

# **SOCIAL SKILLS, AUTISM AND TECHNOLOGIES: AN ANALYSIS OF THE EFFECTIVENESS OF THIS TRIAD**

## **Abstract**

Students with Autism Spectrum Disorder (ASD) present needs in the social sphere that have repercussions on their development. It is essential that, at school, they are offered interventions that provide them with an answer to their needs and use appropriate tools. One of the resources that can be effective is the use of technologies, which possess a series of characteristics that favour their implementation in the population with ASD. For this reason, and with the aim of analysing the impact a technology-based social skills programme has on students with ASD, a mixed study based on case studies was proposed. Specifically, the sample consisted of four pupils with ASD. Data collection was carried out, on the one hand, by means of objective tests administered at three points in time, which measured the level of ability in identifying emotions and in emotion awareness. On the other hand, the behaviours were also observed systematically in all the sessions that made up the intervention. The results point to an improvement in the identification of emotions and emotion awareness. Likewise, a decrease in non-social behaviours such as inappropriate behaviours or stereotypes and an increase in social behaviours such as eye contact or joint attention were noted.

**Key words:** Educational programme; Social skills; Autism Spectrum Disorder (ASD); Information and Communication Technologies (ICT)

## **1. Introduction**

In 2015, the United Nations drew up the 2030 Agenda, which includes 17 goals (called Sustainable Development Goals) that must be met by 2030 in order to transform the world, thereby leading us towards a more sustainable model in economic, social and environmental terms (UN, 2015). One of these goals, number four, highlights the importance of ensuring inclusive and equitable quality education that promotes opportunities for lifelong learning for all (UN, 2015). In order to achieve true inclusion, it is necessary to understand the presence of functional diversity and address it with suitable educational methodologies and strategies (Ortega, 2020) and to recognise the potential of each person (López & Carmona, 2018).

In particular, it is essential to focus attention on disorders that have become more prevalent in recent years, such as Autism Spectrum Disorder (hereinafter ASD) (Maenner et al., 2020), so that we can offer adequate and effective educational attention to a population that is increasingly present in schools (Silveira-Zaldivar et al., 2021).

ASD is a multi-causal neurodevelopmental disorder characterised by needs in two domains. On the one hand, there are repetitive and restrictive patterns of behaviour, interests or activities and, on the other, needs in the area of communication and social interaction (American Psychiatric Association, 2013). In relation to this last area, people with ASD have needs in the use of looks, smiles, gestures or joint attention patterns (Murillo, 2013). Similarly, limitations appear when it comes to handling topics, reciprocity and the use of information in conversations (Carpenter, 2013; Rodríguez, 2016), as well as in social play and in the management and identification of emotions (Palomo, 2017).

Many of these needs are associated with social skills (Davenport et al., 2018; March-Miguez et al., 2018), which are conceptualised as a set of behaviours and competences used in everyday life to successfully relate to others (Caballo et al., 2017). In the case of people with ASD, these skills do not tend to improve with development and, in fact, their needs become more pronounced as social demands increase (Picci and Scherf, 2015). It is therefore essential to implement appropriate interventions that promote this social competence (Gates et al., 2017) and avoid the high risk of social isolation in this population (Hobson, 2014; Mendelson et al., 2016).

One of the aspects linked to the social domain, and in which people with ASD have needs, is the identification of emotions and feelings in themselves and in others (Costescu et al. 2017; Palomo, 2017).

This circumstance gives rise to difficulties when it comes to implementing adaptive strategies in social situations (Mazefsky et al., 2013). They also have needs when it comes to emotion regulation, which is linked to social and academic success and includes difficulties associated with behavioural problems over time (Berkovits et al., 2017).

In view of this situation, several studies (Bru, 2020; Moody y Laugeson, 2020; Leaf et al., 2017) have shown that people with ASD can learn and improve their social skills with the implementation of appropriate interventions based on an educational-psychological approach that reinforce and stimulate the child's social development (Silveira-Zaldivar et al., 2021). In the first study, a programme was implemented that produced a significant improvement in the social behaviours of its 15 participants, which were maintained and even improved in the evaluations carried out 32 weeks after the intervention had finished. In the second study, following a systematic review, improvements were observed in aspects such as cooperation and self-control (Yoo & Kim, 2018), empathy (Sung et al., 2018) or verbal greetings and eye contact (Tsui & Rutherford, 2014).

To meet this challenge, education professionals must incorporate new methodologies, resources and tools into the teaching-learning process. In this way, the interventions will make it possible to provide a response that is better tailored to meet students' needs (Cored et al., 2021). One of the resources and instruments used, and is yielding successful results, is technology, which has influenced education and the way in which knowledge is transmitted (Chica, 2019). This influence has favoured the emergence of different terms that link education and technology, such as the so-called "Learning and Knowledge Technologies" or "Mobile Learning" (McQuiggan et al., 2015), which refers to the use of mobile devices as a teaching tool.

Similarly, much research has been conducted that supports the use of technologies in people with ASD to improve their social skills (David et al., 2020; Hanna et al., 2021; Leung et al., 2021). This is not only due to the great interest they arouse in people with ASD (Corso et al., 2020), but also to a number of specific characteristics and potentialities of technological resources. On the one hand, they are designed in such a way as to make them easy to use (McQuiggan et al., 2015) and they favour flexible and personalised learning (Sanromà et al., 2021). Thus, students with ASD can become part of their own teaching-learning process in accordance with their potentialities (Roldán-Álvarez et al., 2016). At the same time, they offer a controllable environment and eminently visual multisensory stimulation (Cabiellas-Hernández et al., 2016) that favours their understanding, since people with ASD are better at processing the information received visually (Parsons et al., 2016). In addition, the audiovisual and gamification characteristics of technology allow for the creation of environments that favour the participation of all, with dynamics that are fun, varied and motivating (Deterding et al., 2011).

Studies such as those carried out by Walker and Weidenbenner (2019) or Zhang et al. (2019) have confirmed the effectiveness of interventions with the use of technologies in the field of social skills in people with ASD, which have led to a significant improvement in the identification of emotions and feelings, and consequently in their adaptive capacity in social relationships. In the first of these studies, the authors showed that technological tools improved important skills such as empathy, which is essential to be able to put oneself in the other person's place and identify their emotions. In the second study, the researchers observed that technological resources could improve the identification of emotions from facial features, thus allowing them to understand what other individuals are trying to say (Shoaib, 2020).

Other authors have confirmed very promising results in their programmes in relation to basic aspects of social skills, such as increased joint attention (Kumazaki et al., 2018), which is essential for social development (Mundy et al, 2016) or a reduction in the number of inappropriate behaviours (Schuck, 2016) that hinder and interfere in interactions with other people.

### **1.1. Technology-based social skills programme**

In order to achieve improvements in the social sphere in this type of population, a technology-assisted social skills intervention programme was designed and implemented, which had the Theory of Mind Manual for children with autism (Cornago et al., 2012) as a reference and was based on two of the psychological theories related to the social needs of people with ASD (Jodra, 2015), namely, the Theory of

Mind (Baron-Cohen, 2005) and the Weak Central Coherence Theory (Happé & Frith, 2006). As indicated above, technological tools were used in this intervention, in this particular case iPads and wearables. The iPad was the technological resource from which the different sessions of the programme were developed. The iPad contained the presentations that guided the interventions and with which some of the tasks were carried out. It also housed the different applications that were used. The more than 15 applications used were previously analysed and evaluated by authors such as Cored et al. (2020) were used. In this way, technical, functional and pedagogical aspects were assessed to confirm their quality. Two Empatica E4 wristbands were also used. This device was a non-intrusive multi-sensor wearable that had the ability to measure different parameters: heart rate, electrodermal activity, blood pressure and temperature. This information could be transferred to a computer through a web application to be displayed in a very simple and visual way through graphs.

The programme was initially designed to run for one academic year, but because of the COVID pandemic, the intervention ended up being extended and split into two parts. One part was carried out in the academic year 2019-2020 and the other in the academic year 2020-2021. Four pupils from a primary school offering preferential attention to ASD participated in this programme. Initially, work was carried out in pairs, with the aim of encouraging interaction between them. One of the pairs remained for the 20 sessions of the programme, but the other did the second part of the intervention individually due to the bubble groups that were formed in the schools as a result of the COVID pandemic. Thus, of the 22 sessions that their programme consisted of, only 11 were carried out jointly. The one-hour sessions were held on a weekly basis.

Finally, as distinctive elements of this programme, it is important to highlight the large number of sessions that made up the intervention as well as the fact that it was implemented through technological resources. Very few social skills programmes have such a prolonged intervention with ICT. The aim was to have a significant positive impact on this facet or area that people with ASD have difficulties with.

