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PAPER

Educational Platform to Improve Learning for Children with Autism

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ABSTRACT

The research focuses on children with autism, who cannot access education either because they do not have a school near their homes or because they are misinformed by their parents that they can access education regardless of their disability. By not receiving an education, children are deprived of their right to education. The objective is to design a prototype of an educational platform taking advantage of technological tools for the learning of children with special educational needs. A hybrid methodology and the balsamiq tool were used, as they were appropriate for developing the project. The result was that children with disabilities can learn by interacting with technology and in the same way their parents can visualize some exercises and crafts that they can do at home with their children, since it is based on their educational needs. It is concluded that teachers are in total agreement with the use of technology for children with autism, since this will help to improve their learning. The research contributes to society, teachers and parents with children with autism problems.

KEYWORDS

autism, Balsamiq, educational software, hybrid methodology, learning of children, special education

1   INTRODUCTION

Autism spectrum disorder (ASD) is a developmental disorder that affects children worldwide. These children have impairments in social interactions, verbal and nonverbal communication and repetitive behaviors [1]. Every year on April 2 is celebrated the World Autism Awareness Day, when we take the opportunity to instill in society what autism is and how to treat people who suffer from it. It is known that autism is not a disease but a condition that, with therapies and learning, can be coped with [2]. That is why it is important to know that there is no discrimination and not to discriminate against children and people with different abilities. It is also known that autism is characterized by severe and profound lifelong developmental deficits that affect socialization, communication, imagination and behavior [3].

One of the main consequences affecting autism in Peru is an educational system that serves only 29,157, or 3%, in 1,393 educational centers 07 special education schools, 927 special schools and 59 PRITES (Early Intervention Programs) [4].

The problem posed by the research work is that children with autism present different learning difficulties in writing, reading and developing mathematical problems. Likewise, it is difficult for them to socialize with their classmates. Therefore, special education is needed to nurture their knowledge.

Special education is the model that seeks to meet the learning needs of children, adolescents and adults with disabilities. The concepts of inclusive education and special education can be differentiated and corrected. Since the student has a mild disability, he or she could transfer to a regular, special school, where he or she should receive an unrestricted education like those students without any disability. However, in the AVATAR study, of the 57,000 students, only 10,000 received specialized assistance [4].

That is why having a child, family member or friend who has a special education need does not prevent them from receiving a quality education. There are effective strategies for teaching children with autism: adapt a special environment, apply the visual learning style, make an agenda of activities with a prelude, make these children able to interact with their classmates through games with the teacher's guidance. As the demand develops, increase strategically; guide them appropriately, clarifying the rules of behavior. Many times, these children do not receive adequate instruction in schools because their disability limits the child's ability to learn. For that reason, there are learning methods that can be done from home; just as babies have early stimulation, special education can also grow and improve over the years. As a result, special-education teachers have been searching for the best way for their students to learn, resolving the conflicts they go through when it comes to stimulation [5].

It is important to point out that pediatricians face one of the greatest difficulties, which is the delay in diagnosis, given that babies before 9 months of age can visually follow their mother's movements, while children suffering from autism may present symptoms such as little eye contact, i.e., reduced eye contact, not much smiling and difficulty responding to their name; it can be said that they are very quiet children. The symptoms often progress as they grow. It can be observed that they do not imitate (do what parents do to stimulate them, such as playing with their toys, make them sleep) or demonstrate the need to interact and share with other children of their age, through games. Therefore, the importance of this work is to find a technological solution to improve the learning of children with autism through an educational platform, where they can reinforce their knowledge acquired in class.

Our research focuses on special education and not inclusive education, since special education focuses on children with psychological and mental problems, among others, whereas inclusive education focuses on the fact that children can be included regardless of their religion, socioeconomic level, or other. The two educational approaches are different. The scope of our research is special education.

There are different types of autism, which include Rett Syndrome, which occurs almost only in girls; Asperger Syndrome, which is considered the most problematic autism and is usually late to diagnose; Heller Syndrome, which usually appears from the age of 2 years; and Pervasive Developmental Disorder not otherwise specified.

