LITERATURE REVIEW ON THE CURRENT KNOWLEDGE AND PRACTICES OF TEACHERS IN USING DIGITAL TOOLS AND SOCIAL STORIES FOR TEACHING CHILDREN WITH ASD IN SPAIN

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Upskilling Preservice Teachers to Support Young Children with Autism Spectrum Disorder
through Digital Social Stories
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INTRODUCTION

This document contains the results of a review work focused on understanding current knowledge and practices related to the use of digital tools and social stories in teaching children with ASD by preservice teachers in Spain. We used the second cycle of Spanish Early Childhood Education as the reference age, which corresponds to children between 3 and 6 years old.

According to the structure agreed upon at the EARLY-ASD project meeting on 5 December 2024, this review is made up of three parts:

1) An overview of the care system for children with ASD in Spain;
2) Review of the role of digital tools in educating children with ASD;
3) Review of the use of social stories as a method to support social-emotional development.

A similar strategy was used in each of the topics of the literature review addressed in sections 2 and 3, with appropriate adaptations based on the results obtained for each topic. The conclusion provides the main results of the description of the context considered in part 1 and the results of the reviews in parts 2 and 3. These are also presented schematically in two final appendices.

1. The context of care for children with ASD in Spain

In Spain, the Early Childhood Education stage is divided into two cycles, from 0 to 3 and from 3 to 6 years old. Despite not being compulsory, enrolment in the second cycle is almost universal and constitutes students' first step into formal schooling. Spanish legislation makes inclusion a guiding principle of the organisation of the educational

system from this stage onwards. In accordance with this principle, the schooling of children with autism spectrum disorder (ASD) should preferably be done in ordinary classrooms, with specific educational support. There are different resources, both from the educational field and from the health and social care fields, available to facilitate the diagnosis and educational care of these children.

The general Educational and Psychopedagogical Guidance Teams (EOEP, by their Spanish initials) provide care to students enrolled in Early Childhood Education starting from 3 years of age. They provide guidance to schools, students and families. The Early Care EOEPs (EATs) conduct psychopedagogical evaluations of children and, if warranted, make a "determination of special educational needs" associated with ASD. The Special Educational Needs Student (ACNEE, by its Spanish initials) report allows the student to access ordinary support (such as the services of a Therapeutic Pedagogy [PT] specialist or Hearing and Language [AL] specialist). If deemed appropriate, schooling in a preferential centre for children with ASD may also be recommended. In private centres and charter schools, there are usually Guidance Departments that offer assistance to students with ASD who are enrolled there. Lastly, there are also special education centres that offer instruction aimed at students with special educational needs that cannot be met as part of diversity care measures in ordinary schools.

The health system and social care services work alongside the education system. Specialists at Primary Health Care centres make referrals to the Hospital or Mental Health Service, who in turn may make a "clinical diagnosis" of ASD. Additionally, the regional governments (Catalonia, Community of Madrid, Andalusia, etc.) have specific centres to carry out assessments of a situation of dependency – that is, the formal "Recognition of disability" -- for children from 0 to 6 years of age, as well as the "Assessment of the need for early care". These teams assess the child's degree of autonomy and the need for support, while proposing the corresponding interventions from social care services. In some regions, there are what are known as "Specific Teams", which collaborate with the EOEP and the Guidance Departments, especially at the preferential schooling centres. Specific student care teams servicing students with ASD are involved in cases of special difficulty and advise on psychopedagogical evaluations and tailoring educational

adaptations. They also offer educational and socio-community guidance for families and educational teams that serve students with ASD. Likewise, Specific Teams also provide guidance to centres on implementing proposals made by Preferential Centres on the schooling of students with ASD.

There are four basic types of schooling for students with ASD. A fifth modality could be added to these, but it is essentially a variation of the fourth. It does not exist in all regions and, in those where it is used, it is only applied to a small number of students.

1. Ordinary modality without supports or adjustments. This is generally used in cases that do not yet have an autism diagnosis, but do have other diagnoses, such as Attention deficit hyperactivity disorder (ADHD) or High capacity. Many students have good or very good oral language skills, as well as good grades, and only have some "trait" or other. They also do not cause conflicts in the classroom and can go more or less unnoticed as being on the autism spectrum until adolescence or adulthood.

2. Ordinary modality with support. Students in this modality receive a certain number of sessions per week from the guidance team, usually less than 9 hours, and sometimes along with other students. On occasion, they are recently diagnosed students in the Early Childhood Education stage who have to spend a year in this modality before being assigned a place in a preferential centre. This modality also accepts students with autism who have fewer support needs, students who have not yet received the diagnosis, but who have other comorbidities, such as Specific language impairment (SLI) or ADHD, or students who, having previously spent time in ASD preferential centres, have not required significant curricular adaptations.

3. ASD Preferential Centre. This includes everything in the Ordinary Modality plus two professionals on site who are either specialists in ASD or social integration. They usually serve a maximum of 5 children, both in the ASD classroom (a specific physical classroom) or in the ordinary classroom with the other ASD students.

4. Special Education Centre. These centres have curricula that are not comparable to those of ordinary schools. They are aimed at students who require generalised and significant support in all areas of development.

5. Combined Special Education. This final modality combines schooling in a regular centre and in a special education centre, alternating activities between the two.

The specific educational care measures that can be taken with students with ASD in Early Childhood Education are:

1. Curricular adaptations. These consist of adapting or modifying different aspects of the learning process to minimise barriers while seeking maximum development of student capabilities. Curricular adaptations are considered "significant" when they extend to the contents or evaluation criteria of previous cycles or courses.

