AUGMENTED REALITY PROMOTES SOCIAL RESPONSES IN AUTISM SPECTRUM DISORDER SUBJECTS

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Abstract

Inclusive education is a pedagogical proposal that pursues the basic right to a joint education for all students. In this line, the increasing prevalence of students with Autism Spectrum Disorder (ASD) in the classroom requires a greater understanding of their academic abilities, experience and outcomes. Given recent education reform processes, experts are actively developing opportunities for the educational and personal fulfilment of this group. Among these is the use of a set of technologies that take into account the characteristics of learners. It is for this reason that the need arises to talk about the application of technologies in the classroom, which invite reflection on the teaching-learning process. In this sense, this study aims to apply Augmented Reality to enhance social responses in students with Autism Spectrum Disorder. This research is based on a quantitative approach with a quasi-experimental design with a control group and an experimental group. The sample is made up of 12 students with ASD who are enrolled in a Special Education Specific Unit. Regarding the participant selection procedure used in this study, it was non-probabilistic sampling with an available or accidental nature and easy access or accessibility. The study variable is the social response that has been studied based on three parameters: the greeting at the beginning of the session, the farewell at the end of the session and the communication presented throughout the session. Regarding the instrument used in the educational intervention, the research was carried out through a field notebook designed *ad hoc*. Subsequently, once the intervention and data collection had been planned and implemented, data analysis was carried out using the SPSS statistical package for Windows (Statistical Package for Social Sciences) version 25. The results obtained show that from the first session more than half of the students in the experimental group (83.33%) said hello at the beginning of the session, as opposed to the control group (16.67%). Likewise, with regard to saying goodbye, the percentage of learners who produced this skill was higher in the experimental group than in the control group. Finally, in terms of communication presented throughout the sessions, the same results were obtained for both groups from the third session onwards. As future lines of research, we propose the continuation of the study with the possibility of applying this tool to a larger group of students, as well as the study of other variables.

Keywords: Autism Spectrum Disorder (ASD), Augmented Reality (AR), social communication, social interaction, intervention.

1. Introduction

Since the 1990s, the term 'inclusive education' has gained traction in research, policy, and practice (Kielblock and Woodcock, 2023). In this sense, inclusive education can be defined as an educational approach that proposes schools in which all learners can participate, and all are treated as valued members of the school (Moriña, 2017). Furthermore, Mansur (2018) adds that inclusive education is achieved when the educational community, i.e. teachers, families and students work together to minimise the barriers that children face in learning and promote the participation of all children in school. In this perspective, successful inclusive education requires school transformation and systems change. However, much of this reform is focused on design and does not require many resources. It is important to underline, as Schuelka (2018) puts it, that inclusive education means that all children are together in regular classrooms for most of the day, proving to have positive effects on student achievement and social well-being, being much more efficient and effective than special schools and classrooms. It is noteworthy that although the term 'inclusive education' is often made synonymous with education for children with

disabilities, it will be inclusive for all children with very different attributes, such as ethnicity, language, gender and socio-economic status (Schuelka, 2018).

This inclusive school has been reinforced in the Salamanca Statement (UNESCO 1994) adopted at the world conference that recognised education for all as an institution. According to Messiou (2017), it can be interpreted that all children can learn, all children are different, and that difference is a strength, therefore, the quality of the learning process must be improved through collaboration with students, teachers, parents and society.

On the other hand, within the large group of students in school classrooms, Autism Spectrum Disorder (hereinafter ASD) is a topic of interest for current educational issues due to the prevalence figures. According to the World Health Organisation (WHO, 2022), one in every 100 children in the world is diagnosed with ASD. Specifically, the American Psychiatric Association (2013) defines ASD as a disorder characterised by difficulties in communication and repetitive behaviours, presenting persistent impairment in social interactions and communication in different situations, including the destruction of mutual socio-emotional relationships. As Abdollahi and Ershad (2023) point out, ASD is diagnosed and recorded according to the severity of symptoms as well as the amount of support needed in social interactions. Authors such as Vargas and Gutiérrez (2023) indicate that these deficits in social interaction lead to a delay in the effective development of social skills, which are considered essential for the individual's future autonomous decision-making. Therefore, taking into account the above, the importance of training individuals with ASD in social skills has been demonstrated, and it is essential to stop seeing it as a difficulty that has no solution and to start taking actions to improve the quality of life of these individuals (Vidriales, et al., 2017).