## **1.2. Objectives**

Taking into account all of the above, the main objective of this research was to analyse the effect of a technology-based social skills programme on the development of the social domain in people with ASD while it was being carried out and after its implementation. The following specific objectives were also proposed:

- To assess the improvement in emotion identification and emotion awareness after the intervention of the social skills programme.
- To analyse the evolution of non-social behaviours and social interactions among students and between students and the researcher during the intervention.

## **2. Method**

This longitudinal study is based on a mixed methodology that integrates qualitative and quantitative aspects (Fetters, 2020) through active and reflective relationships (Akerblad et al., 2021). Furthermore, this methodology is built on the concept of triangulation of methods, facilitating a greater understanding of the phenomenon under study (Rodríguez, 2012). Similarly, the method employed was the case study, which makes it possible to characterise the development and peculiarities of a subject and is useful for diagnosing or performing a comprehensive assessment of a given situation in the educational context (Soto & Escribano, 2019). In addition, the pretest/post-test methodology was also used, which facilitates the study of the processes of change that can be obtained as a result of an educational intervention.

### **2.1. Population and sample**

For this research, the sample was selected in a non-random manner and, more specifically, purposive or convenience sampling was carried out. Therefore, the participants in the study were pupils from a school offering preferential attention to ASD, selected taking into account two inclusion criteria: diagnosed with

the disorder and presence of verbal communication (language). The characteristics of the four subjects who finally participated in the study are shown below (Table1).

**Table 1.** Characterisation of the sample

| Subjects         | Age         | School year<br>(Curriculum gap)                     | Level of severity<br>ASD   | Social and communicative<br>development  |
|------------------|-------------|---|--|--|
| <b>Subject 1</b> | 6-7 years   | 1st and 2nd years of<br>primary school<br>(1 year)  | Grade 1<br>No associated<br>intellectual<br>disability and no<br>comorbidity with<br>other disorders | Has needs in both verbal and non-verbal communication. Functional language. Difficulties in relating to others and the (decreasing) use of echolalias stand out.   |
| <b>Subject 2</b> | 6-7 years   | 1st and 2nd years of<br>primary school<br>(2 years) | Grade 2<br>No associated<br>intellectual<br>disability and no<br>comorbidity with<br>other disorders | Has needs in both verbal and non-verbal communication. Poorly functional language. Significant difficulties in relating to others and the use of echolalia (both verbal and motor) with no communicative function. |
| <b>Subject 3</b> | 11-12 years | 4th and 5th years of<br>primary school<br>(2 years) | Grade 1<br>No associated<br>intellectual<br>disability and no<br>comorbidity with<br>other disorders | Has needs in both verbal and non-verbal communication. Functional language. Difficulties in relationships with others (no impulse control)   |
| <b>Subject 4</b> | 10-11 years | 3rd and 4th years of<br>primary school<br>(1 year)  | Grade 1<br>No associated<br>intellectual<br>disability and no<br>comorbidity with<br>other disorders | Has needs in both verbal and non-verbal communication. Highly functional language. Difficulties in relating to others (pragmatic domain).  |

## 2.2. Instruments

Three different instruments were used to collect data for the quantitative part of the research. On the one hand, all participants were given the "test to assess the ability to perceive, express and value emotions in children in the infant stage" (Mestre et al., 2011), which consists of 15 questions of three different types. Seven of the questions are based on identifying the emotion indicated on six different faces (each of them expresses a basic emotion), five of them involve distinguishing which of two people is expressing the indicated emotion and four of the items are based on identifying the emotion produced by a melody among the six faces that appear (each of them is also associated with a basic emotion).

In addition, during the sessions, the participant observation method was used to identify the (previously recorded) interactions of the subjects. The questionnaire developed by Arias-Pujol et al. (2015) was used to systematise the data. This questionnaire records behaviours linked to two broad categories: those in which there is no social interaction (No\_ISR), made up of 12 items, and behaviours in which this interaction does occur, consisting of 22 items. In turn, the latter category differentiates between social interaction with the researcher (ISR) and with the companion (ISRC). Likewise, and in a complementary manner, the student interaction observation protocol (SIP) was used (Pedrosa et al., 2013). Specifically, category 2, which is related to negative interactions, and category 5, related to unclassifiable or unobservable behaviours (INC), were introduced.

Moreover, qualitative data were obtained through the test (LEAS-C) by Bajgar et al. (2005) that was administered to the two elder subjects and which reports on levels of emotion awareness. This instrument

consists of 12 statements in which the subject has to be able to identify how he/she and other people would feel in particular situations of everyday life involving interaction with others.

### **2.3. Procedure and data collection**

The following steps were taken to carry out this research. Once the study had been designed, it was submitted to the CEICA ethics committee, which issued a favourable opinion for the project to be carried out. The process began by establishing contact with the informants and intervention scenarios. An initial institutional contact was made with the Department of Education of the Government of Aragon, explaining the purpose of the study and receiving their support. Subsequently, contact was made with the management team of a centre with preferential attention for ASD students and they were informed of the study in detail. After their approval, an informative meeting was held with the parents of the pupils who could potentially take part in the research.

It should be noted that throughout this process, the families involved, and the teachers gave their informed consent to participate in the study. The data in this study have been processed exclusively for research purposes. In this way, aspects related to respect for privacy and the preservation of intimacy were taken into account. Likewise, current legislation was taken into account for the storage and coding of personal data held by the research group.

As regards the data collection procedure, the tests put forward by Mestre et al. (2011) and LEAS-C (Bajgar et al., 2005) were administered at different points in time, before starting the intervention (baseline assessment), in the middle of the intervention (to collect data before the unexpected halt brought about by the COVID pandemic) and at the end of the intervention (in order to apply a pretest/post-test methodology). This ensured that a sufficiently large amount of time elapsed between test applications. In the first test, the number of answers the children got right and wrong was recorded. In the second, the responses were analysed with reference to the three sub-processes outlined by Miles and Huberman (1994): data reduction, data presentation and verification/conclusions, with four broad categories being identified according to the developmental evolution and complexity of the students' responses.

Furthermore, the coding and registration of the behaviours in the recorded sessions were carried out with the observational software LINCE PLUS (Soto et al., 2019). This software package facilitates the observer's task because it allows different behaviours to be identified and categorised in a very simple way. Once these data had been obtained, they were analysed with the statistical programme SPSS (version 26) and the relative frequencies of the behaviours recorded in the intervention sessions were extracted.

In order to guarantee the validity of this research, methodological triangulation was used as a strategy, implementing different methods - qualitative and quantitative - with the aim of ensuring a more comprehensive approach to the object of study. Likewise, a triangulation of the data was carried out using different collection strategies, considering different sources and, finally, comparing them.

## **3. Results**

The results obtained are presented below, divided into two large blocks. On the one hand, we present the identification of emotions and emotion awareness – data collected through the objective tests answered by the subjects. On the other, we have the results linked to the different behaviours (social and non-social), and interaction skills that the subjects displayed throughout the intervention are presented.

### **3.1. Identification of emotions and emotion awareness**

In relation to the identification of emotions linked to the "test to assess the ability to perceive, express and evaluate emotions in children in the infant stage" (Mestre et al., 2011), an increase in the number of correct answers given by the four subjects was observed.

Subject 1 had a higher number of correct answers in the exercises related to the identification of an emotion according to facial features (type 1) and the tasks in which he had to indicate whether one of the two people that were shown can be identified as reflecting a specific emotion (type 2). In general, before

starting the intervention, he answered a total of 8 questions and at the end of the intervention he answered 11, which is a significant change.

On the other hand, subject 2 experienced an increase in the success rate in the exercises linked to the identification of emotions according to facial features (type 1) and in the tasks where the subject has to indicate which of the two people is feeling a specific emotion (type 2). On the other hand, no improvement was observed in the exercises in which he had to discern which emotion can be triggered by a specific piece of music (type 3). Overall, he went from initially answering 6 tasks correctly to 11 after the intervention.

In the case of subject 3, an improvement was observed in all three types of exercises. In other words, the results improved in identifying emotions according to facial features, indicating which person is feeling a specific emotion and indicating which emotion is triggered by a specific melody. In general, 8 tasks were solved correctly before starting the intervention and 13 after its completion.

Finally, subject 4 improved his performance in the tasks of identifying emotions according to facial features (type 1) and in the exercises in which the subject must know if one of the two people shown to him is feeling a specific emotion (type 2). Overall, before starting the intervention, the subject obtained 9 correct answers and after the intervention, 13 out of a possible total of 16.

An overview of the results for all the subjects is shown below (see Table 2).

