The impact of augmented reality in improving non-verbal communication in children and young adults with autism spectrum disorder (ASD)

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Abstract: Our paper focuses on the question of the potential of new technologies (NT) like augmented reality (AR) in the educational action of people with autism spectrum disorder (ASD), more specifically on the development of non-verbal communication (NVC). This study is part of special education (SE) where the educator is encouraged to seek new avenues and supports in order to improve the skills and abilities of the target population. The educator is perceived as: "the person who promotes the implementation of specific methods and techniques ... either within an establishment or a service, or in the usual living environment of the people concerned". Our research is interested in the question of the advantages of new technologies like augmented reality in the care of children and young adults with ASD, who are non-verbal. The intention of our paper is to highlight the strengths of using AR in the management of people with nonverbal ASD. In fact, the design and 3D modeling of objects, avatars and a daily virtual environment (VE) close to a real situation have become firmly established in the field of special education, which has many advantages.

Keywords: new technologies, augmented reality, autism spectrum disorder, non-verbal communication, 3D modeling, avatars, virtual environment.

1. Introduction

The agency "WE ARE SOCIAL" and the platform "HOOT SUITE" publish their report (2020) on digital in Tunisia, this annual and international study carried out (in January 2020) shows that there were 7.55 million people who use the internet. This increase is due to the diffusion of technologies in Tunisian society. The latter notably revealed a clear increase in equipment such as computers, mobile phones, and touch pads.

Digital technology occupies an increasing place in our daily life and is now becoming obvious. IT occupies a large part of our activities. The use of AR remains essential in educational circles (schools, colleges and specialized centers, etc.). Its dissemination in education constitutes a powerful tool for modernization, educational innovation and also in the field of specialized education. Usage allows people with disabilities to find their place by providing them with multiple and diversified resources to overcome deficiencies and developmental disorders [1].

While recognizing the right to the singularity of learning, to the difference of skills and pathways. Human assistance from specialists in care, families and techniques (digital tools, equipment, software, etc.) has taken place to overcome the difficulties and obstacles resulting from the situation of disability, especially people with disabilities. Autism view deficits, alterations, and complex disorders.[2]

Faced with this digital evolution, the care of children and young people with ASD encourages us to think about other appropriate and beneficial uses for this population which generally shows communicative alterations.

In order to improve communication (verbal or non-verbal), we must not limit ourselves to traditional methods and

means. It seems imperative to me to study and assess the impact and effect of digital technology on the care of children with ASD. Even if the improvement and the development of these young people thanks to these tools, are evident, one must first reflect on the frequency of use and above all determine the educational goals, one must also ask about the feeling of this population faced with this use. [3]

As soon as the diagnosis of autism is established, children or adults must benefit from appropriate care, which aims to improve the quality of life through activities promoting communication, learning and socialization the earlier we intervene. The more chances there are to re-educate them adequately.

The objective of this end of study report is to analyze the potential of augmented reality in the care of people with ASD, specifically non-verbal communication. The contribution linked to

2. Problem and research questions

Our research addresses the question of the strengths of AR in the care of children and young adults with ASD, who are non-verbal.

Nowadays, several studies and research have shown the usefulness of digital media and their beneficial role in the care of a population with specific needs, which requires more specific and adequate means and supports. Digital like AR could be an educational support in the hands of specialized educators to address the needs and support non-verbal people in order to improve qualitative alterations in communication and social interaction.

To this end, several testimonials from parents of children with ASD advocate the benefit of using these digital instruments in the improvement of their non-verbal or low-verbal children through applications, carried out by AR [5]. Not to mention that we are living in the era of the Internet revolution and new technology whose propagation and use are unlimited, they are accessible to everyone.

the integration of AR in education and in teaching practices is not to be demonstrated, we will therefore insist on the practice of professionals in our specialized centers; did they use these tools in their practices? Are they aware of the advantages and disadvantages of using digital technology?