2. Specific support for the teaching and learning process in cases where a significant curricular adaptation has been made, when necessary, as well as to overcome the difficulties students have due to their special condition. This is done via teachers specialised in Therapeutic Pedagogy or in Speech and Language, as set out in the school enrolment report.

3. Applying specific measures for access to the school setting, including those relating to assessment processes. This may include providing resources that are difficult to implement across a school population or the implementation of specific methodologies for cognitive, sensory and social accessibility.

4. Flexible teaching. The time spent in Early Childhood Education may be made more flexible and schooling may be extended for one additional year.

In July 2023, the *National Council on Disability* approved the *First Spanish Strategy Action Plan on Autism Spectrum Disorder 2023-2027* (Ministry of Social Rights and Agenda 2030, 2023). The Plan establishes six lines of action: promoting knowledge and respect for people with autism; encouraging early detection and diagnosis, and a comprehensive approach to people with autism; promoting independent living and inclusion in the community; contributing to inclusive and quality education and employment; guarantee access to justice and the strengthening of rights; promoting

research, training and innovation. In addition, it includes specific measures related to each line of action, while allocating funds to reach those goals in the five-year period envisaged. Early diagnosis and care are considered key to achieving all of the objectives.

The Plan has detected some gaps in early care, such as the absence of health protocols in most regions. It also notes a lack of systematic implementation of preventive and early detection actions, which would make it possible to identify early signs of neurodevelopmental disorders that may lead to ASD. The need for exhaustive neuro-paediatric follow-up of the population at higher risk of autism due to genetic vulnerability or perinatal complications is also confirmed. Special emphasis is placed on the care of girls, who often receive misdiagnoses prior to the diagnosis of ASD. Likewise, the plan also notes that it is desirable to use diagnostic means that are more sensitive to the clinical manifestations of girls, who tend to have more social and linguistic skills, greater ability to adapt to their environment and fewer stereotyped behaviours and behavioural difficulties. All this highlights the need for national regulations that eliminate regional differences in the provision of care to this population, and for the consolidation of teams that include professionals from the fields of education, health and social services whose intervention will be part of children's natural environments. The plan therefore proposes the establishment of national criteria and evidence-based practices in order to ensure respect for and consideration of the realities of life for people with ASD.

2. The role of digital tools in educating children with ASD.

This review on "State of the arts on the use of digital tools for education of children with ASD" has been carried out through a search in the Google Scholar and Scopus databases, with 2010 as the lower limit for publication date. On Google Scholar, the search terms, in Spanish, "recursos digitales (digital resources)", "trastorno del espectro autista (autism spectrum disorder)" and " infantil (early childhood *adj*)" have been used together. Terms could appear anywhere in the text, and the scope was set to exclude Bachelor's Degree Final Projects and Master's Degree Final Projects. In Scopus, the following concepts have been used together, in English, "autism spectrum disorders" & "information technology". Terms could be located indistinctly in the title, abstract or keywords, and a search filter

was set to Spain. The search yielded 298 results, 253 in Google Scholar and 45 in Scopus. In Google Scholar, however, the largest proportion of works corresponds to Spanish-speaking countries in Latin America, or do not fully match the search criteria. In both databases, most of the publications do not specify the educational level, address levels other than Early Childhood Education, or are review works that are not based on research and interventions carried out in Spain. After a preliminary analysis of the content, five works have been selected that include Early Childhood Education, although most of them do not address it exclusively (see appendix I).

In general terms, in Spain, as in other countries, there is an upward trend in publication of works and research about the use of digital resources or, in general, Information and Communication Technologies, for the education of children with ASD. This can be seen in the following Scopus chart on the concepts indicated in the search, showing changes over the last twenty years:
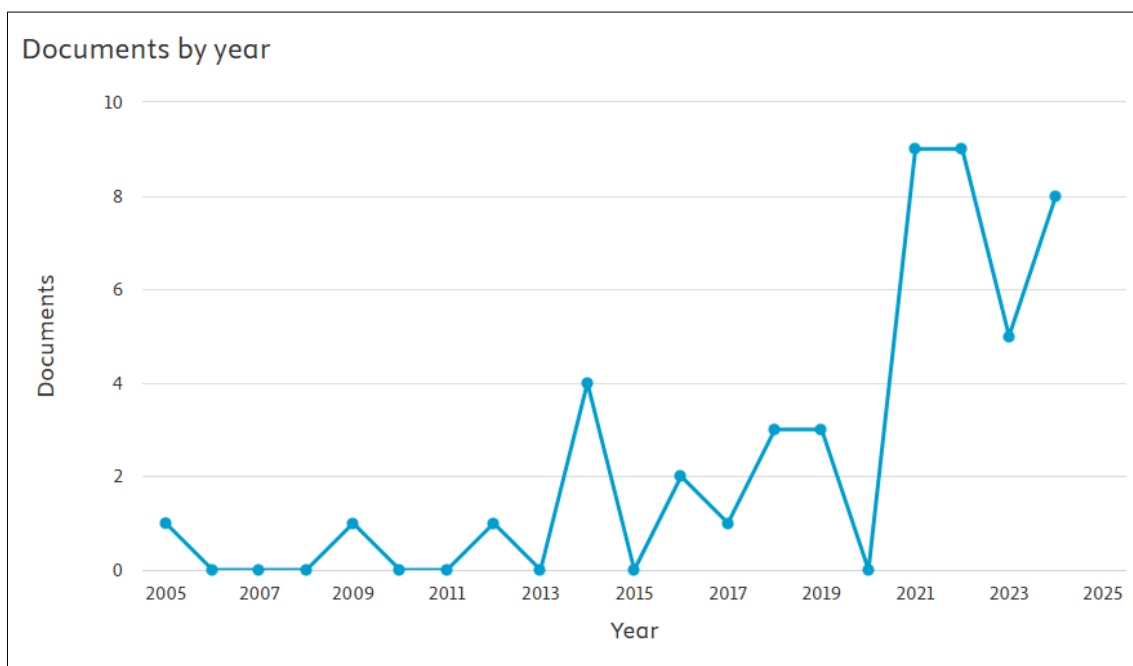
Source: Scopus