**Table 2.** Registration and evolution of the subjects' correct answers

|               | SUBJECT 1 |    |    | SUBJECT 2 |    |    | SUBJECT 3 |    |    | SUBJECT 4 |    |    |
|---------------|-----------|----|----|-----------|----|----|-----------|----|----|-----------|----|----|
|               | T1        | T2 | T3 | T1        | T2 | T3 | T1        | T2 | T3 | T1        | T2 | T3 |
| <b>Pre</b>    | 3         | 3  | 2  | 3         | 1  | 2  | 4         | 3  | 1  | 4         | 3  | 2  |
| <b>Post 1</b> | 4         | 4  | 2  | 3         | 3  | 1  | 4         | 5  | 2  | 6         | 3  | 2  |
| <b>Post 2</b> | 6*        | 5* | 0  | 5*        | 4* | 2  | 6*        | 5* | 2* | 7*        | 4* | 2  |

T= Type of exercise

\*= improvement

With regard to emotion awareness, measured by the LEAS-C test (Bajgar et al., 2005), evidence was also found of an improvement in the responses of both.

Subject 3 (see Table 3) added other emotions to his answers in post-test 1 and 2 in two statements and identified correct emotions in himself and in other people on five occasions. On the other hand, an improvement is observed when it comes to specifying and using a more complex emotion adapted to the situation in four of the statements. Similarly, he was able to add a possible cause accounting for the emotions experienced by himself or others in four of the situations.

**Table 3.** Result emotion awareness subject 3

| Type of improvement in emotion awareness                                    | Statements enhancing emotion awareness |         |
|---|--|---------|
| Adds other emotions   | In the subject him/herself             | 5, 11   |
|   | In other people                        | –       |
| Identifies emotions correctly (not so in the pretest)                       | In the subject him/herself             | 4, 10   |
|   | In other people                        | 1, 4, 6 |
| Specific emotion that is more complex and more appropriate to the situation | In the subject him/herself             | 1, 8    |
|   | In other people                        | 2, 7, 8 |
| Adds causes of the emotion  | In the subject him/herself             | 2, 12   |
|   | In other people                        | 1, 3    |

Subject 4 (see Table 4), on the other hand, added other emotions that he himself felt in two statements and identified correct emotions in himself and in other people in four of the situations presented, whereas in the pretest he was unable to do so. In the same way, there was an improvement in the realisation of more

complex emotions that were more closely matched to the situation in four of the statements. Finally, on three occasions he added causes to the emotions identified both within himself and in others.

**Table 4.** Results emotion awareness subject 4

| Type of improvement in emotion awareness                                    |                            | Statements enhancing emotion awareness |
|---|----------------------------|--|
| Adds other emotions   | In the subject him/herself | 3, 6, 7, 8, 11                         |
|   | In other people            | 2, 8                                   |
| Identifies emotions correctly (not so in the pretest)                       | In the subject him/herself | -                                      |
|   | In other people            | 6, 11                                  |
| Specific emotion that is more complex and more appropriate to the situation | In the subject him/herself | 6, 7, 8, 9, 10                         |
|   | In other people            | 2, 8                                   |
| Adds causes of the emotion  | In the subject him/herself | 3, 9, 10                               |
|   | In other people            | 3                                      |

### 3.2. Social behaviour: social interaction and non-interaction skills

If we delve deeper into each subject and look at the behaviours of subject 1, of the 4 main categories, the No\_ISR behaviours have significantly decreased and the ISRC behaviours have increased (see Figure 1).

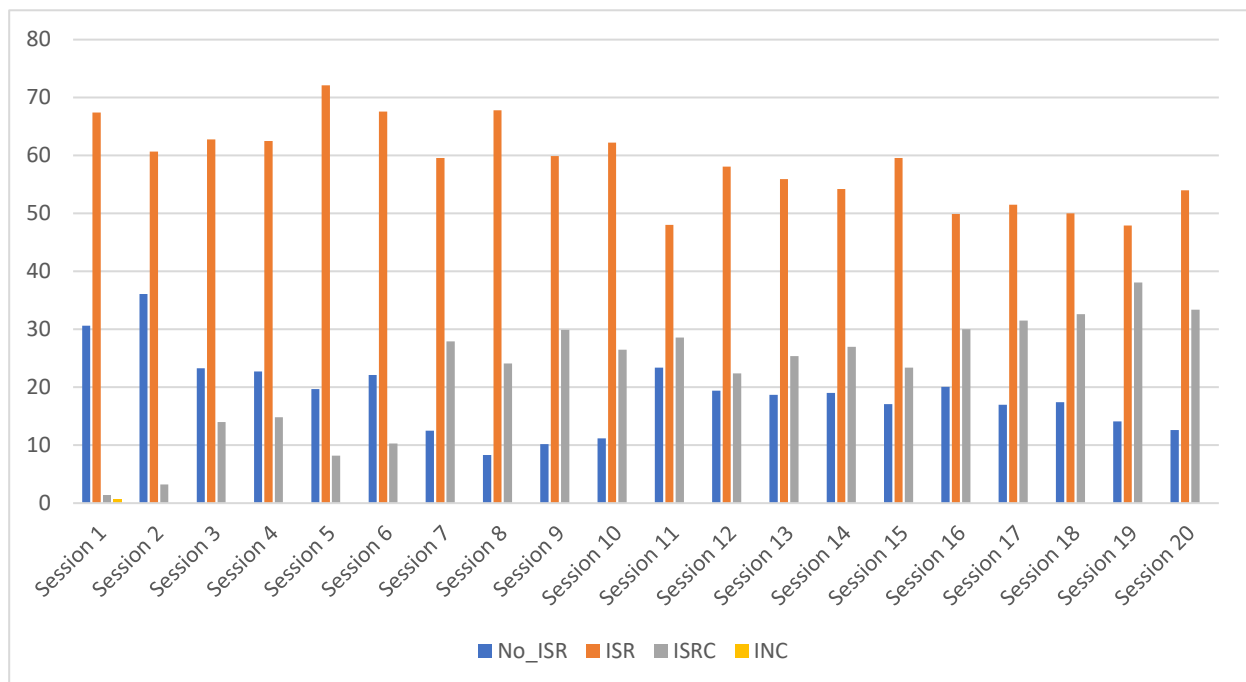


Figure 1. Observable behaviours Subject 1

Specifically, in relation to the No\_ISR behaviours, there was a decrease in stereotypies, which in the first session accounted for 19.4% of all behaviours and only 1.6% in the last session. Likewise, inappropriate behaviours, which in session 1 represented 2.1%, also disappeared and staring decreased from 4.9% to 1.6%.

In relation to ISRC behaviours, a significant increase was observed in joint attention from 1.4% to 19.1%, as well as in proxemic behaviour, which increased from 0% to 3.2% by session 20.

In relation to subject 2, there is a significant decrease in No\_ISR behaviours and an increase in both ISR and ISRC behaviours. It must be stressed that, as we can see in Figure 2, in session 11, when the second part of the intervention began, there was a small increase in No\_ISR behaviours and a decrease in ISR and ISRC behaviours.

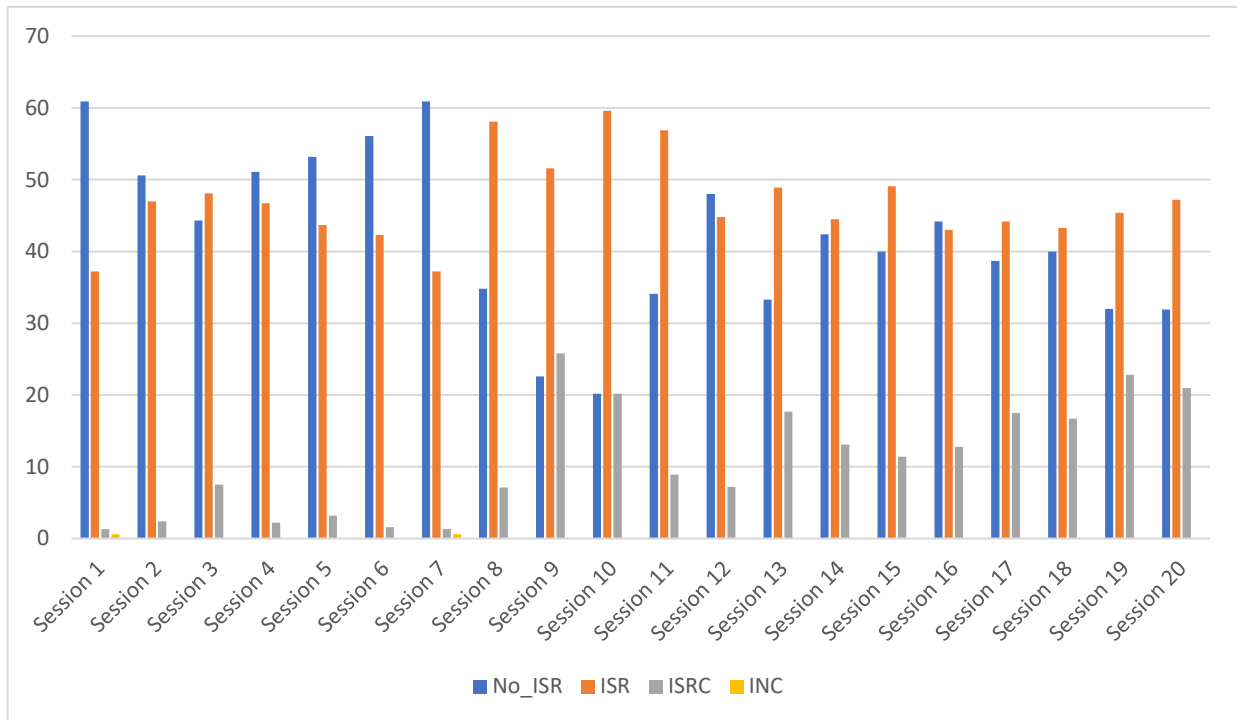


Figure 2. Observable behaviours Subject 2

With regard to the No\_ISR behaviours, a decrease from 21.2% to 5.1% is observed in stereotypies, in staring, which went from 14.1% in the first session to 6.9% in session 20, and in leaving the workplace, which dropped from 5.8% to its complete disappearance. Moreover, staring at the object (specifically, the iPad) is the only behaviour that increased: from 7.1% to 11.1%.