A process of taking charge of children and adults with ASD is a long process which will make it possible to bring out or develop knowledge or a skill for people of different functioning compared to "neurotypical" people, in other words one should not no longer talk about "handicap"[4].

In this paper, we will present the fundamental concepts of our research namely ASD autistic spectrum disorders, impaired non-verbal communication and digital media applied in the context of special education.

Just like the digital evolution, autism is a topical subject in this sense, specialized educators are called to take advantage of the interest of people with ASD to work with them in the field of non-verbal communication, by inspiring multiple and diverse methods and activities. These instruments play the role of facilitators and mediators, which is why they are called upon by professionals in special education as well as by families and parents of people with ASD.

As part of this research project, the following central research question will be asked: What is the impact of the use of AR in improving non-verbal communication in children and young adults with ASD?[6]

To do this, we ask the following research questions that we may or may not wish to assert during our study.

-What is the place given by specialized educators to the use of new technologies such as AR in the care of people with ASD?

-What contribution of digital tools such as AR in the field of non-verbal communication in people with ASD?

3. New technologies AR in the care of people with ASD
3.1.Augmented reality

In recent years the world of computers has taken an important place in everyday life, over time computers, as well as digital and touch tablets have imposed themselves in most families. The major development of digital technology is growing, it is becoming almost inevitable in order to manage our daily lives, both from a professional and personal point of view, and this major development affects our modes of communication, our social relations, our thinking and our actions.

The intention of our paper is to highlight the strengths of using AR in the management of people with nonverbal ASD. In fact, the design and 3D modeling of objects and avatars have become firmly established in the field of special education, which has many advantages.

4. Design of a 3D Model of a Daily Environment for ASD

Virtual or augmented reality has several exploitable advantages for working with children who suffer from autistic spectrum disorder, ASD. Indeed, it facilitates the control of the environment, as well as social interactions of the personality.

This can contribute to increasing the self-esteem of patients who encounter difficulties in the real environment in controlling social situations [11]. The CVE offers high flexibility in the sense that social norms can be developed between users to facilitate communication. Researchers in this field confirm that virtual objects, or "avatars," can facilitate social encounters, as well as the processes of communication between people. This communication can be simpler than face-to-face in the reality [10]. Indeed, users can play major roles in a virtual environment created by virtual reality or in an environment created by augmented reality to imitate certain specific social situations [12]. Interaction in virtual reality does not require a strong direct relational engagement of the autistic individual with

Augmented reality is a "scientific and technical domain using computing and behavioral interfaces to simulate in a virtual environment the behavior of 3D entities that interact in real time between them and with one or more users" [7].

Perhaps, it is necessary to explain the terms "virtual reality" and "augmented reality." The virtual environment is defined as a "computer generated three-dimensional simulation of a real or imaginary environment" [8]. People who use these environments can interact through "an avatar"; so, users can get direct responses based on their behavior in a virtual environment [9]. In a collaborative virtual environment (CVE), multiple users can communicate with each other through their avatars. If we have a single user, we are talking about a simple virtual environment [10].

another person [11]; the same is true for augmented reality. As a result, interactions are realized slower, and ASD children have more time to think about different ways of reacting to one situation or another. Motions and recognition of emotional expressions [13]. In addition, using educational potentials of this technology, we can have the autistic person interact with an avatar that is a street, a building, or an animal (Fig. 1). It is also interesting to create situations, such as to cross a boulevard or a fire to put out, in order to anticipate events in the real world [14]. The researchers add that the CVE allows patients to practice real conversation in a virtual world [8]. Indeed, if it is the researcher who chooses the real activities and the modeled ones, he/she can choose models of real buildings and real situations around the real environment of the autistic. This point takes up the consideration made previously related to the importance of the customization of the models.

To the question of how children with autism interpret the virtual environment, probably the first researchers who used virtual reality in the field of autism were

Strickland et al. [15], who employed a complete immersion system to learn the steps to cross a boulevard (Fig. 2). In this memory, a more extensive study was carried out to observe that these experiments could be transferred to a real situation.