In the research work, the hybrid methodology was applied, which is a soft-systems methodology of structuring complex problems and developing desirable and achievable changes in a disparate group of people [6]. Likewise, we used the Design Thinking methodology, which is a process oriented to problem solving to reduce risks and increase possibilities and is one of the easiest methodologies to use, as it helps to generate innovative ideas and adapt to user needs [7].

The objective of the work was to design an educational platform for children with autism to improve their learning in the areas of mathematics and communication, since these are the most important areas for learning. It was also expected to improve their learning and develop their social and educational skills.

This paper is structured as follows: section 2 presents the literature review, section 3 describes in detail the methodology used for the educational software, section 4 presents and discusses the results obtained, and finally, section 5 presents the conclusions.

2 LITERATURE REVIEW

The proposed research work details educational platforms related to the improvement of learning of children with autism. Since the use of new information and communication technologies (ICTs) has become a primary teaching method, through many educational platforms and mobile applications, it has been proven that students learn in a dynamic and didactic way.

According to Zaki et al. [8], learning is a problem for children with autism as they tend to have changes in their behavior and tend to be distracted too quickly, which is why the teacher has to look for educational strategies to achieve their concentration during class. Likewise, the authors emphasize the new technological tools, which open the way to a great change in the educational sector, proving that technology can be used in the development of classes.

El-Seoud et al. [9] emphasize that children with autism who cannot speak often cannot communicate using natural language normally. However, it does not limit them to learn to communicate by other didactic and intuitive methods, as they include images and symbols. Therefore, the authors proposed an application that would allow children with nonverbal autism to learn to communicate with their environment through this application. The main result was that children improved their knowledge outside the classroom with the proposed application.

On the other hand, some authors [10] have proposed that the perception and manifestation of children's emotions should be recognized as a daily communication and psychosocial regulation. Therefore, they proposed to investigate the experimental knowledge of psychoemotional development in children with autism; they also studied the deficiencies in emotional recognition as the treatment of emotional expressions to highlight and characterize these children with autismsince acquiring social skills and emotional intelligence can help.

In Peru, school inclusion is a process that guarantees the right to quality education for all students, regardless of their origin. Thus, th it is important to teach children that everyone is equal and has the same rights and opportunities [11]. However, throughout history, efforts have been made to integrate students with special abilities into regular classrooms. To achieve this goal, ICTs have been implemented to facilitate their access to information and educational resources.

There are countries where there are few special-education schools and not all children with special abilities attend one, due to either lack of parental interest or lack of information about the existence of special schools, and likewise there are few teachers specialized in special education [12]. Therefore, teachers and students should develop a friendly bond, so that teachers can get to know their students closely and see what their needs and requirements are in the classroom.

A major challenge for teachers is to create learning environments that are in line with special education [13]. Classrooms must guarantee equal opportunities and the necessary support to develop self-esteem and reinforce respect for human rights.

Therefore, it is important to know that the use of technological tools must be done safely and with adult supervision. The world of the internet has many open doors that are often used in a negative way, and most teenagers already have a technological device to access this doorway.

Even with that warning, Halabi et al. [14] the importance that the educational sector should include technological devices in the classroom. The use of ICTs facilitates the teaching process by providing interactive support to students with autism, making them learn faster. Teachers should also be trained on the use and strategies to implement technologies in the classroom, so that the teacher can be able to guide and accompany the learning process in the classroom. On the other hand, the authors emphasize that technology also benefits and facilitates the work of teachers, since a more interactive class is achieved, and there are schools that have already implemented the use of technological devices in their classrooms that seek to reinforce education for children with autism [14].

Accordingly, mobile applications aimed at education allow obtaining valuable information about the different users, so it will be known what their learning level is and what needs to be improved [15]. They are also used to help students with special abilities to concentrate on learning, since the different mobile applications are customized according to their educational requirements. In fact, as the years go by, technology is increasing and is showing us many benefits that are often used to improve the learning of students with special abilities.

