Investigaciones y Experiencias

TIC y Aprendizaje de Idiomas para Adolescentes con TEA

ICT and Language Learning for Adolescents with ASD

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Resumen: En los últimos años se han planificado múltiples intervenciones relacionadas con la enseñanza de idiomas y con el desarrollo de habilidades lingüísticas, sociales y comunicativas en adolescentes con Trastornos del Espectro Autista (TEA). Un rasgo común a la mayoría de los programas de intervención es el aprovechamiento del potencial de las Tecnologías de la Información y la Comunicación (TIC), ya que, con base en la literatura internacional, se presume la efectividad de su uso en el campo de la educación y especialmente en el campo de la Educación Especial, a través de la activación de diversas prácticas docentes. En la revisión bibliográfica específica se estudia el uso de las TIC en la enseñanza de idiomas de adolescentes con TEA, un trastorno del neurodesarrollo cuya característica más importante son las conductas repetitivas y limitadas, pero también importantes déficits en el campo del lenguaje y la comunicación social y la Interacción. En base a las conclusiones de este estudio, se confirma la contribución de las TIC a la enseñanza de idiomas de los adolescentes con TEA, ya que conduce a la ampliación de sus habilidades lingüísticas y comunicativas.

Palabras clave: TIC, TEA, aprendizaje de idiomas, adolescencia, educación especial

Abstract: In recent years, many interventions have been planned related to language teaching and to the development of linguistic, social and communication skills in adolescents with Autistic Spectrum Disorders (ASD). A common feature of most intervention programs is the utilization of the potential of Information Communication

Technologies (ICT), as, based on the international literature, the effectiveness of their use in the field of education and especially in the field of Special Education is presumed, through the activation of various teaching practices. In the specific bibliographic review the use of ICT in the language teaching of adolescents with ASD is studied, a neurodevelopmental disorder with its' most important characteristics to be the repetitive and limited behaviors, but also significant deficits in the field of language and social communication and interaction. Based on the conclusions of this study, the contribution of ICT to the language teaching of adolescents with ASD is confirmed, as it leads to the expansion of their linguistic and communication skills.

Key words: ICT, ASD, Language learning, Adolescence, Special Education

Introduction

In recent years, educational technology plays a key role in the field of special education. As pointed out, among the many students receiving special education are students who are in the ASD (Torres et al., 2017; Fteiha, 2017). The difficulties faced by adolescents with ASD are multiple and are considered to cover a wide range, including the difficulties in the field of social interaction, communication and the various stereotypes of repetitive behaviors (Hussain, Abdullah, Husni & Mkpojiogu, 2016). Regarding the epidemiological features of ASD, the researchers point out that boys can be diagnosed with this disorder more often than girls, with a ratio 3/1 (Franchini et al., 2018). ASD also has a high incidence of comorbidity, with the result that a child with ASD is expected to be a candidate for the development, alongside, of other forms of disorders. It is noteworthy that about 70% of people with ASD also experience significant mental disabilities (Franchini et al., 2018).

The symptoms of ASD are considered to be numerous and can affect significantly different areas of the child's development. For the best evaluation and interpretation of ASD, its symptoms are most often categorized into the following categories, with various others that do not clearly fall into the criteria established for each one (Snow, 2019):

- language and communication
- social interaction
- mobility

Particularly, in the language field, the acquisition and cultivation of language skills is considered to be a special developmental milestone. This milestone's main feature is a relatively identical development among all children, regardless of the specific language learned, the family context, the cultural environment and the individual differences in mental ability. However, it should be highlighted that it is not always possible for all children to develop functional language skills (Fteiha, 2017).

Therefore, it is required to study the various language deficits of adolescents with ASD for their evaluation and then for the organization and implementation of appropriate intervention and therapeutic procedures (Snow, 2019; Rivilla & Serna, 2016). On a more theoretical level, it is argued that studying the informal course of language development in

children with ASD, can also work effectively to inform about the necessary and sufficient conditions for the normal course of language development, followed by children with typical development (Torres et al., 2017; Liu, Wu, Zhao, & Luo, 2017).

Meanwhile, the role of ICT is considered crucial both in strengthening independence and in maintaining the attention of adolescents with ASD in all kinds of activities (Law, Neihart & Dutt, 2018). For this reason, the importance of language learning, using ICT, to adolescents with ASD will be analyzed, showing that ICT can be used as a flexible and easy-to-use tool to provide important facilities to teachers for improving the language skills of adolescents with ASD.

Methodology

In this study the literature review is used, specifying to the narrative review, which follows the structure of the systematic review to some extent, yet lacks certain stages and is more narrative in nature. Literature reviews are useful when the aim is to provide an overview on a certain issue, since knowledge production is accelerating at a tremendous speed, while simultaneously remaining fragmented and interdisciplinary (Snyder, 2019).