Along these lines, Newbutt et al., (2020) suggest that people with ASD are impacted by the way people relate to the environment through perception, communication and interaction. Furthermore, Lorenzo et al., (2016) state that students with ASD are characterised by extremely specific visual preferences and learning needs. It is this preference for visual learning that has encouraged the use of new emerging technologies such as the use of Augmented Reality (AR). In this regard, AR is presented as an emerging and motivating technology to be included in teaching-learning processes and allows the combination of digital information and physical information in real time by means of different technological supports, such as tablets or smartphones, to create a new enriched reality (Cabero-Almenara and García-Jiménez, 2015). The possibility of experimenting with the object provides great opportunities for learning, improving attention, motivation and memory; consequently, the technological possibilities of AR can be used to help children with ASD (Lim et al., 2019).

2. Objectives

The main objective of this project is to apply Augmented Reality to enhance social responses in students with Autism Spectrum Disorder. The following research questions have been extracted from the general objective underpinning this intervention:
  1. Do students with ASD say hello at the beginning of the session?
  2. Do students with ASD say goodbye at the end of the session?
  3. Do students with ASD communicate throughout the session?

3. Method

This project has been carried out thanks to the collaboration of all the members of the IncluTIC research group. Specifically, the method of this work is a quantitative approach, with a quasi-experimental design with a control group and an experimental group. Participants were selected using a non-probability sampling method with an available or accidental nature that was easily accessible or accessible. To prepare for the creation of the AR environments, an interview was conducted with tutors, therapists, psychologists, and speech therapists.

3.1. Description of the context and participants

The sample consisted of a total of twelve students with ASD aged between 4 and 24 years, with an average age of 13.66 years. With regard to the degree of ASD according to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) (American Psychiatric Association, 2013), 16.67% of the students have level I ASD, 50% have level II ASD and, finally, 33.33% have level III ASD. On the one hand, 6 of the subjects attend a Special Education centre and, on the other hand, 6 of the students attend a Specific Special Education Unit. Both locations are in the city of Alicante.

3.2. Study variable and instrument

In this research, the social response of students with ASD based on the intervention carried out with the application of AR through the use of the tablet has been selected as the study variable. In this line, the research variable has been studied based on three parameters: the greeting when the session begins, the farewell when the session ends and the communication presented throughout the session.

Regarding the instrument used in the educational intervention, it consists of a field notebook designed *ad hoc* to collect the information. For this purpose, a descriptive statistical analysis of the participants was carried out to calculate frequencies and percentages.

3.3. Procedure and data analysis

The educational intervention is based on the design of a set of activities that the students have to carry out and that constitute the instruments for collecting information. To this end, visual learning is promoted in such a way that, in the event of any success, the AR system reinforces this behaviour, and, in the event of any error, the system guides the student towards the correct path. In order to develop the research, a series of steps have been carried out, which are detailed below.

1. Selection of the subjects who took part in the study.
2. Preparation of the intervention through the design of activities.
3. Implementation of the activities in the control group and the experimental group.
4. Data collection throughout the sessions.

Once the intervention had been planned and implemented and the data had been collected, the results obtained were analysed using the SPSS statistical package for Windows (Statistical Package for Social Sciences) version 25.

4. Results

With respect to the results, following the analysis of the data obtained, a table has been created in which the responses to the three study parameters, derived from the main variable, chosen for this research, can be seen.

Table 1. Values obtained for the three study parameters.