The most common type of work among these results are articles in scientific journals (61.7%), with some contributions in other formats as well. Most of them come from the field of Computer Science (20.7%), followed by Social Sciences, including Education

(19.6%) and then Medicine (16.3%), Psychology (8.7%), Engineering (7.6%) and others with minor proportions. By educational level, the largest volume of works focuses on Primary Education (6-12 years). Comparatively, the contributions related to the second cycle of Early Childhood Education (3-6 years) are very rare, and references to this stage frequently appear in comprehensive works that cover Primary Education and sometimes also Secondary Education. The narrower studies that consider the Early Childhood Education stage focus mainly on three types of resources: digital applications for mobile devices, robotics and augmented reality.

The usefulness of digital applications in educational care for children with ASD, has been analysed by Gallardo-Montes and his collaborators in several works. One of them (Gallardo-Montes, Rodríguez, Crisol, & Caurcel, 2020) addresses the impact that these applications can have on strengthening theory of mind (ToM), a key skill that allows people to understand the mental states of others and adapt their behaviour accordingly. ToM development is often irregular in children with ASD, thus hindering their ability to engage in social interactions or understand communicative contexts.

The study analysed 101 mobile applications available for free on Google Play, some of which were particularly appropriate for the second cycle of Early Childhood Education. These applications were evaluated based on a system of indicators relating to three main dimensions: design/form, content, and pedagogical aspects. The analysis allowed researchers to classify applications into three groups: highly recommendable (11.9% of applications), recommendable (83.2%) and dispensable (5%). Most of the digital applications simultaneously address more than one area related to ToM: communication and language (49.5%); communication, language and emotions (11.88%); language and emotions (5.9%); and communication and emotions (3.96%). Although in smaller numbers, there are also applications focused on a single area, mainly on language development (21.78%) and fostering communication (5.94%). None of the applications work exclusively in the area of emotions.

Although the applications considered in that research offer great potential, the study points out several limitations: a) insufficient attention to the emotional field, which only a fifth of the applications (22 of the 101 evaluated) engage with, despite it being a critical

area for children with ASD b) technical limitations: some applications do not incorporate voices or audio recordings, which reduces their usefulness for language learning; c) linguistic restrictions: many applications are not available in multiple languages, which restricts their functionality.

In a subsequent study, Gallardo-Montes, Rodríguez, Caurcel, & Capperucci (2022) used questionnaires to compare the assessment and use that two groups of educators -- one from Spain and the other from Italy -- make of mobile digital applications to care for people with ASD. The research included 286 professionals from Early Childhood Education, Primary Education, Secondary Education and Adult Education, who work directly with people with ASD. 159 were from the Granada area in Spain and 127 were from Florence in Italy. Spanish educators reported slightly higher use of apps compared to their Italian colleagues. 50.3% of participants from Spain said they used them frequently, while in the Italian sample this figure was 44.9%. In both countries, women use apps more frequently than men. In Italy, female teachers primarily use the apps to keep the attention of autistic people for longer, and Spanish female teachers primarily use the apps to work on emotions.

Participants from both countries agree that apps are motivating tools that complement traditional teaching methods. They also highlight their usefulness in reinforcing concepts that were addressed previously and in keeping students' attention for longer. However, differences are detected in specific areas depending on the educational level. In Italy, primary school teachers utilise apps more than early childhood teachers in the areas of reading, self-regulation, numeracy and consolidation of learning, while early childhood teachers find them more useful than their primary school colleagues do for working on socialisation and attention. In Spain, early childhood teachers use apps more than primary school teachers for working on memory, but less in the areas of recreation and attention.

The results highlight the importance of digital applications as complementary tools when educating people with ASD at an early age. However, they also reveal persistent challenges, such as the lack of adequate training in digital technology for educators. The differences that can be observed between professionals in both countries, as evident in

the different assessment of applications in the Early Childhood Education stage, call for more attention to the training processes and the conditions of use of these resources.

The incorporation of students with ASD into ordinary educational centres (mainstreaming) represents a significant advance for inclusion, but it also poses a challenge due to the lack of teacher training and specific resources. Corrales and Rodríguez (2022) have analysed, through a case study, the use of robotics as an innovative tool to overcome these barriers, taking advantage of the capacity of robots to interact and motivate students. The commercial robot PLEO Rb was used for this purpose. It is a computer-powered pet in the shape of a juvenile dinosaur that responds to the environment, making it a very attractive resource for children.