IBakola et al. [16] explain that the use of ICT helps to improve students' academic performance. A study conducted in a special education school showed that children with autism and attention deficit hyperactivity disorder (ADHD) were able to pay more attention to a class with technological devices than in a normal class, without technology. It is important to meet the educational needs of students so that they can learn without any difficulty. Some mobile applications have congratulatory messages when students pass a level, making the students feel more motivated to continue advancing with their learning.

Finally, Khan et al. [17] mention that the use of educational applications and games is becoming more and more common in the classroom, since they help children with autism to improve their learning. Likewise, the authors suggest that the use of educational applications should be taken advantage of, since many of these applications help them overcome their problems with reading and writing, self-esteem, and concentration, and encourage the development of memory and coordination, mathematical ability, environmental awareness, and social skills.

In conclusion, a literature review of the different research works related to the topic of autism for the improvement of learning in children was carried out. This review highlights the difficulties that children have and that they require special education with the use of technology, either through an educational platform or a mobile application. The gap found in the literature review of the mentioned authors was that they did not make qualitative research through interviews that collect the perceptions of those involved. In addition, a deep analysis by education levels and by selected courses was missing. For this reason, the research being conducted will focus on improving these aspects.

3   METHODOLOGY

The research is qualitative in approach and descriptive in scope. The population was 8 teachers in the school, where all of them were interviewed. In other words, we worked with the entire population. This section explains the steps of the

hybrid methodology. Which is the soft-systems methodology and the Design Thinking methodology, taking into consideration the first two stages, which are sections A and B of the soft-systems methodology, and C, D, E, F of the Design thinking methodology. Next, the following stages are explained:

3.1 Unstructured situation

At this stage, interviews were conducted with 8 teachers, where we wanted to know a little more about the treatment and teaching method used by the teacher for students with autism. The following questions were asked in the interview:

– What are the behaviors that may alert a teacher that a student may have autism?
– What are the rules for dealing with children with autism?
– How are classroom activities adapted to children with autism?
– How will the use of technology influence the use of technology to improve learning?

3.2 Structured situation

For the development of the research, those involved are the children with autism—the parents, the teachers, the schools, the local school board and the ministry of education—are represented in Figure 1.
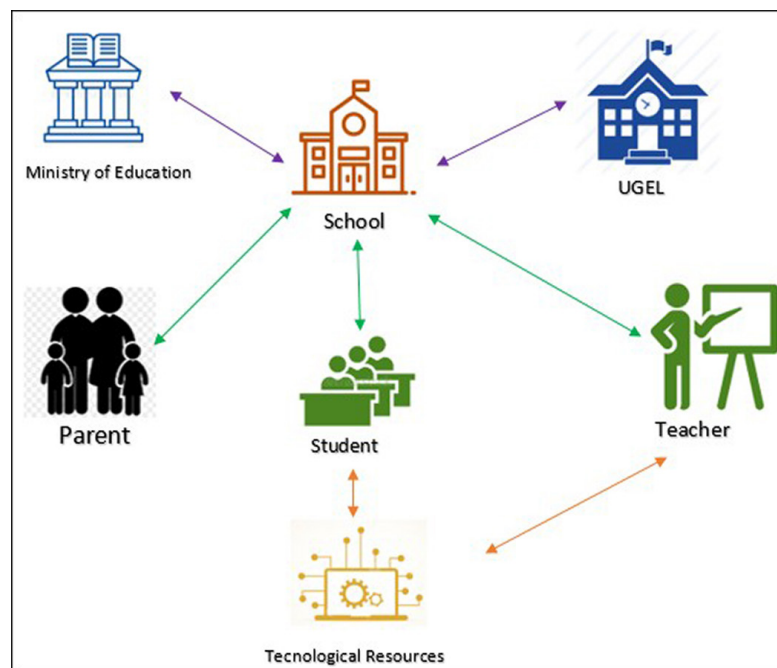

Fig. 1. Stakeholder structure

3.3 Define

The United Nations Educational, Scientific and Cultural Organization (UNESCO) program examines ICT methods for implementation in learning, which must be easily transportable and accessible in order to improve education [18].