Various analyses have also been carried out to check whether the technology of virtual environments with a computer, a large projection screen, and an application of augmented reality could be applied.

In our case, Nichols [16], who was able to work with children with ASD, attested that the virtual environment with these systems is more accessible, especially for this type of population. The research subsequently disclosed was carried out with the latter system [17]; it was demonstrated that new technologies, such as virtual reality, are effective, comfortable, facilitative, and offer a supportive emotional context. The researchers continued their assertions by adding that virtual and/or augmented reality shares its advantages but increases the potential of its effects. More precisely, it increases its benefits in terms of the generalization skill, thanks to the great ability to engage and control the attention, control, and commitment of the emotional participation that virtual environments can offer.

This device is practical and very useful for working with the problem of autism because it can provide a large amount of exploitable resources to create a project appropriate to the needs of an autistic child.

Fig01: Large-scale 3D model of a daily VE close to a real situation
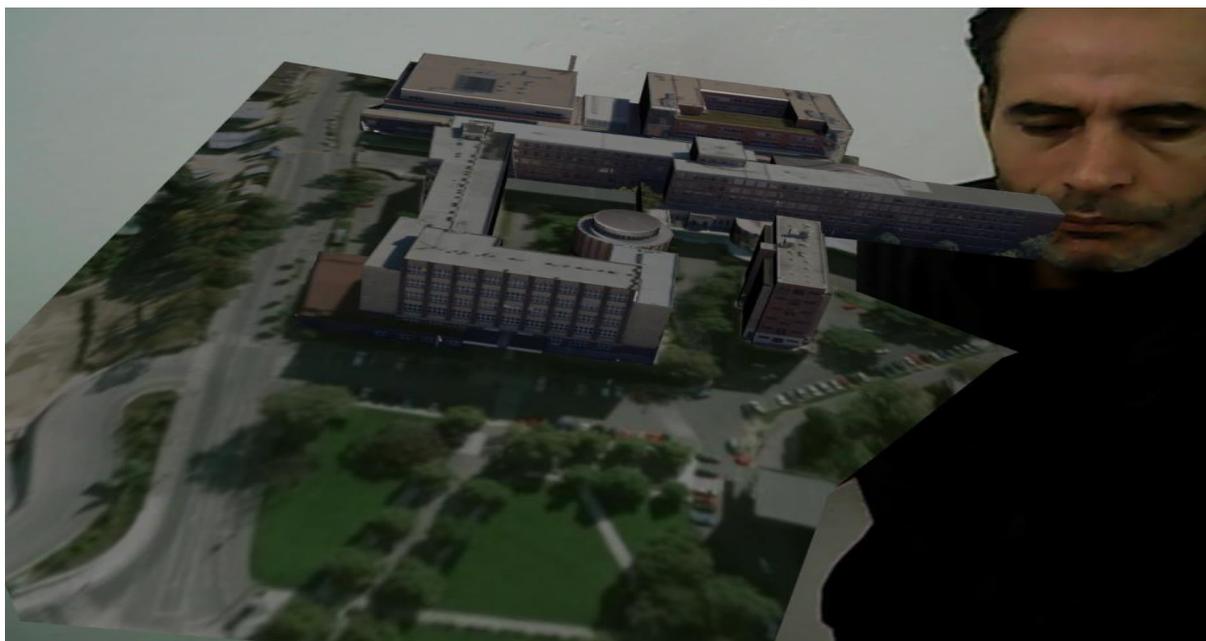
Fig02: face 2 a daily EV complete immersion system to learn the steps to cross a boulevard

4.1. The benefits of augmented reality

Several research studies and studies have agreed to confirm the usefulness of AR for interacting with people with ASD. Different arguments are cited in their research to strengthen the use of this technology. As we have shown in the previous part the affinity of people with

5. Results

5.1. Study carried out as part of the Program supported by the Higher Institute of Specialized Education (HISE) for children

Search title: "Autism and RA"
Objective of the study:
This literature review on the use of AR and its effectiveness in the development of non-verbal communication and social interaction, but we will focus more on the field of communication and more particularly the non-verbal communication in people with ASD.
Sample:
We made the selection of 16 relevant researches from a thematic point of view according to a few criteria that the higher institute of specialized education (ISES) called them by the applied researches. The latter use the AR in the care of the children non-verbal or little-verbal.