The research was conducted with a 5-year-old autistic student who was enrolled in a regular Spanish school and had specialised support. The student was diagnosed with autism spectrum disorder when she was 3 years old. According to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), her need for help in the psychopathological domains of social communication along with restricted and repetitive behaviours would be classified as grade 3 -- that is, need for very significant help. The project was carried out over the course of a school year and had three phases: initiation, teaching-learning and evaluation. The sessions were designed to work on communication skills and basic concepts (such as notions of shapes and sizes). The intervention was led by the Therapeutic Pedagogy teacher, who received training in the use of the resource and the creation of specific materials. Each session, lasting 45 minutes, once a week, included structured activities around the PLEO Rb robot, which acted as a mediator between the teacher and the student.

The use of the resource produced advances in the field of communication and social interaction. Initially, the student showed rejection towards the robot, limiting her interaction with it to directed activities, but gradually developed curiosity towards the digital pet and initiated more autonomous interactions. At the end of the intervention, she was able to interact independently with the robot and share experiences with the adult. The robot made it easier to transition from a more instrumental communication style to a more functional one, including spontaneous requests and the use of basic expressions

such as "hola (hello)" and "adios (goodbye)". A decrease in disruptive behaviours was also observed, especially in moments of uncertainty, thanks to the predictability and consistency of the robot. It also acted as a motivating element, helping to maintain the student's attention and improved performance on academic tasks. The student learned to position the robot following instructions such as "dentro (in)" or "fuera (out)", was able to recognise and manipulate materials associated with the robot's features, and completed activities with minimal support, generalising concepts to other contexts.

The study shows that social robotics can be an effective tool to address the specific needs of students with ASD. However, it also highlights the importance of careful design in interventions, with there being a need for personalised materials along with teachers trained in the use of these technologies.

Pérez-Fuster, Herrera, Kossyvaki, & Ferrer (2022) address improvement in responding to joint attention (RJA) skills in autistic children, with an intervention mediated by augmented reality (AR) technology using the "Pictogram Room" tool.

Joint attention involves the ability to share a focus of attention with another person, either through gaze tracking or gestures such as pointing. In typically developed children, these skills begin to emerge between six and twelve months, but in children with ASD they tend to be markedly diminished. This difficulty not only affects social interaction, but also limits critical areas of development, such as language and processes associated with theory of mind (ToM). Augmented reality is a useful resource for working on these skills, combining the physical environment with virtual stimuli, offering an immersive platform that can be customised for each user. Unlike virtual reality, AR maintains elements of the real world, which facilitates the generalisation of skills learned in virtual contexts to everyday situations. One prominent tool in this area is "Pictogram Room," a Kinect-based system that uses games to develop skills such as imitation, body awareness, and specifically, joint attention.

The study included six children with ASD, aged between 3 and 8 years enrolled at a Spanish public school. A multiple baseline single-subject experimental design (SSED) across three groups of two participants was employed. The intervention consisted of a series of sessions spread over 12 weeks and divided into several phases. A) Pre-baseline:

The children's initial skills in joint attention were assessed using specific tools. B) Baseline: Joint attention behaviours were observed without intervention. C) Learning Phase: children learned to interact with "Pictogram Room" through basic games. D) Intervention Phase: A specific game, "Gaze Following," was introduced to improve gaze following and pointing. E) Post-intervention: Progress and its generalisation to non-virtual contexts were evaluated.

The design of "Pictogram Room" made it possible to personalise visual and auditory stimuli, while maintaining high levels of interest and participation from the children. After the intervention, all children showed significant gains in gaze tracking and signalling skills. These improvements were sustained and generalised to real situations. The study thus demonstrates that an intervention mediated by augmented reality technology can be highly effective in improving specific skills in children with ASD. "Pictogram Room" not only improves joint attention, but also offers a replicable and accessible model for schools and families, opening new possibilities for inclusive and technologically advanced educational interventions.

Baixauli-Fortea, Gómez-García, Andrés-Sebastiá, & Berenguer-Forner (2020) present another intervention proposal based on augmented reality, in this case in conjunction with dialogic reading, to work with young children with ASD.

Dialogic reading is a shared reading technique that puts adults and children into active interaction during story reading. This method encourages child participation through open-ended questions, sentence completion, and connecting the book content with their own experiences. Previous studies have shown that this technique is effective in developing expressive and receptive language skills, as well as narrative skills. For children with ASD, this intervention can be particularly useful, as it addresses deficit areas such as joint attention, communication and narrative skills, and the use of language in social contexts.

Augmented reality is integrated into this proposal as a complement that amplifies the impact of dialogic reading. By overlaying virtual elements on the real world, AR maintains the connection with the physical environment while introducing visual and auditory stimuli that capture the child's attention. In the context of ASD, AR helps

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reinforce visual and emotional cues in stories, helps keep children's attention on the task, and facilitates understanding of abstract concepts such as emotions and cause-effect relationships.

The proposal uses three stories designed specifically for children with ASD, starring a character named Ismael. The topics of the stories are a birthday, a field trip, and a day at the beach. Each story follows a simple narrative structure and addresses specific skills related to theory of mind (ToM), such as emotion recognition and understanding of intentions. The illustrations are designed to avoid over-stimulation. The implementation of the dialogic reading technique includes strategies adapted to children with ASD, known as CROWD: a) *Completion*, pauses for the child to complete sentences; b) *Recall*, questions about what happened in the story; c) *Open-Ended*, open-ended questions that encourage description; d) *Wh-Questions*: specific questions about what, where, how; e) *Distancing*: connections between the story and the child's personal experiences. These aids are complemented by specific AR tools to emphasise key aspects of the story and capture the child's attention.