Moreover, linked to SRI behaviours there is an increase in responses to demands from 3.2% to 6.9%, in joint attention from 7.7% to 12.6% and in eye contact from 4.5% to 13.9%.

Finally, in ISRC behaviours there was an increase from 0% to 4.2% in responses to a demand, as well as in joint attention, representing 1.2% in session 1 and 8.4% in session 20, and in eye contact, with an increase from 0.6% to 2.8% of the total number of behaviours.

In relation to subjects 3 and 4, it must be pointed out that as the second part of the intervention was not carried out jointly, the data below are classified by the two parts of the intervention: from session 1 to 11 (ISRC behaviours appear) and from 12 to 22 (no ISRC behaviours appear).

As regards subject 3, in the first part of the intervention, a decrease in No\_ISR behaviours and an increase in ISR behaviours have been observed (see Figure 3).



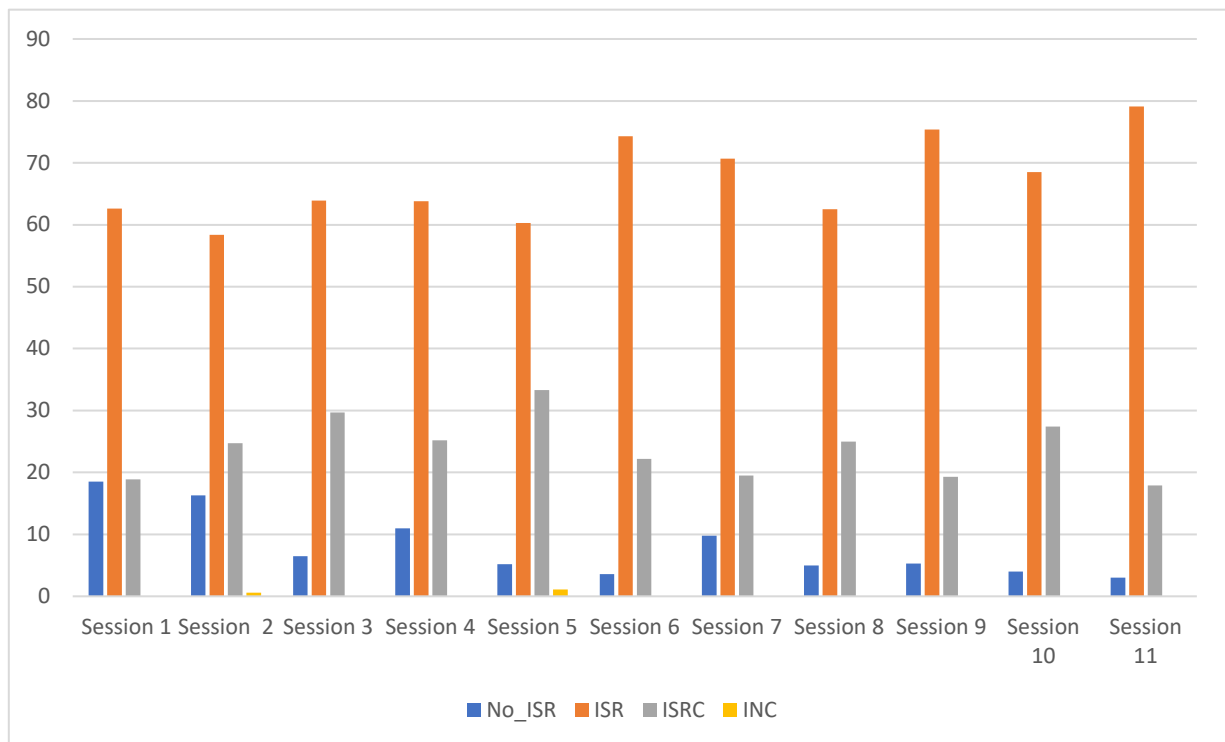


Figure 3. Observable behaviours Subject 3 (first part of the intervention)

Specifically, with regard to No\_ISR behaviours, there was a very significant decrease in inappropriate behaviours, which represented 7% in session 1 and only 0.7% in session 11. Likewise, in ISR behaviours, there was an increase in the number of demands towards the researcher from 9.7% to 14.1% and in joint attention, which increased from 21.5% to 41.1%.

With regard to the second part of the intervention, a decrease in No\_ISR behaviours and an increase in SRI were also observed (see Figure 4).

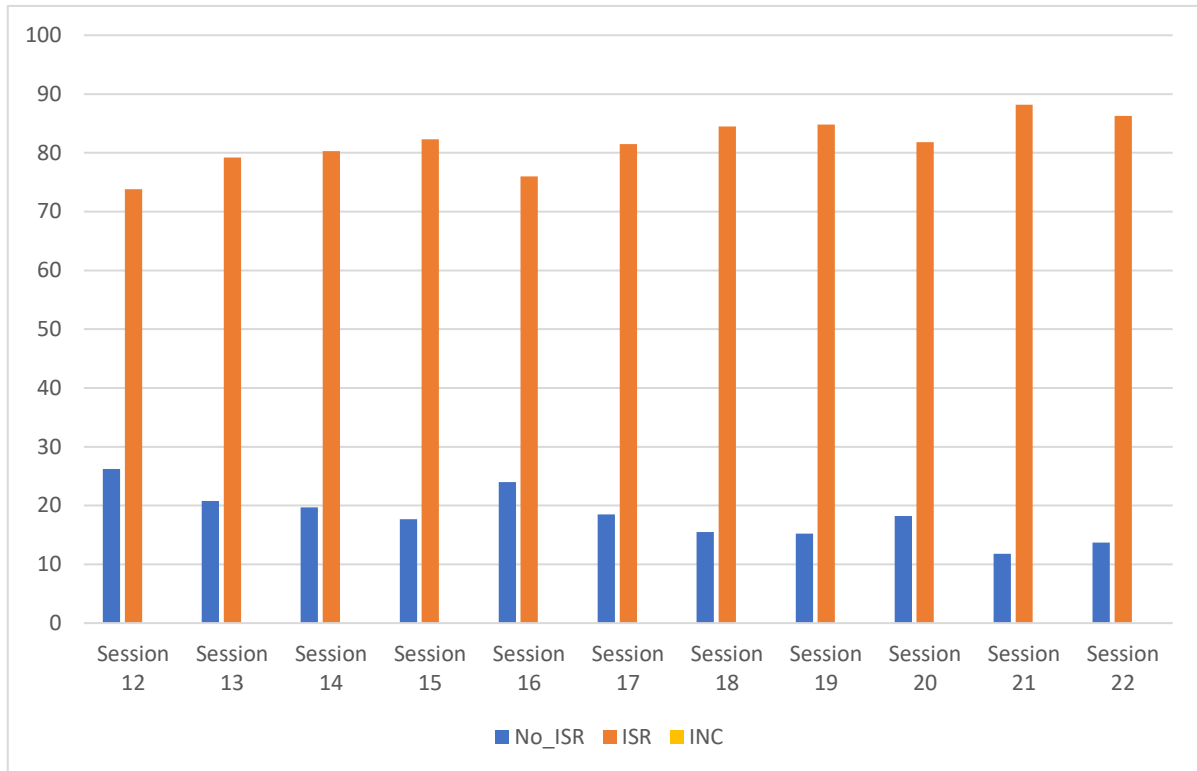


Figure 4. Observable behaviours Subject 3 (second part of the intervention)

With regard to the No\_ISR behaviours, stereotypic behaviours, which accounted for 1.5% of the behaviours in session 11, disappeared and staring decreased from 7.5% to 2.4%.

Looking more closely at SRI behaviours, there is a significant increase in joint attention. Specifically, in one of the behaviours that form part of joint attention, sentences, an increase from 26.2% to 36.6% was perceived. In addition, eye contact also improved from 13.8% to 20% of the total number of behaviours.

