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# Augmented Reality in the Education of Children with Autism Spectrum Disorder

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## Abstract

*Currently, despite the technological advance that often makes school education accessible to children with Autism Spectrum Disorder (ASD), there are still certain difficulties in understanding the teaching passed on in the classroom to the autistic. Therefore, this research aimed to propose an approach to AR technology (Augmented Reality) as an aid in teaching-learning within the school environment where it provides a means*

*of pedagogical resource in class. For the development of this research, bibliographic research was carried out, where it is evident that through Augmented Reality combined with education it has many benefits, accessibility and inclusion. With this, it is possible to conclude that the use of the technological tool in question can contribute to the TEA to facilitate learning, understanding, communication, interaction with other students and their perception, not only that, but also a benefit for the educator who can pass on content of more didactic way in the school class.*

**Keywords:** Augmented Reality; Autism Spectrum Disorder; Benefits; Education;

## 1. Introduction

In our society, children grow up in an environment that involves a lot of technology, where videos, music, animations draw a lot of attention and end up conquering them. In view of this technological and human acceleration, schools need tools that involve students in a significant way because most of the use of this medium is not for knowledge that they add to school education. Based on this, the study carried out is specifically about how this advance can benefit the learning of children with ASD (Autism Spectrum Disorder) and how augmented reality technology can add more clarity to their understanding.

In addition, children with ASD often have difficulties in the way of expressing themselves as well as understanding written or spoken language depending on the degree of this adversity of autism, but they are extremely interested in electronic screen media, and on In addition, educators need strategies to help children with this disability to understand tasks and the world more fully, and with that augmented reality helps to unite the physical and digital worlds, superimposing an image on a physical environment.

In this way, the visual nature of augmented reality becomes a promising and innovative technology to assist in the Autistic learning process. Because, it allows a more interactive approach to educational content, so that illustrations, images and texts that are real physical objects along with virtual objects coexist in the real world. Attracting attention to topics addressed, allowing the flow of this teaching within the classroom with teachers. Therefore, this research aims to study the augmented reality technology when combined with education can promote many benefits to this condition of ASD (Autistic Spectrum Disorder), making this child have a faster learning process, and an ease in communication in the social sphere. And that these tools serve as an aid in this educational development.

## 2 Theorical Reference

### 2.1 Research Methodology

From a theoretical point of view, the present study is classified as a case study that aims to explore the object of study and investigate the applicability of augmented reality technology in the education of children with ASD. Thus, we proceeded to the analysis of studies already carried out on the subjects covered in this research to absorb and expose in a more complete way.

It was necessary to examine much more in depth about how augmented reality has been applied in the education of children with ASD and how its use can help them to be inserted in the social environment in the

most inclusive way possible, thus, the potential of the technology of RA's can be explored as per the child's need.

## 2.2 Advances in Technology

For Attaran (2003), information technology (IT) can be defined as the capabilities offered to organizations for the transition of data, information and knowledge to individuals and processes, through computers, systems, applications and telecommunications. In recent years, online internet services, software and web and mobile applications, have had great benefits and advances, however, it has also been noticed that it has brought with it problems in several segments. It can be highlighted as benefits, the ease of disseminating and obtaining information, without having to pay high costs, which is of real importance and is fundamental for some economic areas, also reducing the use of paper and consequently deforestation and aggression to the environment.

Specifically, in education, technological advances have brought enormous benefits, especially when it comes to Distance Learning (EAD), a technology that has been giving space to many people in the world, from children in elementary school to young people and adults in universities, to advance with their learning without leaving home.

A problematic fact to be highlighted is the improper and lazy use of platforms that easily distribute information in droves by children and adolescents in the learning phase, making irresponsible use of the "ctrl+c / ctrl+v" resource popularly known as "copy and paste", causing difficulties in learning and reducing the effectiveness of teaching. This can lead to a future generation that will not be able to do a simple calculation without the use of a calculator.

The technological advancement of communication and information is inevitable and if used correctly there can be appropriate teaching for children and adolescents, parents and teachers must be more attentive and work more on their children's and students' abilities to criticize and think, so that this future generation is not technology-dependent professionals accommodated in all areas of life.

## 2.3 Technology in Autistic Education

Technology is constantly evolving and it is possible to observe it on a daily basis, be it on TV, clock, computer, remote control, automobiles. And this comes to facilitate and benefit some daily activities, following this same idea of help and task facilitation is that technology should be understood as an aid that brings the expansion of skills, enabling the realization of functionalities in the education of children who are in disabilities, such as ASD (Autism Spectrum Disorder).