The proposal offers a new perspective on how emerging technologies can be integrated into traditional pedagogical methodologies to create richer and more effective learning experiences. The combination of dialogic reading and augmented reality can enhance the child's engagement in the activity, produce advances in vocabulary, literal comprehension and inference, and increase interest in the task. The proposal also represents an innovative approach that not only addresses the educational needs of children with ASD but can also be adapted to include contexts to benefit the entire educational community. The article highlights the need for further studies to evaluate long-term effectiveness and explore its application in diverse contexts.

3. The use of social stories as a method to support social-emotional development

As for the second search strategy on "State of arts on the use of Social Stories for education of children with ASD", a systematic review was carried out on the Google Scholar, Scopus, Dialnet, Latindex, Redined, Redalyc and Scielo databases. These

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databases contain literature published in Spanish-speaking countries and regions such as Spain, Latin America and the Caribbean. In the selected databases, the words in Spanish "Historias Sociales (Social Stories)", "Autismo (Autism)" or "Trastorno del Espectro Autista (Autism Spectrum Disorder)" and "Infantil (Early Childhood *adj.*)" or "Educación Infantil (Early Childhood Education)" were used together as search parameters and could be anywhere in the text. In Scopus, the following concepts were used, in English, "Autism Spectrum Disorder", "Social Stories" and "Childhood" together, and could be located indistinctly in the title, abstract or keywords. As observed in the Scopus chart, publications on social stories have been increasing for the past two decades, with notable spikes in the years 2014, 2019, and 2024. The search in this database has resulted in 155 publications. However, when selecting the filter "publications from 2010-2024," no results related to Spain were returned.
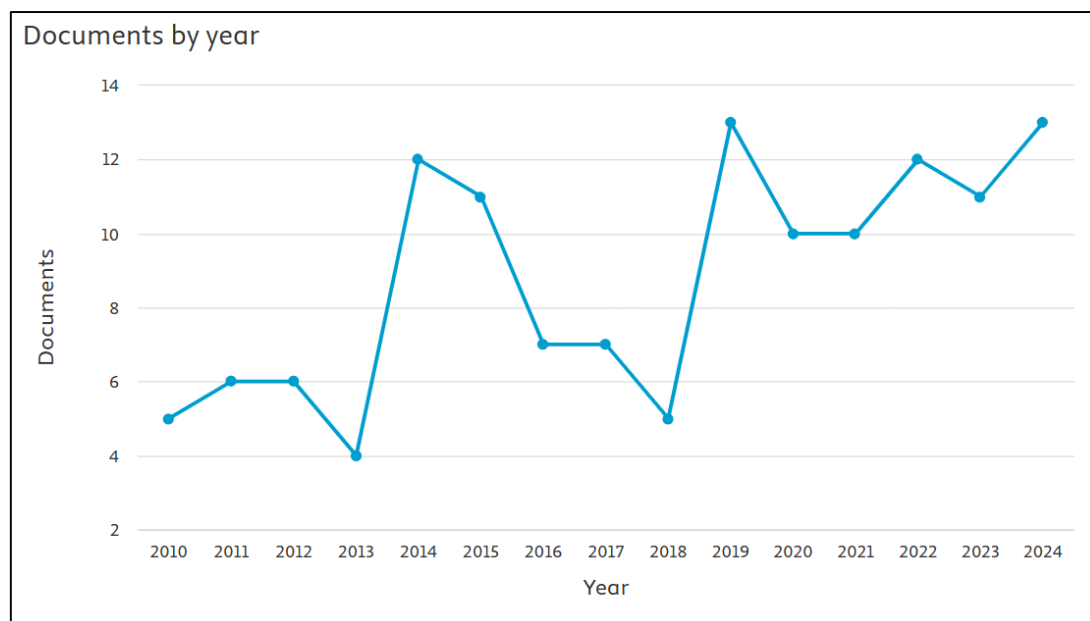
Source: Scopus

In the Google Scholar database, once the keywords were entered, the 2010-2024 interval was selected, documents written exclusively in Spanish were searched for and only peer-reviewed articles were considered. Once the filters were applied, 30 results were returned. For the rest of the databases, the aforementioned filters were applied, returning the following results: 1 article in Dialnet, 0 results in Latindex and Redined. Regarding the

Redalyc database, 5 articles were found. Finally, in the Scielo database, 5 results were obtained, but these were research from countries other than Spain. Therefore, these publications were excluded. Altogether, a total of 46 articles were collected.

Once the documents have been selected, a final filtering procedure was carried out on the publications to include or exclude them definitively. The following key inclusion criteria were established: (1) that the articles' objects of study are wholly or partially children who are in the educational stage of Early Childhood Education and (2) that they refer to the strategy of using social stories. Only those papers that have been peer-reviewed were included. A great abundance of Bachelor's Degree Final Projects and Master's Degree Final Projects was observed. These works were excluded because they had not been reviewed by a scientific and editorial committee. Unlike what has been done in the previous section on the use of Information and Communication Technologies, in view of the small number of works detected, in this case it has been decided to include particularly significant review articles. These criteria have allowed us to select a total of 7 articles (see appendix II), whose main findings are discussed below in chronological order of publication.

The article by Carmen Gregori Signes, Lorena Orellana, and Marisa Samblas Beteta (2013) addresses the thesis of the potential of digital storytelling as an innovative pedagogical tool for educational intervention in children with ASD, namely through the integration of multimedia resources such as images, narrations, pictograms and sounds. The article aims to solidify the place of digital stories as a key resource for the inclusion and comprehensive development of people with ASD, while making it possible for them to participate in diverse social and educational environments. This framework also includes digitalised social stories, thought of as an evolution of traditional social stories. Social stories are proposed not only as a support for structuring routines and anticipating new situations, but also as a means of reducing anxiety and facilitating the understanding of challenging contexts.