Research was conducted referring to certain and known data bases: Google Scholar, PubMed and IATROTEK. Specific filters were applied in every data basis, so as to narrow down the findings, according to the research objectives: year of the studies and articles is in-between 2014-2022; languages of the articles assessed are English, Spanish and Greek. Key-words used: ICT tools and ASD, language deficits of adolescents with ASD, use of ICT for adolescents with ASD, ICT tools in education, ASD. The number of articles used after the application of all the above data filters is 42.

In a narrative review there is an informal process of reviewing the literature, based on a gradual expansion of knowledge and is adapted alongside the development of theory through a process of discovery (Fan, Breslin, Callahan & Iszatt-White, 2022). The study seeks to find out the contribution of ICT to the language learning of adolescents with ASD and has the following objectives:

1. Detect the language deficits of adolescents with ASD and the utilization of ICT in their language learning.
2. Investigate the resources offered by ICT tools in addressing the language deficits of adolescents with ASD.
3. Research literature on the effects of the use of ICT in education to address ASD's adolescents' language learning.

Language learning and ASD

ASD is distinguished by its' heterogeneous nature. However, the characteristics of people with ASD are consistent, regardless of frequency and intensity. Regarding language learning, ASD individuals show some weaknesses, such as significant deficits in verbal communication (Rivilla & Sern, 2016). Children and adolescents with ASD in many cases fail to understand the context as well as the meaning of words especially when used metaphorically (Sourla, 2019). In addition, their inability to adapt their speech based on the context, but also on the basis of the people to whom they are addressed, is considered

important. In this way, it is argued that adolescents with ASD have difficulty processing spoken language. Yet, there are many children who do not possess oral speech, leading to the thought that these individuals may have no functional speech or may not be healthy (Lord et al, 2020). The avoidance of eye contact with other people, while facial expressions and gestures are absent, makes this form of communication difficult, as well (Hussain et al., 2016).

At the same time, the deficits in the written word are noteworthy. Writing is essentially a complex activity, in which a combination of various cognitive and linguistic processes is required, where the role of pragmatism is considered important, meaning the social context in which each text is chosen to be written (Law et al., 2018). Adolescents with ASD are often unable to assess the social context when writing a text, and are frequently incapable of putting their thoughts in order to compose a text (Hyman et al., 2020).

It is argued that no significant deficiencies have been observed in adolescents with ASD in the areas of grammar, syntax and phonology. Although these areas present serious difficulties, this may be attributed to the limited mental ability or to some additional speech disorders, rather than the onset of ASD. Several adolescents with ASD in recent years, despite their co-occurring problems, possess word reading/decoding skills which are occasionally well-developed and learn to read satisfactorily (Brimo et al., 2021). These adolescents most of the time read aloud, without making mistakes and have the competence to fill in the incomplete sentences, according to their correct grammatical form. On the other hand, based on important research data, it is highlighted that, while the same population shows quite good performance in the field of syntactic and phonological skills, it faces significant problems in the semantic processing of various texts (Pierce, Courchesne & Bacon, 2016).

The most important problems that adolescents with ASD face at the language level are the following (Hyman et al., 2020):

- drawing conclusions
- processing of various verbal stimuli
- understanding of the various prosodic elements of speech
- discussion and at the same time understanding of the implied, metaphors and humor
- narrative ability and understanding of narrative speech

The importance of language deficits for the further development of adolescents with ASD, leads to the recognition of the role that ICT can play in their subsequent improvement in terms of their language and communication skills (Aguilar & Marín, 2015).

Is ICT essential for addressing the language deficits of adolescents with ASD?

In the context of ASD, it is claimed that language cannot be considered creative and productive. For this reason, the interest is focused on the speech of ASD adolescents and more specifically on the peculiar form of speech and the emerging comprehension difficulties (Liu et al., 2017). Generally speaking, it is considered that the areas of speech, which are mainly affected by ASD and concern comprehension and expression, are those areas, which are associated with the various prosodic and paralectical elements of speech. They are also related to the factual level of speech on a verbal, as well as non-verbal level, thus making the use of language for communication quite burdensome (Cakir, Frye & Walker, 2020).

The main language development disorders of adolescents with ASD can be basically focused on the factual part of the language, which has aroused the interest of several researchers (Aguilar & Marín, 2015). The term pragmatics can describe in essence the appropriate communication through an individual's ability to express whatever is right in the right way and at the right time, as defined by the social group (Fteiha, 2017). In ASD it is considered that, no matter how high the level of various semantic or syntactic skills is presented, the level of factual skills will be lower. In this context, people with ASD, even when they have achieved speech development to a satisfactory level, still present serious communication deficits (Petrocchi, Levante & Lecciso, 2020).