A study indicated that children who handled technology improved their student performance and concentration, as they were attracted to the use of mobile devices [19]. Also, by using technololgy in class, all children were able to socialize in order to develop the activity provided through the device, which is why implementing a mobile application to improve the learning of children with autism will improve certain educational and social areas [19].

3.4   Ideate

The aim is to create a mobile application so that children with autism can improve their learning by using it, and also to improve the area of communication and social skills. Thus, it is necessary to identify the appropriate resources so that children with autism can learn through this application and improve communication with others. Thid can be done by implementing school activities to increase the level of learning through games [20].

3.5   Prototype

The following programs were used to develop the research work, since they were the most appropriate for the survey and the design of the prototype.

a) **Google Forms:** This tool allows us to conduct surveys, collect data, and carry out evaluations, since it can be connected to a spreadsheet [21]. In this way, it will allow us to know the statistical data of our survey of a group of people and to know how we can develop the prototype, knowing the causes, the levels of illiteracy, and the implementation of the prototype according to the characteristics provided by the respondents.
b) **Balsamiq:** This is a very easy-to-use tool that allows one to design user interfaces for web pages and mobile applications, making them look real and allowing the developer to implement all his or her creativity while using it [22].

3.6   Evaluate

It is known that children use technology from an early age, whether through tablets, cell phones or laptops. For this reason, one of the main advantages of the use of technology in education is that children as well as adults can have access to a greater amount of didactic materials such as electronic books. Using technology favors autonomous learning, since users only need access to educational applications and games to improve their learning [23].

In the same way, the use of technology in the classroom generates a great advantage, since students will pay more attention and the class will be more fun and entertaining [24].

4   RESULTS AND DISCUSSIONS

4.1   About the prototypes

This section shows the designs of the educational platform to improve the learning of children with autism. The designs were developed to be very didactic

and intuitive. The prototype designs are a serious game, since it is expected that at a later stage, they will be developed into software such as visual studio, in java script language. Figure 2 shows the main screen of the educational platform, named "TEAcompaño." (I accompany you), which was chosen because it is aimed at children with autism and we wanted to introduce the use of technology in their learning. Likewise, Figure 3 shows the registration form and a brief description of the objective of the educational platform.

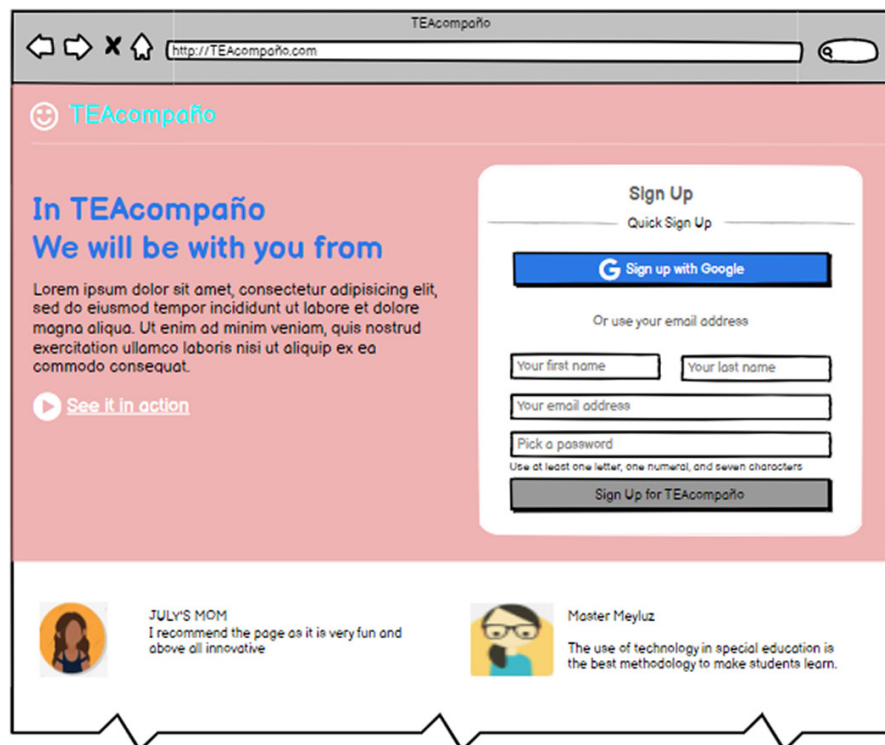**Fig. 2.** Main screen of the educational platform