The project developed within this framework combines the principles of social stories with the possibilities offered by digital storytelling, creating highly customisable tools that can be adapted to the individual needs of the user through portable digital devices. In

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particular, a pilot project was developed to familiarise children with ASD with dental procedures, as these contexts are often particularly stressful. The project included incorporating real images, personalised narrations, and sounds to build a multimodal experience that facilitates learning and reduces the stress associated with these visits. According to the study authors, digital stories stand out for their flexibility, allowing therapists and family members to modify the content in response to specific situations, and supporting the continuity of learning between the classroom and home. The authors emphasise that, although the preliminary results of the project are encouraging, it is essential to carry out additional research to validate the effectiveness of these tools and expand their applicability to other educational and therapeutic contexts.

Marta Calleja-Bautista, Pilar Sanz-Cervera, and Raúl Tárraga-Mínguez (2016), analyse the effects of music therapy on children with ASD, highlighting promising findings in children under 6 years of age. Schwartzberg and Silverman (2013) have found positive effects on social and affective development in the singing of social stories. Although repetition is a basic component in the forms of intervention of people with ASD, studies such as those by Kim et al. (2008, 2009) showed that musical improvisation improves joint attention, emotional responses, and social interaction in children aged 3 to 5 years. Likewise, research such as that of Lim (2010) and Lim & Draper (2011) demonstrated improvements in speech through the use of therapeutic songs, which were more effective than traditional techniques without music. LaGasse's study (2014) documented improvements in joint attention and communication in group activities with 6-year-old children. These interventions, carried out in environments such as home, school and therapeutic centres, included brief 15-minute sessions to programmes lasting several months, highlighting the importance of personalisation in the therapeutic approach.

The research carried out by Inmaculada Baixauli-Fortea, Belén Roselló-Miranda, Carmen Berenguer-Forner, Carla Colomer-Diago and María Dolores Grau-Sevilla (2017) explores various approaches to addressing social communication difficulties in children with ASD. Among the strategies highlighted, social stories are presented as key tools in therapeutic interventions that are pedagogically valuable. Their design takes advantage of strengths such as visual processing and the need for predictability, including clear

descriptions, guides for behaviour, and positive reinforcement. The article stresses that these stories are most effective when they are illustrated, read immediately before the situations to be worked on, and are aimed at children with sufficient verbal skills. In addition, it is indicated that these narratives not only address social issues, but can also reinforce positive behaviours, thus promoting a child's self-esteem.

According to the article, although most of the findings focus on children with verbal skills, social stories can also be adapted to early ages, including the Early Childhood Education stage, where play and visual resources have a fundamental role. In this context, these tools are particularly useful to prepare children for new routines, changes or group activities, supporting their integration into school and social environments. The article highlights the need for more comprehensive approaches that include the active collaboration of families, teachers and peers, thus optimising the benefits of these interventions for young children.

Marta Ginestar Rodríguez, Gemma Pastor-Cerezuela, Amparo Tijeras-Iborra, and María Inmaculada Fernández-Andrés (2019), analyse the effectiveness of social stories as a psychoeducational tool in people with ASD. This strategy is noted for being of great value for the development of social, communicative and affective skills. The article reviews the current scientific literature, with a focus on the effectiveness of social stories as an intervention strategy. To do so, 29 empirical studies were analysed. They were selected according to specific criteria to cover different ages, contexts and intervention objectives.

The article analyses two studies in particular that were conducted with children under 6 years of age. The results of both studies affirm that social stories are effective in implementing new behaviours and improving basic social skills when used in school environments or at home with the active participation of family members. Studies such as those by Cihak et al. (2012) and Mandasari et al. (2011) demonstrated positive results in the acquisition and maintenance of desired behaviours in this age group. Cihak et al. (2012) used social stories to increase participation in children aged 4 to 6 years, showing positive results with maintenance of learned skills. Mandasari et al. (2011) found improvements in the behaviour of children with ASD from 3 to 5 years old by implementing social stories in combination with other visual resources. According to

these studies, interventions that seek to implement new behaviours (for example, initiating social interactions or following basic rules of being around other people) obtained better results in children in Early Childhood Education than in Primary Education.

On the other hand, the effectiveness in reducing problematic behaviours depends on the design and customisation of the stories. Successful interventions were carried out in school settings or with the active participation of family members. In addition, it is concluded that social stories are highly valued by parents and teachers due to their ease of use and integration into daily routines, although in some cases other strategies, such as video modelling, have shown greater effectiveness for specific objectives. The study concludes that social stories are a valuable tool to promote social and communication skills in children under 6 years of age, especially when implemented in collaboration with family members and educators. However, their effectiveness may vary depending on the context, the design of the intervention, and the specific objectives.

The research by Carmen del Pilar Gallardo-Montes, María Jesús Caurcel Cara, Antonio Rodríguez Fuentes, and Davide Capperucci (2019), analyses the educational and therapeutic potential of social stories, highlighting how digital technologies, such as web platforms and mobile applications, have expanded their scope and accessibility for people with ASD. These tools combine text, pictograms, and visual elements, and they are shown to be highly effective resources for teaching social skills, regulating behaviours, and facilitating the understanding of everyday interactions and situations. Consequently, this approach is key to fostering independence and reducing anxiety in daily tasks, such as personal hygiene or complex social interactions.