Pragmatics can be initially characterized as prolectic, when it refers to human communication with the environment and is distinguished by the following characteristics (Lord et al, 2020):

- limited skills in switching the communication sequence

- limited intention for any kind of communication

- lack or also limitation of the initiative for the emergence of any kind of interaction

- reduction or lack of interest in people

- limited understanding of the environment in a differentiated way

- limited interest in the environment

These language deficits request the use of ICT, as it is considered that they can limit the various sensory stimuli of adolescents with ASD, while providing the opportunity for students to communicate, by structuring the learning framework in the appropriate way (García, Garrote & Jiménez, 2016). The specific structure can be implemented based on the personalized needs of these adolescents and at the same time provide the possibility of control and evaluation. Additionally, the contribution of ICT is considered important in providing unlimited personalized options for the needs of adolescents with ASD while simultaneously enhance their both verbal and non-verbal communication opportunities (Arenas, 2016).

The contribution of ICT to education

ICT enlightens the field of education, as it can facilitate the educational process, enhancing its interactive and attractive nature. ICT offers various applications and tools, which facilitate the work of teachers and at the same time contribute to the expansion of students' knowledge (Arenas, 2016; Fernandez-Batanero & Colmenero-Ruiz, 2016). Their use provides unhindered and direct access to information through the use of various databases, electronic journals, learning management systems and at the same time a variable of educational tools, software and applications that complement and empower the curriculum (García, Garrote & Jiménez, 2016).

The issue of the introduction of ICT in the field of education has provoked intense scientific dialogue, as the interest is focused on the use or non-use of ICT in the classroom, implied by general education teachers (Bravou & Drigas, 2019). The ICT-inclusive education binomial entails considering two elements that must converge in a kind way a single purpose, the improvement of the training of individuals in general, meaning the teachers and the participating society. Overcoming integrative visions of ICT in the inclusive sphere will mean

that students feel comfortable in the classroom, their motivation for learning settles and/or increases, as well as the level of security and their feeling of belonging to a group (Marín, 2018). In the research of Vega-Gea, Calmaestra & Ortega-Ruiz (2021) teachers' perception of ICT application in inclusive education is positive overall. Most of the teachers, specifically the specialized ones, use ICT tools to improve communication during the lesson and to facilitate the presentation of the teaching material (Vega-Gea, Calmaestra & Ortega-Ruiz, 2021). However, although many teachers are familiar with the use of ICT, they cannot be considered sufficiently trained, as they lack satisfactory information about their multiple uses and their significant contribution to the educational process (Bravou & Drigas, 2019).

In the special education field, ICT is considered to be a powerful tool to facilitate the implementation of the educational process and the school integration of students with learning difficulties and disabilities (Acevedo, 2018; Hyman et al., 2020). More specifically, the important issue of educating children with learning disabilities and disabilities highlights the need to explore practices by which these students can gain equal access to education and all infrastructure, services, goods and benefits, enjoyed by the student population without disability (Charitaki, 2015).

ICT can provide the right support and the right software, thus facilitating the work of Special Education teachers and the learning process for the students themselves (Vega-Gea et al., 2021). Most of the time, with the rich interactive educational material, designed for classroom usage, they can simplify the procedure during the educational processing, allowing the virtual representation of various complex concepts and thereby contributing to their effective understanding (Bravou & Drigas, 2019). Meanwhile, it is argued that, as ICT uses interactive environments, with images, sound, movement and video, this enables students with disabilities to use all their senses, thereby enhancing their sense of integration (Domínguez, 2019; Hussein et al., 2019).

Furthermore, ICT is considered to be able to enhance students' autonomy during the learning process, and also in this context provide them with modern tools to demonstrate their abilities and skills, which may not have been achieved with traditional practices and traditional tools (Stathopoulou et al., 2020). These modern tools are able to offer new communication opportunities to students who are experiencing difficulties in this area, thereby facilitating their school integration. The opportunity for students to work in the classroom at their own pace is particularly important (Silva & Rodríguez, 2018). Moreover, it is pointed out that the use of computers in the classroom acquaints students with the use of ICT and gives them the necessary motivation to use them further at home for recreational or educational purposes (Charitaki, 2015).

In a relevant study by Fernandez-Batanero & Colmenero-Ruiz (2016), with the participation of Special Education teachers, it was pointed out that most teachers are clearly willing to use ICT in the classroom. Even more, in this research the teachers pointed out that ICT can be adapted to the diversity of students inside classroom, thus stimulating students' learning interest and at the same time acquiring knowledge and enhancing both individual and collaborative learning between students (Fernandez-Batanero & Colmenero-Ruiz, 2016). A case study from Martínez, Gutiérrez & Fernández (2018) highlights further the need to train and sensitize teachers in the use of ICT, with respect to diversity.