On the other hand, the teaching-learning process of autistic children requires a lot of attention and support from their teachers, as they are the mediators in the inclusive process, they are the ones who promote the child's initial contact with the classroom. Along with that, technology can help you in this development of activities with students, having the first contact with the school, classroom, teachers and other students through technology with augmented reality, producing a unique experience and, in view of this, overcoming possible limitations with a real first contact.

In addition, according to PCN'S (1998, p.17), the educational system needs the inclusion of everyone, thus being an organized system, it achieves and offers better specific conditions equivalent to the characteristics of the student. Based on this, technology comes precisely to help this organization within the classroom as it includes the diversity of students without distinction of conditions.

Children with ASD have varied characteristics as well as difficulty in socialization, communication and limitation of spontaneous activities. In view of this, technology is a strong ally for development in education and can facilitate the insertion of content, in different ways, attracting the child's attention to participate in activities, involving audiovisual, televisual, textual, oral, musical, playful technologies. and bodily.

## 2.4 Augmented Reality and ASD

The first point to clarify is that augmented reality is very different from virtual reality. This concerns an immersion environment created through computational tools in which the user performs certain tasks. Augmented reality designates the interaction between virtual environments and the physical world. A good example of augmented reality is the QR Code labels in tourist spots in cities.

Through the reader application of this type of tag installed on a tablet or smartphone and with an internet connection, you can have access to a kind of virtual guide, which indicates the places to which the tourist should go (including tracing the route to reach the location) and, upon arrival, show the history, curiosities, tour options and everything else that is pertinent. Given this, it is not necessary to go far to wonder why augmented reality is so popular in many fields, including marketing and advertising. According to KIRNER, T.g (2008), Augmented reality is the insertion of virtual objects in the physical environment, shown to the user, in real time, with the support of some technological device, using the interface of the real environment, adapted to visualize and manipulate the real and virtual objects.

Augmented reality is the combination of a QR code with a computer program. With two-dimensional codes it is possible to project virtual objects into an image of the real world in order to provide more information, expand the boundaries of interactivity, as well as enable the use of new technologies and make current ones more accurate.

The phenotype of individuals with ASD can vary greatly, however, this technology can help a lot in the development of pedagogical activities, in addition to contributing to the progress of social skills, both in the child's communication and in the sentimental, even improving the attention of the child. individual, this technology provides better social interaction, reducing their isolation.

For AR, a certain type of digitally produced data can be used (images, animations, videos, 3D models) and end users (people) will see the result as if it were a live event, with natural and synthetic light.

## 2.5 Augmented Reality in the Education of Children with ASD

Education is a fundamental process in people's lives, especially in the early years, but this is not always seen as a good and interesting thing, especially in the case of children, it gets worse when we talk about children with autistic spectrum disorder. Based on this, it is important to emphasize why the use of augmented reality.

According to Professor Dr. Antonio Carlos Sementille, specialist in virtual reality and augmented reality, simulate medical procedures, so we can also perform simulations with high school and elementary school content that in practice is much simpler than simulating medical procedures and virtual reality can even be used to create more empathy in people, so it is very possible that it can be used to teach autistic children dealing with problems common to this specific audience such as lack of attention, lack of empathy itself, interest in certain subjects, reaction to emotions, high and low sensitivity among many others.

Augmented reality is a very interesting feature that has the ability to catch the attention of not only children, but adults as well. This resource has a high degree of interactivity that provides a deep immersion within any content that, in the context of education, is textbooks, multiplication tables, grammars, among others, which can be enhanced with videos, animations and interactions that leave the process of learning much more fun and interesting.

Added to this, you can also have games through augmented reality that can replace the role of exercises and activities that are often not so well assimilated by students and thus stimulate a greater pleasure in studies and a desire to learn in the child, a fact that can maximize the expected result with it.

However, there is a challenge related to how to implement this in schools and through which platforms this technology can be used. Augmented reality is not something distant as it seems, it can be accessed through a smartphone, a device that is very accessible these days, in addition there are already applications that can be used and projects that are already implementing this feature in some places.

According to Sementille, in an interview with the website Tecnoblog, years ago there really wasn't so much technology. Today there are high resolution front and rear cameras, good and very high resolution screens, quad-core, octa-core processors, things that are extremely necessary for augmented reality.