Fig. 3. Registration form

Figure 4 shows the 4 areas that our educational platform will have, which are: mathematics, communication, social skills, and educational games. These 4 areas have been chosen according to the ABA method, which is a method where students can learn those skills that will facilitate their development and autonomy. What is expected from these 4 educational options is that students can learn from a basic level to an advanced level.
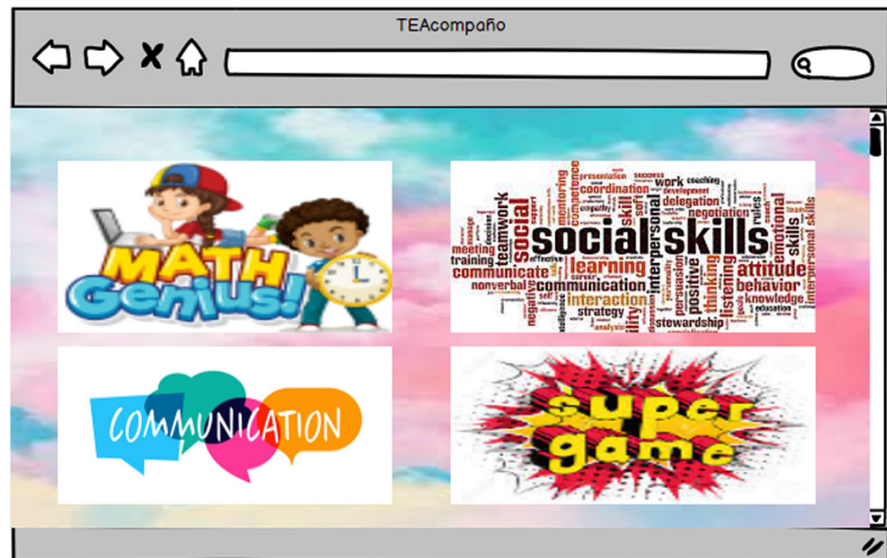

Fig. 4. Educational areas

Figure 5 shows the screen when the student selects the option of the mathematics area, where the student will be presented with options of exercises according to his or her learning needs, if the student is at a basic level, the student will have exercises of that level and will advance according to his or her performance. We have also considered implementing games in the different areas to capture the students' attention and allow them to learn while playing.

Fig. 5. Mathematics area

It is also important to develop in children with autism their social skills, where they can communicate and socialize with others without any problem. Figure 6 shows exercises on social skills, which consists of asking students how they feel today, what they did today, how many friends they made, what they likeand dislike.

Finally, in Figure 7, there is a scorecard where the student can visualize achievements from day 1, seeing how he or she has been improving day by day.
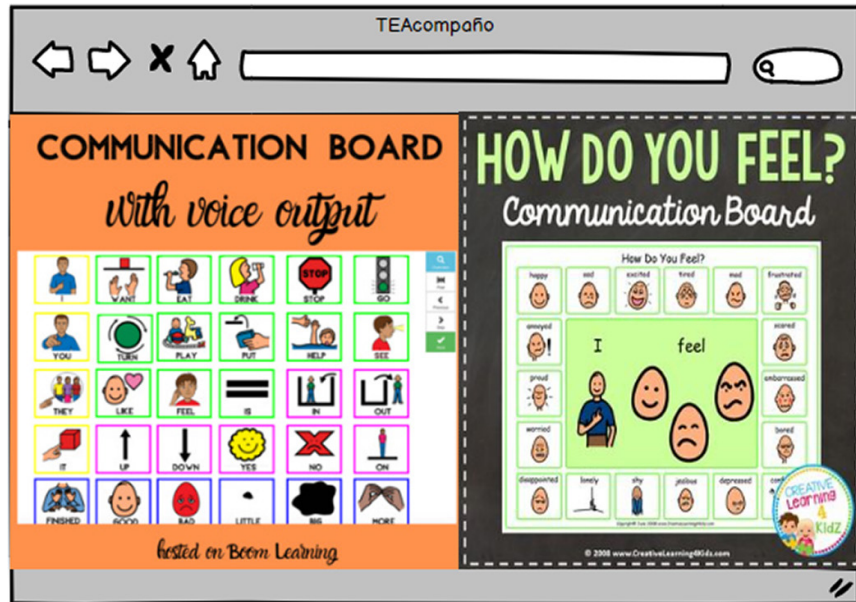