Session	Value		Greeting at the start				Farewell at the end				Oral communication			
			Control group		Experimental group		Control group		Experimental group		Control group		Experimental group	
			f	%	f	%	f	%	f	%	f	%	f	%
1	Valid	No	5	83,33	1	16,67	6	100	3	50	3	50	1	16,67
		Yes	1	16,67	5	83,33	0	0	3	50	3	50	5	83,33
2	Valid	No	4	66,67	1	16,67	4	66,67	0	0	2	33,33	1	16,67
		Yes	2	33,33	5	83,33	2	33,33	6	100	4	66,67	5	83,33
3	Valid	No	4	66,67	0	0	3	50	0	0	1	16,67	1	16,67
		Yes	2	33,33	6	100	3	50	6	100	5	83,33	5	83,33
4	Valid	No	6	100	0	0	2	33,33	1	16,67	1	16,67	1	16,67
		Yes	0	0	6	100	4	66,67	5	83,33	5	83,33	5	83,33
5	Valid	No	4	66,67	1	16,67	1	16,67	0	0	1	16,67	1	16,67
		Yes	2	33,33	5	83,33	5	83,33	6	100	5	83,33	5	83,33
6	Valid	No	4	66,67	0	0	2	33,33	0	0	1	16,67	1	16,67
		Yes	2	33,33	6	100	4	66,67	6	100	5	83,33	5	83,33
7	Valid	No	4	66,67	1	16,67	2	33,33	2	33,33	1	16,67	1	16,67
		Yes	2	33,33	5	83,33	4	66,67	4	66,67	5	83,33	5	83,33
8	Valid	No	4	66,67	2	33,33	1	16,67	2	33,33	1	16,67	1	16,67
		Yes	2	33,33	4	66,67	5	83,33	4	66,67	5	83,33	5	83,33
9	Valid	No	5	83,33	1	16,67	2	33,33	0	0	1	16,67	1	16,67
		Yes	1	16,67	5	83,33	4	66,67	6	100	5	83,33	5	83,33
10	Valid	No	3	50	0	0	1	16,67	0	0	1	16,67	1	16,67
		Yes	3	50	6	100	5	83,33	6	100	5	83,33	5	83,33

Specifically, in relation to the first parameter of the study, greeting at the beginning of the session, we show the number of students with ASD in the control group and the experimental group who greeted at the beginning of the session in each of the sessions carried out. In reference to this first parameter, it can be seen that, from the first session, more than half of the students in the experimental

group (83.33%) greeted at the beginning of the session, compared to the control group (16.67%). Similarly, the data concerning the second parameter of the study can be seen. In particular, it is reflected that the percentage of students who produced this skill was higher in the experimental group than in the control group. Finally, with regard to the communication presented throughout the sessions, the same results were obtained for both groups from the third session onwards.

5. Discussion and conclusions

Based on the research questions derived from the general objective of this study, these questions are answered in conclusion.

In general, it can be seen that students with ASD who have made use of AR greet a higher percentage at the beginning of the sessions than students who do not make use of AR. This fact, as Kellems et al., (2022) argue, could respond to the lack of interest on the part of some individuals with ASD in the use of traditional instructional models. Because of this, students in the control group start the sessions with less predisposition towards the work, obtaining, as indicated by Frolli et al., (2022), a weak rate of motivation towards the initial social response.

In relation to the farewell, the results show that students who have made use of the tablet with AR have responded on a greater number of occasions to the final part of the session. In this regard, Romero et al., (2020) affirm that AR generates positive results, as it proposes a pleasant environment to the subject, which is evidenced by an improvement in participation, a reduction in the level of stress and a predisposition to work and perform new tasks, which can help, according to Almurashi et al., (2022), to prevent students from getting bored quickly. Also, in line with Adnan et al., (2018) the use of this tool provides satisfaction and confidence in the use of AR applications among learners with ASD and this generates an improvement in the response of subjects with ASD to stimuli from other people.

Regarding the oral communication presented in the sessions, the same number of responses was observed from the third session onwards by both working groups. However, the subjects who made use of AR began to communicate orally from the first session onwards. In this line, as in other research using Augmented Reality compared to a traditional methodology, AR increased the emergence of expressive language. Specifically, Nubia et al., (2015) points out that Augmented Reality applications stimulate oral and expressive language through the reproduction of onomatopoeias and sounds representative of the elements in contrast to the traditional method. Similarly, Almeida et al., (2015), illustrate the potential of AR systems to be used in the development of language skills due to the significant increase in interaction and communication initiated by children.

Finally, in reference to the general objective of the study, it can be affirmed that the use of Augmented Reality has been beneficial in increasing social responses in students with Autism Spectrum Disorder, as it has promoted social interaction to a greater extent before starting and after the sessions than students who have made use of a traditional methodology. In this sense, authors such as Lee et al., (2018) support the idea that the use of Augmented Reality can help promote greeting behaviours in individuals with ASD, helping to foster improved understanding of non-verbal social cues and, in this way, they learn to reciprocate when interacting socially with others. However, it should be noted that how AR intervention affects oral communication needs to be further studied, as no relevant results have been found in this regard.

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