Therefore, augmented reality, as well as various information technology resources, has great potential not only in education, but also in areas such as health, commerce, among others. This all has a much greater potential applied in the education of children with ASD, as this public has a much greater learning difficulty added to attention and socialization problems, which can be mitigated with the use of these technologies also associated with the specialization of professionals to address that specific niche.

## 3. Methodology

### 3.1 Augmented reality performance and accessibility for the treatment of ASD

Children with autism often have a hard time assimilating written and spoken language and tend to be much more interested in screens and interactive materials. AR (Augmented Reality), therefore, acts in a strategic way, uniting the virtual, digital and physical world, acting in a complete way with the objective of helping the understanding of children with ASD, helping them to better understand daily tasks. For this, anyone can access this innovation, just needing a smartphone or other device with camera and internet, and downloading an application that will do all the work of interaction with the autistic person.

According to Ramon Ferreira, founding partner of GoEPIK, a company that works with solutions for digital transformation, accessibility is one of the main advantages of augmented reality, which makes its use as an auxiliary tool quite convenient. Today, there are already several studies and research that show the

effectiveness of AR in the education of autistic people, some of them being that of PTC in collaboration with Boston Children's Hospital, in 2018.Manaus has a project supported by the city of Manaus that uses virtual reality as an ally in the education of children with autism entitled “Virtual Reality as an inclusion strategy for autism” developed by startup Hattore Tec. These technologies are becoming more accessible and will become more and more improved, being able to be widely used and well used in education as a whole and facilitating the use for specific purposes such as use with the autistic public.

Ramon explains that technology brings the virtual world closer to the real world. AR allows the application of computer-generated objects in a real environment, through a viewing device (smartphone, tablet or special glasses). From this, it is possible to interact with the virtual elements in various activities.

### 3.2 Augmented Reality as inclusion of TEA in the classroom

Augmented reality can include children with special needs within the school environment, including ASD. Combining the PECS method with AR so that the images used in this teaching are explored from various angles, which the technology in question is capable of reproducing. According to Rosa, V. I. (2018), the PECS (Picture Exchange Communication Symbol) method, which aims to teach people with a developmental disability or ASD (Autism Spectrum Disorder) through images, symbols, miniatures, who cannot understand through speech, combined with AR (Augmented Reality) design and technology, it explores several aspects, enhancing the topics covered, as the use of elaborated images together with an upgrade makes the approach even more attractive and consequently makes the student's inclusion at the same pace of learning as the class. According to VIEIRA, Soraia, the model in figure 1 below shows the traditional PECS method, used by many educators in the classroom with autistic children.

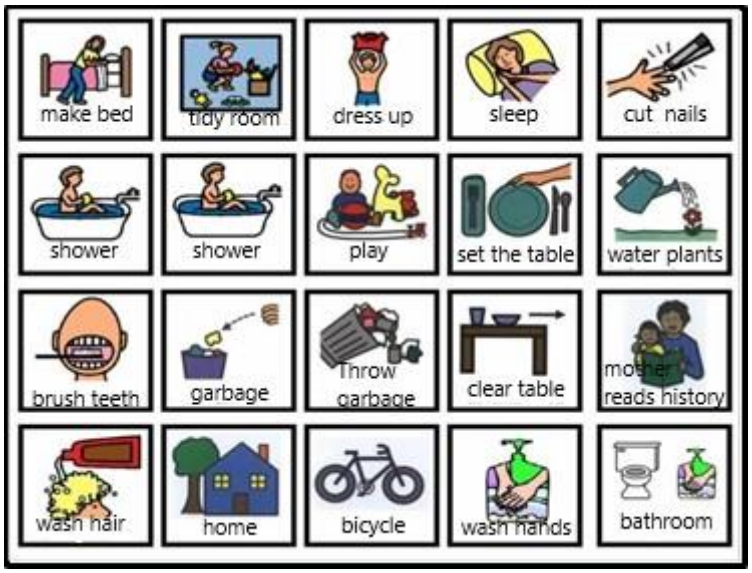


Figure 1: Traditional PECS Model.
Source: VIEIRA, Soraia (2019).

Augmented Reality applied to the traditional PECS method, according to Rosa, V. I., has as a better interaction of what is being taught as can be seen in figures figure 2 and 3:

Figure 2: Augmented Reality and the PECS model.
Source: Rosa, V. I. (2018).