Finally, in the first part of the intervention the fourth subject showed a decrease in No\_ISR behaviours and a significant increase in ISR behaviours (see Figure 5).

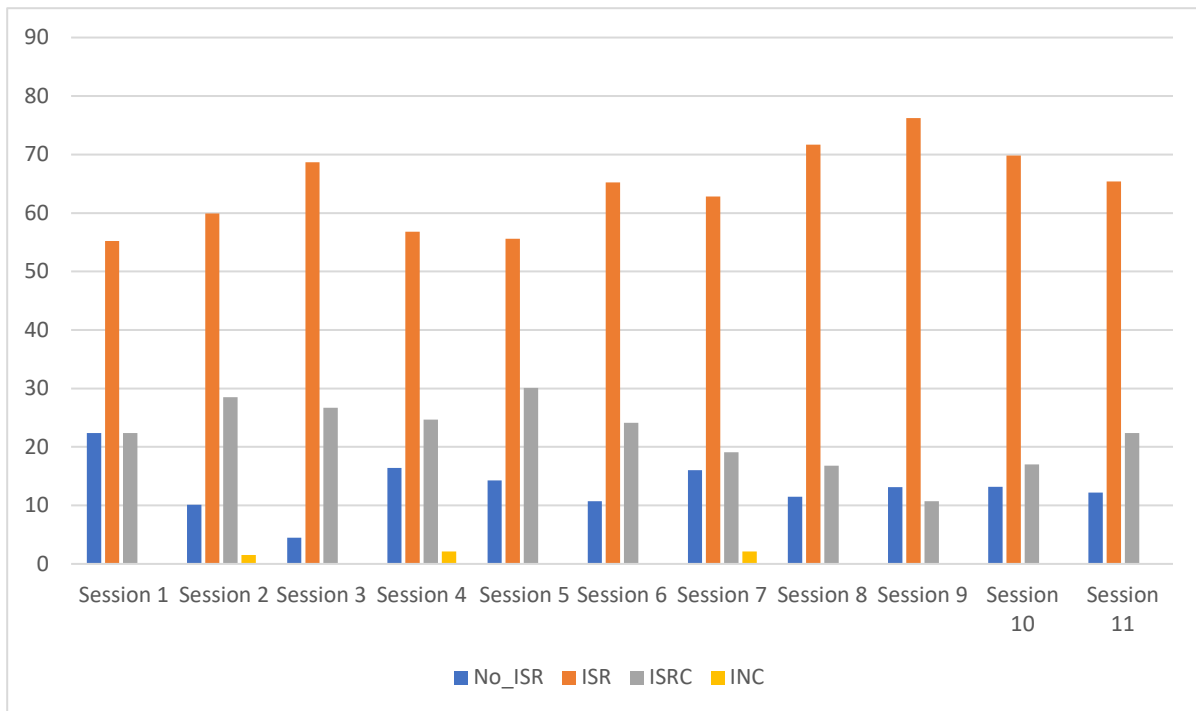


Figure 5. Observable behaviours Subject 4 (first part of the intervention)

If we look at the No\_ISR behaviours, the subject showed a very significant decrease in staring, from 9.7% to 3.1%. In addition, inappropriate behaviours, which represented 1.8% of the total, disappeared by session 11.

In relation to SRI behaviours, there was an increase in joint attention from 27.3% to 44.9%. Among the behaviours that make up ISR, there was an increase in the number of words (from 10.9% to 16.3%) and sentences (from 15.8 to 25.5) uttered by the subject. Similarly, there was an increase in eye contact, with 6.1% in the first session and 10.2% in session 11.

Likewise, in the second part of the intervention, the subject decreased his No\_ISR behaviours and increased the number of ISR behaviours (see Figure 6).

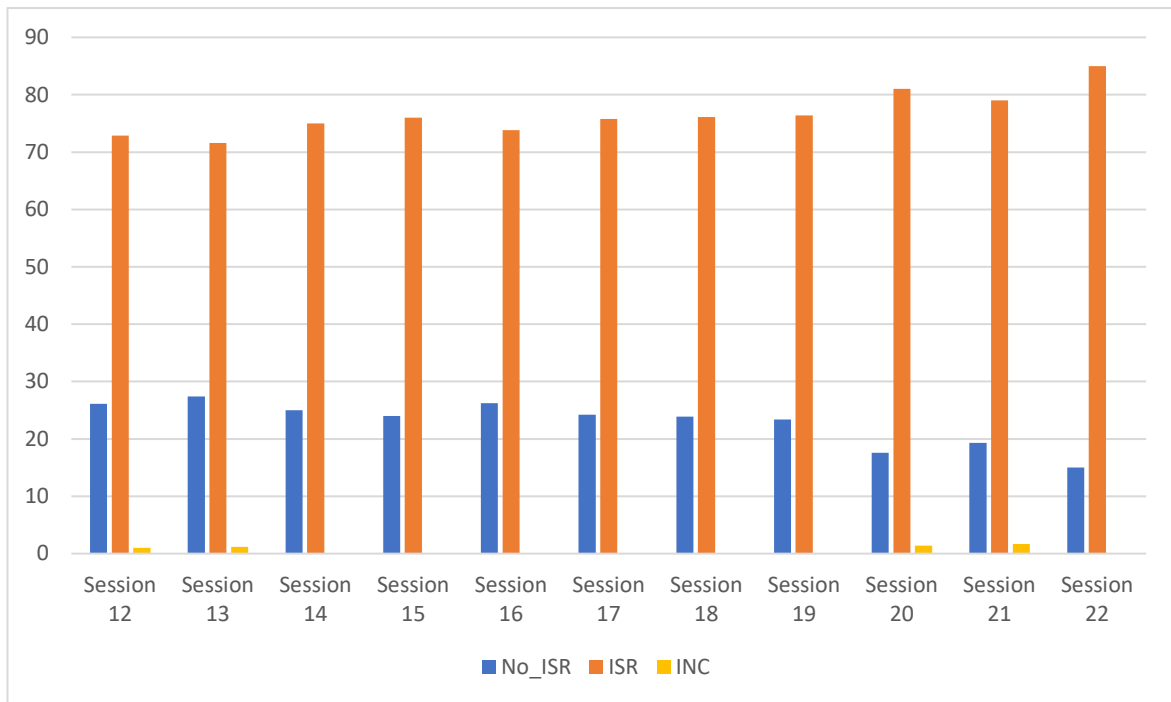


Figure 6. Observable behaviours Subject 4 (second part of the intervention)

Linked to No\_ISR behaviours, stereotypies decreased from 7.3% to 2%, as did staring, from 3.1% to 1%. With regard to ISR behaviours, an increase in joint attention from 41.6% to 48% was observed and, in particular, sentences increased from 22.9% to 35%. Similarly, eye contact increased, representing 6.3% in session 12 and 21% in session 22.

#### 4. Discussion and conclusions

Technology is a tool used in many fields and, more particularly, it is a truly useful resource in education (Chebli et al., 2017; Koumpouros & Kafazis, 2019), with great potential in dealing with students with special educational needs. Likewise, it is essential to carry out evidence-based practices (Silveira-Zaldivar, 2021) and, in this case, to improve the social development of people with ASD. In this way, we will prevent these needs from having a negative impact on other areas such as academic performance or mental health (Patton et al., 2016; Rabiner et al., 2016).

In this sense, this research, which aimed to analyse the effect of a technology-based social skills programme in a population with ASD, has managed to demonstrate its impact through various improvements in social and interaction behaviours as well as in the identification of emotions and emotion awareness after its application.

If we delve deeper into the emotional domain, an improvement has been found in relation to the identification of emotions according to facial features and expressions. These results coincide with those obtained in another research (Cheng et al., 2018; Kouo & Egel, 2016; Lee et al., 2016). Promising results have also been observed for emotion awareness, more specifically the ability to identify emotional states in oneself and in others in different social situations. Other studies (Grynszpan et al., 2008; Marino et al., 2020; Russo-Ponsaran et al., 2016) have shown improvements in this skill with the implementation of ICT-supported interventions.

Improvements have also been found in relation to social interaction and non-social interaction behaviours throughout the intervention. Subjects have seen a decrease in their stereotypies, coinciding with other authors (Mohanaprakash et al., 2015; Syriopoulou-Delli & Gkiolnta, 2020), who observed a decrease in echolalia and stereotypic movements after a technology-based intervention. Similarly, inappropriate behaviours have also decreased. Such behaviours are often associated with irritability (Mayes, 2011), which

decreases in technology-based interventions (Schuck, 2016; Vahabzadeh et al., 2018). Likewise, there has also been a decrease in the rate of staring, evidencing the motivation and attention that technological resources produce in people with ASD (Marino et al., 2020).