ASD for this technology is linked to the fact that these tools have characteristics that correspond to their mode of operation since these tools provide visual information, the visual language is much easier to understand for those people who are often "visual thinkers".

The selection of searches is carried out according to the criteria; First of all, research must be applied and different from fundamental research, the results obtained must be applicable in order to develop good practices among the various actors (specialist education professional). A methodological guide aimed at improving communicational aspects is available to stakeholders.

The common thread of this research chosen by our committee is the proven effectiveness of AR on improving communication in children with ASD. The use of 3D modeled avatars by adding a sound of a lizard or dragon to the scene (Fig. 03) is promising, other non-verbal communication modeled avatars have been created, some are being tested. Young children with ASD benefit more from immersive and interactive interfaces, daily living aids are offered.

Fig04: use of 3D modeled avatars by adding a sound of a lizard or dragon to the scene

The considerable impact of AR is discussed both in support for learning and autonomy, and in support of communication and social skills (Fig. 05).

Fig.05: Teaching respect for distance

The place given by specialized educators to the use of new technologies in their educational practices

We will present the results obtained following the responses of specialized educators concerning the place accorded to AR in their daily practice with people with autism.

"Do you use digital tools in the care of people with autism?" (Fig06)
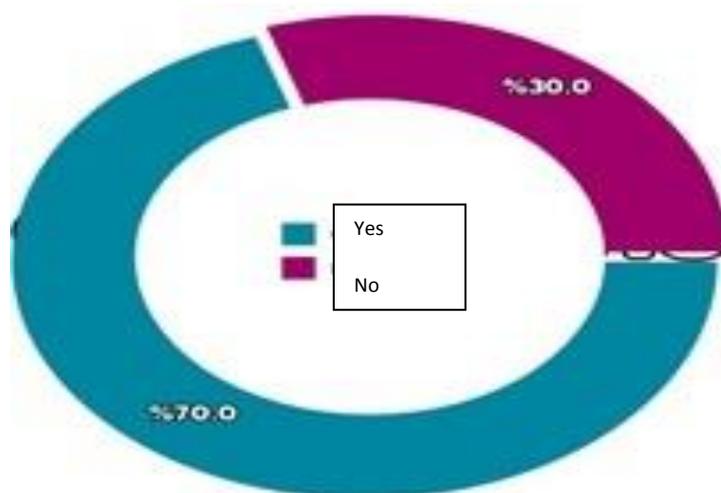
Fig06. Use of AR

6. Conclusion

As part of this study, we wanted to analyze the effectiveness of the use of AR in improving non-verbal communication in children and young adults with autism.

Different data resources made it possible to understand the importance of the use of AR aimed at improving non-verbal communication skills, we relied on the modeling of different types of avatars by adding the sound of each avatars addressed to special educators, by adopting an explanatory method, thanks to the data collected we were able to grasp the usefulness of these means in their educational practice.

We presented the use of AR in the daily practice of specialized educators, the analysis of the answers showed that they are convinced of the potential of these

supports which has in several fields more precisely on the alternative and augmented communication.

Another element that deserves to be pointed out is the virtue of these tools; we are talking here about the attractive, facilitating, fun and repeating aspect which explains the strong interest of ASDs in this technology.

We pointed out the fear of educators, following the use of these tools, manifested in the fear of confinement or isolation, we saw that the activities must be planned and structured.

Another aspect that deserves to be declared is the participation of parents, which is essential but the activities at home must be approved by the intervening team, they are part of an individualized educational project.

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