The authors review several social story apps that stand out for their educational value. These include "Jose Learns" and "Visual Schedules and Social Stories." Both stand out for their intuitive design, neutral colours, and the ability to include automatic narrations, images, and personalised voice recordings, making them more interactive and tailored to individual needs. On the other hand, platforms such as "ARASAAC" provide downloadable resources to create social stories from scratch, facilitating their use at home, at school, and in therapeutic contexts. In this sense, the article underlines the

importance of the active participation of family members and psychotherapeutic and educational professionals, to reflect real situations of the user's daily life, thus fostering a more effective application of the skills acquired.

Lluna María Bru Luna, Manuel Martí-Vilar and Francisco González-Sala (2020), stress the effectiveness of social stories as a tool to promote pro-sociality and empathy in people with ASD. The article is a systematic review of the literature. Among the research reviewed is the study of Crozier & Tincani (2006), who found that the use of social stories in children aged 3 to 5 years reduced inappropriate behaviours and increased appropriate social responses. Social stories are notable for their ability to be personalised, allowing them to be adapted to the specific needs of participants, and were sometimes combined with other techniques, such as video modelling, to improve the generalisation of the skills learned. While the findings on social stories support effective interventions, the authors stress the need to increase the frequency and duration of these interventions, as well as to conduct further research with large samples to optimise their design and maximise their impact.

Finally, the article by Mar Salas Alcayde, Sandra Navarro Sánchez, and Diana Marín Suelves (2022) reviews the scientific literature on intervention cases for the development of social skills in students with ASD. The review was carried out among works that had been published between 2016 and 2021. 19 articles, in English and Spanish, selected from databases such as Scopus, Eric and Dialnet, were analysed. Among the articles, it is worth highlighting the study of Cassia et al. (2020) as a pioneer in verifying the effects of social stories and differential reinforcement in two children in Early Childhood Education with ASD, observing not only the improvement in their social and emotional development but also a decrease in inappropriate behaviour.

CONCLUSION

The Spanish educational system promotes inclusion from Early Childhood Education, with a preference for schooling children with autism spectrum disorder (ASD) in ordinary classrooms with specific support. The health and social care system works closely with the education system to ensure the diagnosis and comprehensive care of children with

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ASD. Four basic modalities of schooling are established for these children: ordinary without support, ordinary with support, preferential centres for ASD and special education centres. In addition to these is a rarely used mixed modality which alternates education in ordinary centres and in special centres. These options are complemented by educational care measures such as curricular adaptations, specialised support and flexibility in teaching time. In July 2023, the *National Council on Disability* approved the *First Spanish Strategic Action Plan on Autism Spectrum Disorder 2023-2027*. It focuses on six lines of action: promoting respect for people with ASD, encouraging early detection and diagnosis, promoting independent living and inclusion of these people, improve education and inclusive employment, guarantee access to justice and strengthening of rights, and promote research and training. The Plan highlights the need to solidify national criteria that guarantee inclusive and quality education, in accordance with the individual needs of students with ASD and their full integration into society.

The Spanish academic literature has repeatedly considered the relevance of Information and Communication Technologies to care for children with ASD. Although more studies dedicated specifically to the Early Childhood Education stage are lacking, the existing evidence underscores the potential of digital or technological resources at these ages. Properly used, these resources can promote attention, communication and social interaction, work on emotions, help to generalise concepts, consolidate learning, promote self-regulation, reinforce memory, and strengthen the processes of memory, theory of mind (ToM) and joint attention, among others. The various studies agree, however, that there is a need for more teacher training in the use of these resources and how they can be adapted to pedagogical action for children with ASD, all while taking into account the children's particular characteristics in each case and the context.

In turn, the findings on the effectiveness of social stories in interventions with children with ASD highlight their role as a valuable educational and therapeutic tool, especially in children under six years of age. Social stories structure narratives tailored to the child's cognitive and communicative level and are particularly effective in promoting social skills, regulating behaviours, and preparing children for new situations or routines. In the field of Early Childhood Education, significant improvements in social interaction and

the reduction of problematic behaviours have been documented when implemented in school or family contexts, when done with the active collaboration of educators and caregivers. Digitised versions of these stories expand their effectiveness by incorporating multimedia elements such as images, narrations, sounds, and music, which increases their personalisation and appeal. The research underscores that the success of social stories depends on proper design that includes visuals, directive phrases, and an approach that encourages children's participation. However, children with ASD face challenges in generalising learning to natural contexts and in the long-term consolidation of acquired skills, which highlights the importance of comprehensive approaches that involve the learner's entire environment. In summary, social stories have proved to be an effective strategy to improve the communication and social skills of children with ASD, particularly in Early Childhood Education, although their effectiveness depends on personalisation, collaboration between educational and family agents, and integration into daily routines.

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Upskilling Preservice Teachers to Support Young Children with Autism Spectrum Disorder
through Digital Social Stories
Project number 2024-1-PL01-KA220-HED-000246304

Annex I

Review of the role of digital tools in educating children with ASD.