Similarly, an increase in joint attention, considered the basis for the development of communicative competence and social skills, has been reported (Mundy et al., 2016). Numerous studies (Charron et al., 2017; Kumazaki et al., 2018; Nie et al., 2021) obtained similar results, supporting the use of technology to improve joint attention. Similarly, subjects increased eye contact, as demonstrated by other research (Conti et al., 2015; Costa et al., 2015; Daniels et al., 2018; Miller et al., 2017) that also evaluated the impact of ICT-based interventions in this domain.

Thus, it can be stated that technology-based intervention programmes are useful because ICT is an effective tool for intervention in the needs of people with ASD, and specifically in the social sphere, which is fundamental for the success of this population in many contexts of life (Silveira-Zaldivar et al., 2021). And let us not forget that these resources also make it possible to assess and monitor their behaviour and cognitive processes more efficiently (Baker et al., 2018).

For all the above reasons, and following the results found in this study, we are in a position to state that the triad made up of social skills, ASD and ICT is highly effective and important. And we can do so without ignoring the need, on the one hand, for digital training for teachers that truly allows ICT to be used as an educational tool for inclusion and accessibility (Lázaro et al., 2015) and, on the other, to advance in research on the use of technologies in the field of special educational needs, as well as the benefits they offer.

Finally, reflecting on the limitations of the study, it is important to point out the small sample that participated in the research and the absence of a control group, a situation that is commonly seen in many other research studies. Another limitation to be highlighted is the forced and unforeseen interruption of the programme caused by the COVID pandemic, although it was resumed as soon as possible to lessen, at least to some extent, the effects of this period of social isolation. In terms of future prospects, it is considered necessary to evaluate the impact of this type of intervention programme in the long term and to verify that the learning acquired is generalised to other situations and contexts of daily life. Furthermore, it would be interesting to be able to replicate the programme in other types of centres and with a larger sample to extrapolate the results obtained in this study.

## 5. Funding

This work was supported by the Government of Aragon's grant for the recruitment of predoctoral research staff in training, which was co-financed by the Operational Program ESF Aragon 2014-2020, resolution of 15th November 2018 (BOA, 22nd November 2018).

## 6. References

- American Psychiatric Association (2013). Diagnostic and statistical manual of mental disorders (5th ed.). American Psychiatric Association. <https://doi.org/10.1176/appi.books.9780890425596>
- Akerblad, L., Seppänen-Järvelä, R., & Haapakoski, K. (2021). Integrative Strategies in Mixed Methods Research. *Journal of Mixed Methods Research*, 15(2), 1-19. <https://doi.org/10.1177/1558689820957125>
- Arias-Pujol, E., Fieschi, E., Castelló, C., Miralbell, J., Soldevila, A., Sánchez-Caroz, E., Anguera, M.A., & Mestres, M. (2015). Efectos de la imitación en la interacción social recíproca en un niño con Trastorno del Espectro Autista Grave. *Revista de Psicopatología y salud mental del niño y del adolescente*, (25), 9-20. <https://www.fundacioorienta.com/wp-content/uploads/2019/02/Arias-E-25.pdf>
- Baker, J. T., Germine, L. T., Ressler, K. J., Rauch, S. L., & Carlezon, W. A. (2018). Digital devices and continuous telemetry: opportunities for aligning psychiatry and neuroscience. *Neuropsychopharmacology*, 43(13), 2499-2503. <https://doi.org/10.1038/s41386-018-0172-z>

- Bajgar, J., Ciarrochi, J., Lane, R., & Deane, F. P. (2005). Development of the Levels of Emotional Awareness Scale for Children (LEAS-C). *British Journal of Developmental Psychology*, 23(4), 569-586. <http://doi.org/10.1348/026151005X35417>
- Baron-Cohen, S. (2005). The Empathizing System: a revision of the 1994 model of the Mindreading System. In B. Ellis & D. Bjorklund (Eds.), *Origins of the Social Mind* (pp. 468-492). Guilford Publications.
- Berkovits, L., Eisenhower, A., & Blacher, J. (2017). *Emotion regulation in young children with autism spectrum disorders*. *Journal of autism and developmental disorders*, 47(1), 68-79. <https://doi.org/10.1007/s10803-016-2922-2>
- Bru Luna, L. M., Martí-Vilar, M., & González Sala, F. (2020). Revisión sistemática de intervenciones en prosocialidad y empatía en personas con TEA. *Revista de Investigación Educativa*, 38(2), 359-377. <https://doi.org/10.6018/rie.395421>
- Caballo, V., Salazar, I., Rivera-Riquelme, M., & Piqueras, J. (2017) Desarrollo y validación de un nuevo instrumento para la evaluación de las habilidades sociales: el cuestionario de habilidades sociales (CHASO). *Behavioral Psychology/Psicología Conductual* 25(1), 5-24. <https://www.behavioralpsycho.com/producto/desarrollo-y-validacion-de-un-nuevo-instrumento-para-la-evaluacion-de-las-habilidades-sociales-el-cuestionario-de-habilidades-sociales/>
- Cabiellés-Hernández, D., Pérez-Pérez, J. R., Paule-Ruiz, M., & Fernández-Fernández, S. (2016). Specialized intervention using tablet devices for communication deficits in children with autism spectrum disorders. *IEEE Transactions on Learning Technologies*, 10(2), 182-193. <https://doi.org/10.1109/TLT.2016.2559482>
- Carpenter, L. (2013). *DSM-5 autism spectrum disorder: guidelines and criteria exemplars*. <https://depts.washington.edu/dbpeds/Screening%20Tools/DSM-5%28ASD.Guidelines%29Feb2013.pdf>
- Charron, N., Lewis, L., & Craig, M. (2017). A robotic therapy case study: Developing joint attention skills with a student on the autism spectrum. *Journal of Educational Technology Systems*, 46(1), 137-148. <https://doi.org/10.1177/0047239516687721>
- Chebli, S. S., Lanovaz, M. J., & Dufour, M. M. (2017). Generalization following tablet-based instruction in children with autism spectrum disorders. *Journal of special education technology*, 32(2), 70-79. <https://doi.org/10.1177/0162643416681499>
- Cheng, Y., Luo, S., Lin, H., & Yang, C.-S. (2018). Investigating mobile emotional learning for children with autistic spectrum disorders. *International Journal of Developmental Disabilities*, 64(1), 25-34. <https://doi.org/10.1080/20473869.2016.1206729>
- Chica, P. (2019). *Uso de las Tics en el aula y Atención a la Diversidad* [Thesis, University of Jaen, Spain]. <http://tauja.ujaen.es/handle/10953.1/11670>
- Conti, D., Nuovo, S.D., Buono, S., Trubia, G., & Nuovo, A.D. (2015). Use of robotics to stimulate imitation in children with Autism Spectrum Disorder: A pilot study in a clinical setting. 2015 24th *IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*. <https://doi.org/10.1109/roman.2015.7333589>
- Cored, S., Latorre, C., Vázquez, S., & Liesa, M. (2020). Análisis de los principales recursos tecnológicos utilizados en la intervención del lenguaje y la comunicación en TEA. En E. Lira (Coord.), *Bienestar Social: Organizaciones Saludables* (pp. 615-627). Tirant Editorial
- Cored, S., Vázquez, S., Liesa, M., & Baldassarri, S. (2021). La potencialidad de la tecnología en la medición del desarrollo de habilidades sociales en niños con TEA: un análisis desde parámetros fisiológicos. *Revista de Investigación Educativa*, 39(2), 445-462. <https://doi.org/10.6018/rie.430891>