Fig. 6. Social skills

Fig. 7. Scorecard

The use of technologies influences children in the teaching of mathematics and communications, among others. Likewise, for children with autism in particular, appropriate strategies are applied so that the child learns using technologies through didactic games.

4.2 Interview analysis

Using qualitative analysis according to the interviews conducted with 5 teachers of I.E.P. Santa María Reyna, the following categories could be constructed. The letter **"E"** represents the interviewees.

Behavioral manifestations. The question asked to the interviewees was the following: What are the behaviors that may alert a teacher that a student may have autism?

E1: … Students with autism do not stare at you.

E2 and **E3:** … Share that, in their behavior, since they can be very introverted and find it difficult to socialize with others.

E4: … A student with autism has a hard time paying attention and is isolated from others, as if he were somewhere else and not in class.

E5: … distracted in the classroom.

E6: … As a teacher, during years of experience and constant training, one can identify when students have a different learning condition. Students with autism are often distracted at times and do not react when their name is called.

E7: … The way they interact with their peers. If the parent does not let us know if the student has a condition, it delays their learning.

E8: … Because of their behavior or the language delay that in some cases they present.

The manifestation of behaviors of children with autism is identified by teachers in their classes. Among the indicators to identify these manifestations are distraction, low socialization and difficult communication. In this sense, the authors [24] states that there are certain attitudes such as being isolated, distracted and not concentrating easily that make a teacher realize that the student has special educational needs.

Educational rules. The question asked to the interviewees was the following: What are the rules for dealing with children with autism? This was done in order to find out how teachers work with a student with autism.

This question was formulated to learn about the attitude that teachers have towards a student with autism.

E1: … Avoid making loud sounds.

E2: … It is recommended that the best way to help him is to take him to a specialist.

E3: … In agreement with the recommendation where it was said that to make the student improve, it is necessary to talk to the parents to work together with the specialist and see improvements in the student.

E4 and **E5:** … There must be a follow-up to all special children, to see the improvement that will be made, with the rules established during the class.

E6: … Include it within the classroom with the different activities provided during the duration of the class.

E7: … It is always good to remind them of the rules and, above all, to include them in school activities.

E8: … The most important thing is to go at their own pace, not to force anything, but that the student gradually integrates.

The educational rules in the classroom are very important, since the teachers will help more by following the rules, so that the children perform much better. It is important to follow up on the improvements of the student and see what methods to apply for better teaching [25].

Classroom activities. The following question was posed to the interviewees: How are classroom activities adapted to children with autism in order to find out which activities are carried out in the classroom?

E1: … The best way for children with autism to adapt to a classroom is to have them rotate from table to table so they can coexist with their classmates.

E2: … The most important thing is to be attentive to them to know their needs and, according to that, plan for a better development of the class.

E3 and **E4:** … The best thing is to get them to work as a team with their classmates so that they can gradually develop their social skills.

E5: … So that the student with autism can develop his learning and social skills, make him work in a team and not to keep him away or treat him in a different way than his other classmates.

E6: … Spend time getting to know what their main interests are in order to achieve adaptation.

E7: … Have audiovisual elements so that the duration of the class is dynamic and, above all, can attract their attention.

E8: … As a teacher, you have to give the student time to adapt and advance little by little.