Author	Year of publication	Study / population	Aim	Methodology	Key findings	Limitation / Weaknesses
Baixauli-Fortea, Inmaculada; Gómez García, Soledad; Andrés-Sebastiá; María de El Puig; & Berenguer-Forner, Carmen	2020	Early Childhood Education Students	To substantiate a proposal for intervention with children with ASD through the combined use of dialogic reading and augmented reality	Descriptive	The combination of dialogic reading and augmented reality can improve the child's involvement in the activity, produce advances in vocabulary, literal comprehension and inference, and increase interest in the task.	Further studies are needed to assess the long-term effectiveness of the proposal and explore its application in various contexts.
Corrales, Laura & Rodríguez, Javier	2022	Early Childhood Education Students	Possibilities of robotics in working with children with ASD	Case study	The use of robotics produces advances in the field of communication and acts as a motivating element, promoting sustained attention and improving performance in academic tasks.	The use of robotics requires qualified teachers and carefully designed interventions.
Gallardo-Montes, Carmen del Pilar; Rodríguez, Antonio;	2022	Teachers of Early Childhood, Primary,	Comparison of the ratings and uses of mobile applications for working with	Quasi-experimental design with questionnaire	Education professionals value the use of mobile applications as complementary tools in the education of people with ASD starting from an early age,	Need for greater focus on teacher training processes in digital skills and the conditions for using these resources.

Caurcel, María Jesús; & Capperucci, Davide		Secondary and Adult Education	populations with ASD in two countries		although differences are detected according to the educational level, for example between Early Childhood Education and Primary Education, according to the areas of work.	
Gallardo-Montes, Carmen del Pilar; Rodríguez, Antonio; Crisol, Emilio; & Caurcel, María Jesús	2020	Mobile applications for use in Early Childhood, Primary and Secondary Education	Evaluation of commercial mobile applications to strengthen the theory of mind (ToM) in people with ASD	Qualitative design using an indicator system	Mobile applications offer great potential in work with ASD starting at Early Childhood Education. Most of the applications analysed were rated as highly recommendable (11.9%) and recommendable (83.2%) while only 5% were rated as dispensable.	Insufficient attention to the emotional field, which is addressed by only a fifth of the applications; technical limitations: some applications do not incorporate voices or audio recordings, which reduces their usefulness for language learning; Language restrictions: Many apps are not available in multiple languages, restricting their functionality.
Pérez-Fuster, Patricia; Herrera, Gerardo; Kossyvaki, Lila; & Ferrer, Antonio	2022	Early Childhood and Primary Education students	Improvement of responding to joint attention (RJA) skills in autistic children with an intervention mediated by augmented reality (AR) technology	Multiple baseline single subject experimental design	The study shows that an intervention mediated by augmented reality technology can be highly effective in improving specific skills in children with ASD, offering a model replicable and accessible to schools and families.	The success of these interventions is affected by the familiarity of the school environment and the involvement of the teaching staff.

Annex II

Review about the use of social stories as a method to support social-emotional development

Author	Year	Study / population	Aim	Methodology	Key findings	Limitation / Weaknesses
Gregori Signes, Orellana, Samblas Beteta	2013	Pilot project of personalised digital stories for children with ASD.	Evaluate digital stories as an evolution of traditional social stories.	Design and implementation of digitalised social stories in specific situations.	Reduction in anxiety and improvement in social understanding; high personalisation and ease of adaptation.	Preliminary results; lack of validation and extension to other educational and therapeutic contexts.
Calleja-Bautista, Sanz-Cervera, Tárraga-Mínguez	2016	Review of music therapy applied to children under 6 years of age with ASD.	Analyse the impact of music therapy on social and communication skills in ASD.	Review of scientific literature, including interventions in family, school and therapeutic settings.	Social stories combined with music improve social interaction, joint attention and emotional regulation.	Limited longitudinal evidence; outcomes depend on personalisation of interventions.
Baixauli-Fortea, Roselló-Miranda, Berenguer-Forner, Colomer-Diago, Grau-Seville	2017	Review of strategies for social communication in children with ASD.	Analyse interventions such as social stories in social and communication skills.	Narrative review of child-centred strategies in early childhood education.	Social stories increase social understanding and are useful for preparing routines in educational contexts.	Limited generalisability to natural contexts; effectiveness depends on family and teacher collaboration.

Author	Year					
Gallardo Montes, Caurcel Cara, Rodríguez Fuentes, Capperucci	2019	Review of digital platforms and apps for social stories in ASD.	Evaluate the impact of technology on the accessibility and effectiveness of social stories.	Analysis of mobile applications and digital platforms for interventions with ASD.	Increasing accessibility, motivation and personalisation in digital social stories.	Need for longitudinal studies and dependence on technological access.
Ginestar Rodríguez, Pastor-Cerezuela, Tijeras-Iborra, Fernández-Andrés	2019	Review of 29 studies on ASD, includes children under 6 years old.	Evaluate the effectiveness of social stories on social and communication skills in ASD.	Systematic review of empirical studies selected under specific criteria.	Improvements in basic social behaviours and reduction of problematic behaviours in children in Early Childhood Education.	Variability in design and objectives; challenges in generalising learning to other contexts.
Bru Luna, Martí-Vilar, González-Sala	2020	Review of interventions in prosociality and empathy in young children with ASD.	Analyse how social stories foster prosociality and empathy in ASD.	Review of literature and empirical studies focused on samples of young children.	Reduction in inappropriate behaviour and improvement in social responses; personalisation key to effectiveness.	Studies limited in sample size and frequency of interventions.
Salas Alcayde, Navarro Sánchez, Marín Suelves	2022	Review of 19 studies on intervention techniques in social skills for students with ASD.	Evaluate the effectiveness of social stories and differential reinforcement on social skills.	Systematic bibliographic review based on literature in Spanish and English.	Social stories and differential reinforcement reduce inappropriate behaviour and improve social skills in early childhood education.	Lack of replicability in some studies and few data on impact in long-term contexts