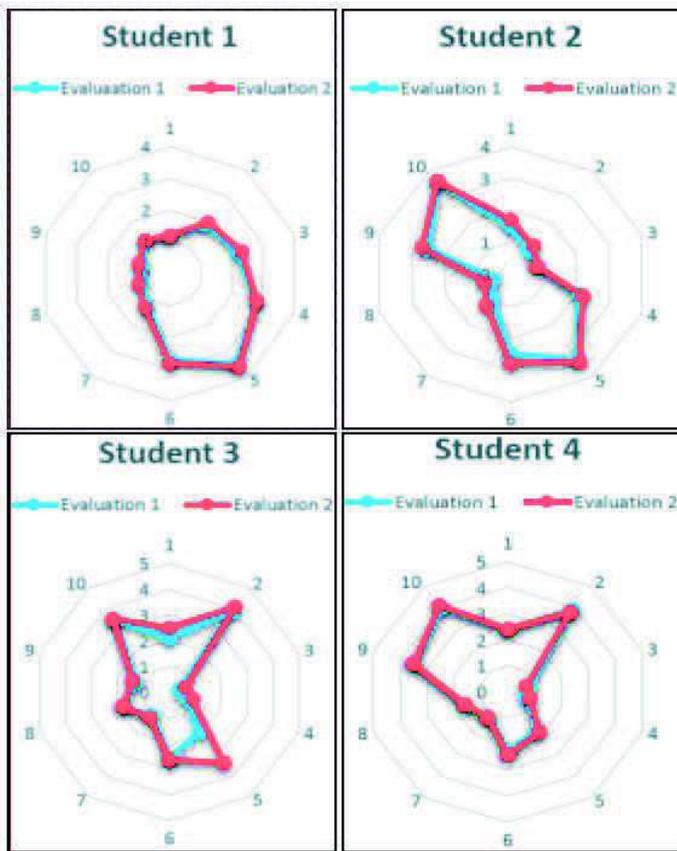


Fig. 8. Evaluation of students during the case study

In Fig. 8, shows the first and second evaluation applied to the students, each evaluation has 10 different items, each item its

evaluate given by a test made by the psychologist and pedagogics. Each item could have a value between 0 and 5, 0 is the less value and 5 the bigger value.

It also allows incorporating different characteristics that can support the teaching-learning process of special education children. During the present case of study, it was observed that the gamification techniques were useful now of incorporating them in the learning process of the children, greater attention was observed by the children towards, the use of applications that contained some elements of gamification, with respect to other applications that did not incorporate the use of these elements.

Also, regarding the teacher, it was easier to select one of these applications based only on the characteristics that each application covered.

VI. CONCLUSIONS

The advantages of using technology in the classroom are already well known, since:

- It is more entertaining and eye-catching than traditional teaching methods
- Help to focus the student's attention
- Development of motor capacity

If we add to this, the incorporation of gamification techniques in interactive applications, a greater benefit is obtained. In special education environments, a positive reception was obtained, both, by the students and by the teachers. In the case of the teachers, they liked the way in which children learn using game techniques; in addition to the fact that the gamification techniques help them when performing the evaluations on whether the expected learning objectives were met or not in each child. Students apart from the advantages of using technology for learning, it was found that it was more attractive for the students to play and without realizing they were learning, also contributed to their social skills, since in many of the games they were asked that they interact with other students in order to achieve an objective.

Regarding the questions that were raised at the beginning of the case study:

What are the main obstacles that USAER teachers present when they want to incorporate the use of technology in the classroom? The main obstacle that has been observed is that teachers do not receive training to be able to use technological means in their teaching methods, also that most of the interactive applications available do not have a manual oriented towards teachers.

Regarding how does USAER teachers benefit from the use of interactive applications that incorporate gamification techniques to assist the student's teaching-learning process? It benefits them because, at first, they have more resources to use when they are teaching their students, in addition to this the

gamification techniques also give them support when reporting the progress the child has had in their learning, for example, through the level gamification technique incorporated in some videogames, the teacher knows exactly in what module of learning the student is and how much is missing to complete the expected objective, that is, they allow follow-up on student learning, identifying aspects in which it can be improved.

About the improvements obtained in the children at the end of the case study, it could be said that the improvement obtained does not depend entirely on the use of the tablets, since, during the elaboration of the case study, the children continued with your normal school activities. The use of the tablets was used to reinforce the knowledge acquired in the classrooms, or the subjects in which the child was noticed had greater difficulty of learning. On the other hand, the collaboration between students is a factor that influences when presenting an improvement, however, it is not a determining factor.

Finally, how does the use of interactive applications that incorporate gamification techniques for special education children benefit? It benefits in many ways since, according to authors, gamification encourages competition and offers a status by offering recognition to the student for carrying out activities or completing levels, it stimulates the social connection since by using this element in a competitive game the segregation of endorphins in students. When endorphins are released they make the student have better retention of knowledge, so it will be easier to remember what was seen in class. Increase the degree of difficulty progressively; By marking objectives based on the user's experience, it is possible for the student to acquire knowledge assimilation as he advances in the videogame. The different levels of difficulty that games can contain help students to develop skills and competences to progress gradually, finally, gamification offers a constant motivation for the student since each technique motivates in one way or another that the student continues to excel in the video game by incorporating knowledge [13-15].

The gamification and the application of videogames in the classroom does not imply the substitution of activities that can be done under traditional situations, but rather implies motivating the student correctly so that he can improve in learning by interacting with knowledge and participating in the elaboration of knowledge.

There are still many challenges to be faced when it comes to special education, however, the use of gamification techniques is beneficial for both teachers and students. The present work exposed experiences collected to incorporate the gamification techniques in special education environments in particular to improve reading and writing skills in special education children. As future work is intended to get these techniques to other areas such as mathematics, following the same methodology used in this case study.

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