Classroom activities are prepared by teachers especially for children with autism. Likewise, it is important to emphasize that the activities should be very didactic and intuitive, so that the child is motivated, and thus improve learning and communication [26].

Use of technology. Answering this question, all interviewees agreed that the use of technology in education allows students to learn in a didactic way; they also pointed out that it is important to know how to use technology with caution.

E1: … Technology would allow students to interact with their peers through video games, so they can feel good about expressing themselves.

E2: … Technology will make the student curious and able to learn in a didactic way.

E3: … It would make classes more didactic.

E4: … It would achieve better attention in the classroom.

E5: … It would motivate students, since nowadays all children have a mobile device at home.

E6: … Technology has many advantages in the educational field; it allows all students to pay attention, since the class is more dynamic for them.

E7: … I agree that technological tools should be implemented for learning.

E8: … I find it fascinating that we want to implement technological tools for the development of a class session.

Nowadays, the use of technologies is a fundamental pillar for special education, since they make use of different types of applications to improve learning. Technology is very important because it mainly helps children with autism to express themselves through didactic games [27].

For the integration of students with autism, the process begins with the integration of student and –teacher, where the teacher works on the integration of the student, verifying how to incorporate him/her with his/her peers. In this way, the teacher integrates the student with 4 peers within the same table. Because the time taken for integration varies wit each student it is important to emphasize that the time of incorporation depends on the individual student and that the main objective of the integration is to work the social skills of each student with autism.

With the presentation of the platform, it is becoming possible to improve the learning of students with autism through games such as Mathematics games that consists of learning to add, subtract and divide; and Communication games that include spelling, word alignment and separation of syllables; and Social skills games that allow the student to solve problems and ask for help when needed.

4.3   Survey analysis

A survey was given to the 15 teachers about the implementation of technology to improve the learning of students with autism. In this way, we could know more about their opinion as teachers. In answer to the answer to the question Do you think that implementing technology in the development of classes would improve the attention of students with autism? the vast majority agreed (80%), while only 20% disagrees. We can conclude from these responses that teachers believe that implementing technology will help students improve their learning through the use of different technological tools.

Likewise, all teachers agreed with the implementation of technological tools in order to improve the learning of students with autism. This was in agreement with Zaki et al [8], who propose teaching strategies for children with autism since they are quickly distracted.

In addition, the use of technologies that complement the didactics of special education for children can be made. El-Seoud et al. focused on the teaching of communication with images and didactic symbols that would allow children to learn quickly without limitations [9], [28]. Our research is similar to the research carried out since an educational platform was designed with images by courses. It is also important to analyze the emotional of children, as established by Lizeta and Drigas [10]; this coincides in part with our research since an interview was conducted with the teachers to find out their perceptions about the behavior of the children in the classes. In the teachers' responses the children's emotions surfaced.