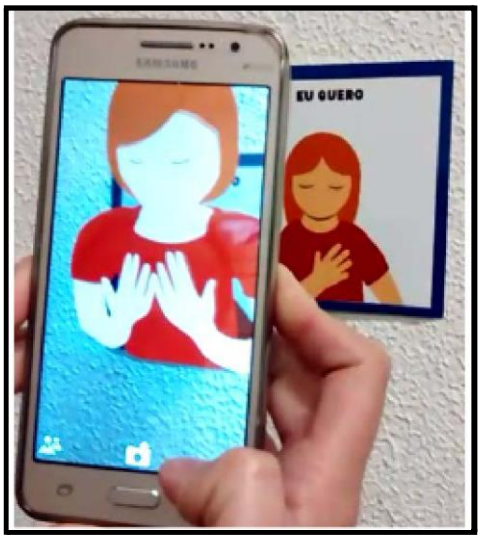


Figure 3: AR and the PECS model.
Source: Rosa, V. I. (2018).

### 3.3 The Benefits of Augmented Reality for Children with ASD in Society

Living in society is one of the biggest challenges for children with ASD, the WHO has warned of better and improved interventions that are more appropriate for these children, with the increasing advances in inclusive technologies facilitating the insertion of these individuals into society, opening paths to personal achievements,

educational and even professional.

According to CHERQUE, the image illustrates how difficult it can be for a child to learn without the help of technology that makes it easier for them to learn.


Figure 4: Autism.
Source: Cherque, Jose (2017).

Thinking about the different difficulties of children with ASD, the company Educ360°, a technology company for learning, carried out studies to create an application that helps children with apraxia of speech, which is a neurological disorder that limits the ability to pronounce. The "AlfabetizaçãoAFI" application contains several speech-language pathology contents that help the child to pronounce syllables and words correctly, improving your communication and understanding significantly.

## 4 Results

AR is an area that involves several disciplines and concepts from different segments, with potential use in several specific areas of economic, social and cultural life. By enabling a more natural human-machine interaction in a three-dimensional (3D) environment and allowing the reproduction of real situations, it becomes a resource with great potential. Medicine is one of the most in demand areas for AR in education, considering training, diagnosis, treatment and surgical simulation. Thanks to 3D visualization and real-time interactive functions, it allows the realization of innovative medical applications that were not possible before. Based on this, the use of AR for the education of autistic children was thought, uniting the fields of medicine, psychology, pedagogy, education itself and, mainly, technology.

In addition, according to the method used by Rosa, V. I. (2018) students with ASD who obtained access to the application of the resource, in which it combines two very important methods for the teaching-learning of the child, first the PECS (Picture Exchange Communication Symbol ) and according to AR (Augmented Reality) with this, we had a better understanding of the subject addressed in relation to students who did not use this method, precisely because the process is slower, it requires a whole didactic creation elaborated by the educator, but with the In Augmented Reality, this becomes more accessible to both what will apply the content

and what will absorb it, as AR provides and explores a better view of what the teacher is addressing in the classroom.

The use of the application created by Educ360°, was successful after carrying out several tests, following the daily life of children together with parents and application developers, based on these analyzes a final version was prepared, after its launch, in the first month of use, the children's parents reported a significant improvement in the pronunciation of some words, facilitating communication between them.

In the world we live in, prejudice against these children is unfortunately still very present, however, as it is an unsettling issue, technology can be inserted to transform the life of an autistic child, from the use of augmented reality new horizons can be explored , such as: significant improvements in attention, identification of images and even a satisfactory improvement in the individual's communication, which is really fundamental for a more practical coexistence in society, augmented reality technology is of great help even for professionals than educators who have the role of taking the first step in improving the lives of these children.

## 5 Conclusion

This research was developed with the aim of presenting studies and methods of applying augmented reality in the education of children with Autism Spectrum Disorder, based on the methodology known as case study. And with that, the AR tool stands out as a research objective, which promotes many benefits for autistic children, because when using technologies to accelerate the learning process, it provides an ease of communication in the social sphere in a dynamic and efficient way. . And after much research it was found that this tool provides the TEA with a lot of ease to understand the subjects covered in the classroom.

Despite being a topic that is not unknown, some limitations were found in the research, but the information found was enough to clarify the subject addressed. However, it can be said that the objective was also achieved by the methodology, and that it clearly shows us the results achieved, making it clear that Augmented Reality can be useful in the way of teaching in the classroom, in a dynamic way, where it's called autistic attention.

We can conclude that ASD and AR should be studied in a multidisciplinary way, ranging from areas such as computer science to areas such as psychology. Therefore, we put together in the theoretical framework different areas of knowledge showing that they all complement each other to reach the expected result and a better understanding of the use of AR to educate children with ASD.

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