- Cornago, A., Navarro, M., & Collado, F. (2012). *Manual de teoría de la mente par niños con autismo: ejercicios, materiales y estrategias*. Psylicom.
- Corso, C., Hug, M., Challiol, C., Evin, D., & Carreras, X. (2020). Enfoque para el diseño de aplicaciones móviles usando técnicas de Design Thinking dirigido a usuarios con dificultades/desafíos en habilidades sociales: fase I. In M. G. Lasso (Comp.), *XXII Workshop de Investigadores en Ciencias de la Computación* (pp. 649-654). Universidad Nacional de la Patagonia Austral (UNPA). <http://sedici.unlp.edu.ar/handle/10915/104224>
- Costa, S., Lehmann, H., Dautenhahn, K., Robins, B., & Soares, F. (2015). Using a Humanoid Robot to Elicit Body Awareness and Appropriate Physical Interaction in Children with Autism. *International Journal of Social Robotics*, 7(2), 265-278. <https://doi.org/10.1007/s12369-014-0250-2>
- Costescu, C. A., Vanderborght, B., & David, D. O. (2017). Robot-enhanced cbt for dysfunctional emotions in social situations for children with asd. *Journal of Evidence-Based Psychotherapies*, 17(2), 119-132. <https://doi.org/10.24193/jebp.2017.2.7>
- Daniels, J., Schwartz, J. N., Voss, C., Haber, N., Fazel, A., Kline, A., & Wall, D.P. (2018). Exploratory study examining the at-home feasibility of a wearable tool for social- affective learning in children with autism. *NpjDigital Medicine*, 1(1), 1-10. <https://doi.org/10.1038/s41746-018-0035-3>
- Davenport, M., Mazurek, M., Brown, A., & McCollom, E. (2018). A systematic review of cultural considerations and adaptation of social skills interventions for individuals with autism spectrum disorder. *Research in Autism Spectrum Disorders*, 52, 23-33. <https://doi.org/10.1016/j.rasd.2018.05.003>
- David, D. O., Costescu, C. A., Matu, S., Szentagotai, A., & Dobrean, A. (2020). Effects of a robot-enhanced intervention for children with ASD on teaching turn-taking skills. *Journal of Educational Computing Research*, 58(1), 29-62. <https://doi.org/10.1177/0735633119830344>
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining “gamification”. In *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments* (pp. 9-15). ACM
- Fetters, M.D. (2020). *The mixed methods research workbook: Activities for designing, implementing, and publishing projects*. Sage.
- Gates, J. A., Kang, E., & Lerner, M. D. (2017). Efficacy of group social skills interventions for youth with autism spectrum disorder: A systematic review and meta-analysis. *Clinical Psychology Review*, 52, 164-181. <https://doi.org/10.1016/j.cpr.2017.01.006>
- Grynszpan, O., Martin, J.C., & Nadel, J. (2008). Multimedia interfaces for users with high functioning autism: an empirical investigation. *International Journal of Human-Computer Studies*, 66(8), 628-639. <https://doi.org/10.1016/j.ijhcs.2008.04.001>
- Hanna, N., Lydon, H., Holloway, J., Barry, L., & Walsh, E. (2021). Apps to Teach Social Skills to Individuals with Autism Spectrum Disorder: A Review of the Embedded Behaviour Change Procedures. *Review Journal of Autism and Developmental Disorders*, 1-17. <https://doi.org/10.1007/s40489-021-00271-w>
- Happé, F., & Frith, U. (2006). The weak coherence account: Detail-focused cognitive style in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 36(1), 5-25. <https://doi.org/10.1007/s10803-005-0039-0>
- Hobson, R. P. (2014). The coherence of autism. *Autism: The International Journal of Research and Practice*, 18(1), 6-16. <http://doi.org/10.1177/1362361313497538>

- Koumpouros, Y., & Kafazis, T. (2019). Wearables and mobile technologies in Autism Spectrum Disorder interventions: A systematic literature review. *Research in Autism Spectrum Disorders*, 66, 101405. <https://doi.org/10.1016/j.rasd.2019.05.005>
- Kouo, J. L., & Egel, A. L. (2016). The effectiveness of interventions in teaching emotion recognition to children with autism spectrum disorder. *Review Journal of Autism and Developmental Disorders*, 3, 1-12. <https://doi.org/10.1007/s40489-016-0081-1>
- Kumazaki, H., Yoshikawa, Y., Yoshimura, Y., Ikeda, T., Hasegawa, C., Saito, D. N., Tomiyama, S., An, K-M, Shimaya, J., Ishiguro, H., Matsumoto, Y., Minabe, Y., & Kikuchi, M. (2018). The impact of robotic intervention on joint attention in children with autism spectrum disorders. *Molecular autism*, 9(1), 1-10. <https://doi.org/10.1186/s13229-018-0230-8>
- Jaliaawala, M. S., & Khan, R. A. (2020). Can autism be catered with artificial intelligence-assisted intervention technology? A comprehensive survey. *Artificial Intelligence Review*, 53(2), 1039-1069. <https://doi.org/10.1007/s10462-019-09686-8>
- Jodra, M. (2015). *Cognición temporal en personas adultas en autismo: Un análisis experimental* [Doctoral dissertation, University Complutense of Madrid, Spain]. <https://eprints.ucm.es/id/eprint/30717/>
- Lázaro, J. L., Estebanell, M., & Tedesco, J. C. (2015). Inclusión y cohesión social en una sociedad digital. *RUSC. Universities and Knowledge Society Journal*, 12(2), 44-59. <https://doi.org/10.7238/rusc.v12i2.2459>
- Leaf, J. B., Leaf, J. A., Milne, C., Taubman, M., Oppenheim- Leaf, M., Torres, N., Townley-Cochran, D., Leaf, R., McEachin, J., Yoder, P. (2017). Autism Partnership Foundation. An Evaluation of a Behaviorally Based Social Skills Group for Individuals Diagnosed with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 47(2), 243-259. <https://doi.org/10.1007/s10803-016-2949-4>
- Lee, I.-J., Chen, C.-H., & Lin, L.-Y. (2016). Applied Cliplets-based half- dynamic videos as intervention learning materials to attract the attention of adolescents with autism spectrum disorder to improve their perceptions and judgments of the facial expressions and emotions of others. *SpringerPlus*, 5(1), 1211. <https://doi.org/10.1186/s40064-016-2884-z>
- Leung, P. W. S., Li, S. X., Tsang, C. S. O., Chow, B. L. C., & Wong, W. C. W. (2021). Effectiveness of Using Mobile Technology to Improve Cognitive and Social Skills Among Individuals With Autism Spectrum Disorder: Systematic Literature Review. *JMIR Mental Health*, 8(9), e20892. <https://doi.org/10.2196/20892>
- López, G. & Carmona, C. (2018). La inclusión socio-educativa de niños y jóvenes con diversidad funcional: perspectiva de las familias. *Revista Nacional e Internacional de Educación Inclusiva*, 11(2), 83-98. <https://revistaeducacioninclusiva.es/index.php/REI/article/view/351>
- Maenner, M. J., Shaw, K. A., Baio, J., Washington, A., Patrick, M., DiRienzo, M., Christensen, D. L., Wiggins, L. D., Pettygrove, S., Andrews, J. G., Lopez, M., Hudson, A., Baroud, T., Schwenk, Y., White, T., Robinson, C., Lee, L. C., Harrington, R. A., Huston, M., ... Dietz, P. M. (2020). Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years — Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2016. *MMWR Morbidity and Mortality Weekly Report*, 69(4), 1-12. <https://doi.org/10.15585/mmwr.ss6904a1>
- March-Míguez, I., Montagut-Asunción, M., Pastor-Cerezuela, G., & Fernández-Andrés, M. I. (2018). Intervención en habilidades sociales de los niños con Trastorno de Espectro Autista: Una revisión bibliográfica. *Papeles del psicólogo*, 39(2), 140-149. <https://doi.org/10.23923/pap.psicol2018.2859>
- Marino, F., Chilà, P., Sfrassetto, S. T., Carrozza, C., Crimi, I., Failla, C., Busà, M. Bernava, G., Tartarisco, G., Vagni D., Ruta, L., & Pioggia, G. (2020). Outcomes of a robot-assisted social-emotional understanding intervention for young children with autism spectrum disorders. *Journal of autism and developmental disorders*, 50(6), 1973-1987. <https://doi.org/10.1007/s10803-019-03953-x>