4.4   Expert judgment validation

Figure 8 shows the 5 evaluation criteria for the prototype of the educational platform: usability, adaptability, integration, creativity and innovation. The evaluation was performed by expert judgment. The experts are from the fields of Computer Science, Information Technology and Software Engineering.
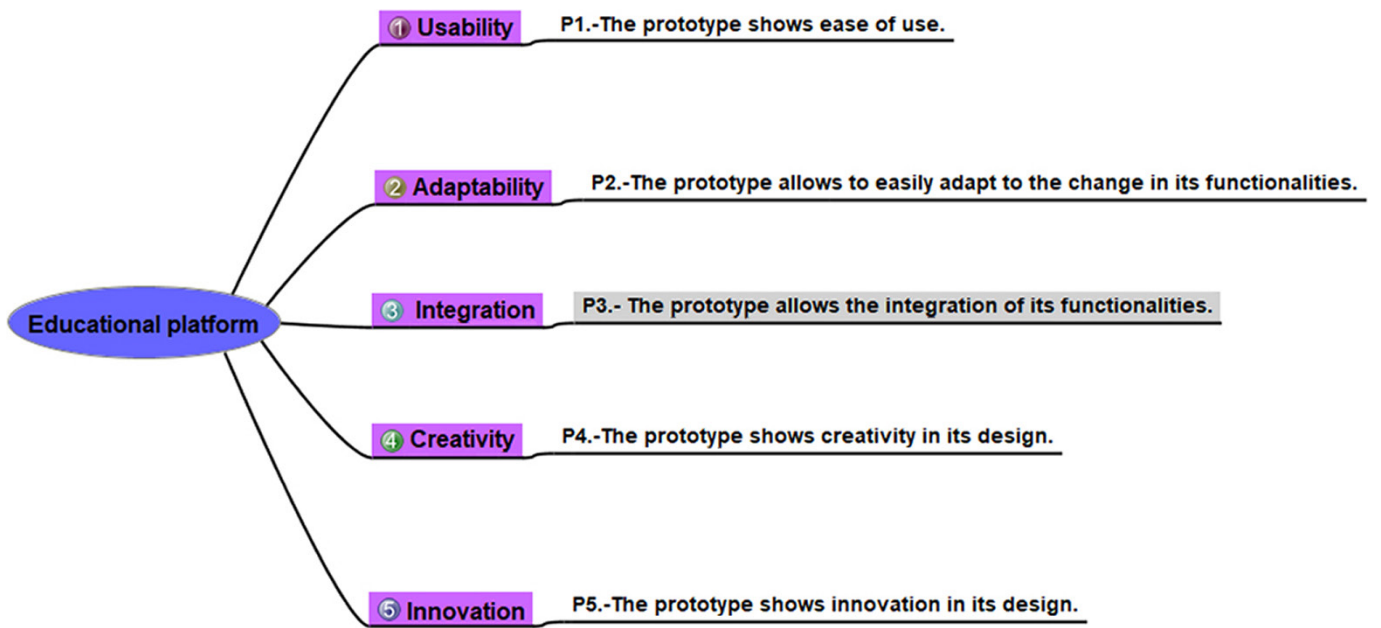
Fig. 8. Evaluation criteria

An evaluation was made using a semantic differential from the value of 1 to 10, where 1 is equivalent to "little" and 10 is equivalent to "quite a lot." Table 1 shows the mean and standard deviation (S.D.). The minimum value obtained for all the pre-questions was 8, with an S.D of 0.50. Regarding the experts, the lowest value obtained was a mean of 7.4 with an S.D of 0.54; and the highest value of the mean was 9, with an S.D of 0.70. Thus, the protype of the educational platform for learning for children with autism is approved.

Table 1. Expert judgment appraisal

Questions	E1	E2	E3	E4	E5	E6	E7	E8	E9	Mean	S.D.
P1	8	7	10	8	7	9	8	10	10	8.55	1.23
P2	7	7	8	7	8	8	8	8	9	7.77	0.66
P3	7	9	8	8	8	9	7	8	8	8	0.70
P4	7	7	7	8	8	9	9	9	9	8	0.86
P5	8	9	8	8	8	8	8	9	9	8	0.50
Mean	7.4	7.8	8.2	7.8	7.8	8.6	8	8.8	9		
S.D.	0.54	1.09	1.09	0.44	0.44	0.54	0.70	0.83	0.70		

5   CONCLUSIONS

In this research, it was possible to design the prototype of an educational platform with the Balsamiq tool, which shows what the platform will contain, helping to ensure that all children with autism can access education through the use of technology. The method that was applied was very agile; therefore, it was

sought that the prototypes designed were very real, where you could see how the educational platform would be understood, satisfying all the needs that involve a student with special educational needs, which is why the Balsamiq tool was used. In the end, good results were seen with the design of the prototype of the educational platform. We want to continue implementing it in Special Education, so that all children can access an education through the use of new technologies. The scope of the research work was to design software for special education. As future work, it is recommended to continue researching to provide solutions to children with special needs, looking for a benefit for all those in need with the support of the Ministry of Education and parents who are directly involved so that the children can continue learning and improving their education using new technologies appropriate for special education.

6   ACKNOWLEDGMENT

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