- Mayes, S. D., Calhoun, S. L., Murray, M. J., Ahuja, M., & Smith, L. A. (2011). Anxiety, depression, and irritability in children with autism relative to other neuropsychiatric disorders and typical development. *Research in Autism Spectrum Disorders*, 5(1), 474-485. <https://doi.org/10.1016/j.rasd.2010.06.012>
- Mazefsky, C. A., Herrington, J., Siegel, M., Scarpa, A., Maddox, B. B., Scahill, L., & White, S. W. (2013). The role of emotion regulation in autism spectrum disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 52(7), 679-688. <https://doi.org/10.1016/j.jaac.2013.05.006>
- Mcquiggan, S., Kosturko, L., Mcquiggan, J., & Sabourin, J. (2015). Making Accessible Apps: Autism and Visual Impairment. En S. Mcquiggan, L. Kosturko, J. Mcquiggan y J. Sabourin (Eds.), *A Handbook for Developers, Educators, and Learners* (pp. 281–303). Wiley & SAS Business Series. <https://doi.org/10.1002/9781118938942>
- Mendelson, J. L., Gates, J. A., & Lerner, M. D. (2016). Friendship in school-age boys with autism spectrum disorders: A meta-analytic summary and developmental, process-based model. *Psychological Bulletin*, 142(6), 601-622. <http://doi.org/10.1037/bul0000041>
- Mestre, J. M., Guil, R., Martínez-Cabañas, F., Larrán, C., & González, G. (2011). Validación de una prueba para evaluar la capacidad de percibir, expresar y valorar emociones en niños de la etapa infantil. *REIFOP*, 14(3), 37-54. <https://www.redalyc.org/pdf/2170/217022109003.pdf>
- Miles, M.B., & Huberman, A.M. (1994). *Qualitative data analysis: an expanded sourcebook*. Sage Publications.
- Miller, N., Wyatt, J., Casey, L. B., & Smith, J. B. (2018). Using computer-assisted instruction to increase the eye gaze of children with autism. *Behavioral Interventions*, 33(1), 3-12. <https://doi.org/10.1002/bin.1507>
- Mohanaprakash, T., Subedha, V., & Lakshmi, D. (2015). Assisting echolalia (Repetitive speech patterns) in children with autism using android mobile app. *International Journal Of Advanced Information And Communication Technology*, 12(1), 928-933. <https://doi.org/10.1401/ijaict.2015.12.04>
- Moody, C. T., & Laugeson, E. A. (2020). Social skills training in autism spectrum disorder across the lifespan. *Psychiatric Clinics*, 43(4), 687-699. <https://doi.org/10.1016/j.psc.2020.08.006>
- Mundy, P., Kim, K., McIntyre, N., Lerro, L., & Jarrold, W. (2016). Brief report: Joint attention and information processing in children with higher functioning autism spectrum disorders. *Journal of autism and developmental disorders*, 46(7), 2555-2560.
- Murillo, E. (2013). Actualización conceptual de los Trastornos del Espectro del Autismo (TEA). In M. A. Martínez y J. L. Cuesta (Coords.), *Todo sobre el autismo: los Trastornos del Espectro Autista (TEA): guía completa basada en la ciencia y en la experiencia* (pp. 23-63). Alcaria
- Nie, G., Ullal, A., Zheng, Z., Swanson, A. R., Weitlauf, A. S., Warren, Z. E., & Sarkar, N. (2021). An immersive computer-mediated caregiver-child interaction system for young children with autism spectrum disorder. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 29, 884-893. <https://doi.org/10.1109/TNSRE.2021.3077480>
- Ortega, P. (2020). *Inclusión en la educación escolar: intervención-acción para entender y atender a la diversidad funcional cognitiva en la institución educativa comfamiliar* [Thesis, University of Norte]. <http://hdl.handle.net/10584/9477>
- Palomo, R. (2017). *Autismo: teorías explicativas actuales*. Alianza Editorial.
- Parsons, S., Yuill, N., Good, J., Brosnan, M., Austin, L., Singleton, C., & Bossavit, B. (2016). What Technology for Autism Needs to be Invented? Idea Generation from the Autism Community via the ASCmeI.T. App. In K. Miesenberger y G. Kouroupetroglou (Eds.), *Computers Helping People with Special Needs*, (pp. 343-350). Springer. [https://doi.org/10.1007/978-3-319-41267-2\\_49](https://doi.org/10.1007/978-3-319-41267-2_49)

- Patton, D. U., Hong, J. S., Patel, S., & Kral, M. J. (2016). A systematic review of research strategies used in qualitative studies on school bullying and victimization. *Trauma, Violence, & Abuse, 18*(1), 3-16. <https://doi.org/10.1177/1524838015588502>
- Pedrosa, I., Borges del Rosal, Á., Herranz, N., Lorenzo, M., & García-Cueto, E. (2013). Desarrollo del Protocolo de Observación de Interacción en el Aula: aplicación en un programa de niños con altas capacidades. *Revista de Educación* (Núm. extraordinario), 293-321. <http://doi.org/10.4438/1988-592X-RE-2013-EXT-250>
- Picci, G., & Scherf, K. S. (2015). A two-hit model of autism: Adolescence as the second hit. *Clinical Psychological Science: A Journal of the Association for Psychological Science, 3*(3), 349–371. <http://dx.doi.org/10.1177/2167702614540646>
- Rabiner, D., Godwin, J., & Kenneth, A. (2016). Predicting academic achievement and attainment: The contribution of early academic skills, attention difficulties, and social competence. *School Psychology Review, 45*(2), 250–267. <https://doi.org/10.17105/SPR45-2.250-267>
- Rodríguez, F. (2016). *Guía de intervención logopédica en los Trastornos del Espectro del Autismo*. Síntesis.
- Roldán-Álvarez, D., Gomez, J., Márquez-Fernández, A., Martín, E., & Montoro, G. (2016). Mobile Devices as Assistive Technologies for ASD: Experiences in the Classroom. In M. A. (Ed.), *Design, User Experience, and Usability: Novel User Experiences. DUXU 2016. Lecture Notes in Computer Science* (Vol. 9747). Springer. [http://dx.doi.org/10.1007/978-3-319-40355-7\\_18](http://dx.doi.org/10.1007/978-3-319-40355-7_18)
- Russo-Ponsaran, N. M., Evans-Smith, B., Johnson, J., Russo, J., & McKown, C. (2016). Efficacy of a facial emotion training program for children and adolescents with autism spectrum disorders. *Journal of Nonverbal Behavior, 40*(1), 13-38. <https://doi.org/10.1007/s10919-015-0217-5>
- Sanromà-Giménez, M., Lázaro, J. L., Usart, M., & Gisbert-Cervera, M. (2021). Design and Validation of an Assessment Tool for Educational Mobile Applications Used with Autistic Learners. *Journal of New Approaches in Education Research, 10*(1), 101-121. <https://doi.org/10.7821/naer.2021.1.574>
- Sarabadani, S., Schudlo, L. C., Samadani, A. A. y Kushski, A. (2018). Physiological Detection of Affective States in Children with Autism Spectrum Disorder. *IEEE Transactions on Affective Computing, 1*-14. <https://doi.org/10.1109/taffc.2018.2820049>
- Schuck, S., Emmerson, N., Ziv, H., Collins, P., Arastoo, S., Warschauer, M., Crinella, F., & Lakes, K. (2016). Designing an iPad App to Monitor and Improve Classroom Behavior for Children with ADHD: iSelfControl Feasibility and Pilot Studies. *PloS One, 11*(10), 1-13. <https://doi.org/10.1371/journal.pone.0164229>
- Silveira-Zaldivar, T., Øzerk, & K., Özerk, G. (2021). Developing Social Skills and Social Competence in Children with Autism. *International Electronic Journal of Elementary Education, 13*(3), 341-363. <https://doi.org/10.26822/iejee.2021.195>
- Soto, A., Camerino, O., Iglesias, X., Anguera, M.T., & Castañer, M. (2019). LINCE PLUS: Research Software for Behavior Video Analysis. *Apunts. Educación Física y Deportes, 137*, 149-153. [https://doi.org/10.5672/apunts.2014-0983.es.\(2019/3\).137.11](https://doi.org/10.5672/apunts.2014-0983.es.(2019/3).137.11)
- Soto, E. R., & Escribano, E. (2019). El método estudio de caso y su significado en la investigación educativa. En D. M. Arzola Franco (Coord.), *Procesos formativos en la investigación educativa. Diálogos, reflexiones, convergencias y divergencias* (pp. 203-221). Red de Investigadores Educativos Chihuahua. <https://mail.rediech.org/joomla30/images/k2/libro-2019-arzola-11.pdf>
- Sung, C., Connor, A., Chen, J., Lin, C., Kuo, H., & Chun, J. (2018). Development, feasibility, and preliminary efficacy of an employment-related social skills intervention for young adults with high-functioning autism. *Autism, 22*(6), 1-12. <https://doi.org/10.1177/1362361318801345>

- Syriopoulou-Delli, C. K., & Gkiolnta, E. (2020). Review of assistive technology in the training of children with autism spectrum disorders. *International Journal of Developmental Disabilities*, 1-13. <https://doi.org/10.1080/20473869.2019.1706333>
- Tsui, G., & Rutherford, M. (2014). Video self-modeling is an effective intervention for an adult with autism. *Case Reports in Neurological Medicine*, 2014(425897), 1-7. <https://doi.org/10.1155/2014/425897>
- United Nations (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations. <https://sdgs.un.org/sites/default/files/publications/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf>
- Vahabzadeh, A., Keshav, N. U., Salisbury, J. P., & Sahin, N. T. (2018). Improvement of attention-deficit/hyperactivity disorder symptoms in school-aged children, adolescents, and young adults with autism via a digital smartglasses-based socioemotional coaching aid: short-term, uncontrolled pilot study. *JMIR mental health*, 5(2), e9631. <https://doi.org/10.2196/mental.9631>
- Walker, G., & Weidenbenner, J. V. (2019). Social and Emotional Learning in the age of virtual play: technology, empathy, and learning. *Journal of Research in Innovative Teaching & Learning*, 12(2), 116-132. <https://doi.org/10.1108/JRIT-03-2019-0046>
- Yoo, G., & Kim, S. (2018). Dyadic drum playing and social skills: Implications for rhythm-mediated intervention for children with autism spectrum disorder. *Journal of Music Therapy*, 55(3), 340-375. <https://doi.org/10.1093/jmt/thy013>.
- Zhang, S., Xia, X., Li, S., Shen, L., Liu, J., Zhao, L., & Chen, C. (2019). Using technology-based learning tool to train facial expression recognition and emotion understanding skills of Chinese pre-schoolers with autism spectrum disorder. *International Journal of Developmental Disabilities*, 65(5), 378-386. <https://doi.org/10.1080/20473869.2019.1656384>