In general, ICT provides crucial tools to facilitate communication between students with disabilities, thus enabling them to cultivate their skills and experience learning, utilizing all their senses (Fernandez-Batanero & Colmenero -Ruiz, 2016). However, the teacher will be the one who finally involves the mentioned software, within his classroom methodology

(Marín, 2018). Therefore, it could be argued that ICT has the potential to be used in a greater scale inside special education classes and to appear particularly effective for adolescents with ASD, reflecting the inclusiveness of education mediated by ICT digital resources (Marín, 2018).

The role of ICT in educating adolescents with ASD

The fact that ICT allows the presentation of information in a way that appears to be tailored to the needs and the way information is processed by people with ASD, is a remarkable reason why it is worth exploring the use of new technologies in their learning process, especially since individuals with ASD themselves, express particular interest in the use of new technological means in their daily lives (Grossard et al., 2018). As highlighted by Marín (2018) and the United Nations (2019), the use of assistive technology can be a significant factor, in means of adapting to the overall integration of individuals in the ASD inside their communities.

Undoubtedly, supporting young people with ASD further, in improving their academic performance through new technologies, is another step towards equal management and inclusion (Ntalindwa, Soron, Nduwingoma, Karangwa & White, 2019). Research on the application of new technologies in educational interventions in adolescents with ASD, emphasizes that through the use of computers, smartphones, tablets, mobile devices, robots or virtual reality, the results are obvious in improving not only communication and socio-emotional skills of adolescents with ASD, but also in presenting a more positive academic profile (Sandgreen, Frederiksen & Bilenberg, 2021). The improvements in the academic field have concerned both theoretical and positive courses, and it is worth emphasizing that the explanation of the effectiveness of new technologies is quite clear: they are interactive tools with adaptable application to any type of intervention, while adolescents present the "digital generation", as they live and mature around technology (Domínguez-Lucio, Compañ-Gabucio, Torres-Collado, & de la Hera, 2022; Antopolskaya, Baybakova & Silakov, 2020; Fortunati, Taipale & de Luca, 2019). According to scientific findings, 98% of adolescents with ASD use computers for an average of five hours a day (Macoun et al., 2021).

The use of ICT in the educational process in adolescents with ASD proves to be a means of addressing the social marginalization experienced by teenagers at this age, especially in the upper secondary education (Sideraki, Papageorgiou, Tsiava & Drigas, 2022). According to Sideraki et al. (2022), school performance, future career prospects and an overall success in school with adequate academic skills present a key factor in the life of an adolescent, as, among other things, they imply social acceptance by the group of peers. The various mobile applications developed can be implemented in the education of adolescents with ASD, modifying to a great extent the educational process in more accessible ways for their learning: they minimize unnecessary information so that individuals can stay concentrated in the educational project, provide the possibility of self-regulation of the educational process and increase the motivation for learning (Vega-Gea, 2021; Stathopoulou, Karabatzaki, Tsiros, Katsantoni & Drigas, 2019).

Adolescents with ASD enjoy interaction with computers and consider electronic environments to be safer. Virtual Environments, which display emotions, seem to enhance teacher's work during the emotional education of adolescents with ASD, providing innovative tools (Law et al., 2018). Also, various multimedia applications as well as virtual reality environments have significant benefits for spelling, reading, phonological awareness and solving the various social problems of adolescents (Ching-Hsiang, Ming-Shan, Shu-Hui &

Chih-Nung, 2014). Meanwhile, most of the interactive environments that are created and used for the education of adolescents with ASD are educational software platforms, while several successful Virtual Reality platforms have been created in recent decades for adolescents with ASD. Predictable and stable environments minimize stress and simultaneously offer realistic and safe 3D scenarios that can be created to depict the various everyday situations that adolescents are called upon to manage (Bravou & Drigas, 2019).

ICT in combination with modern educational techniques can help educate adolescents with ASD, mitigating the challenges in different areas. The use of assistive technology is essentially considered to improve the performance of adolescents with ASD at school (Arenas, 2016). Moreover, it is claimed that these assistive technologies benefit adolescents with ASD by improving their ability to interact in a social context (Fernandez-Batanero & Colmenero-Ruiz, 2016). Adolescents with ASD perform better when the emphasis is on enhancing digital technologies, cognitive software applications, and their senses (Domínguez, 2019). In particular, the interest is focused on the ability of adolescents with ASD to use cognitive software applications installed on the computers and smartphones provided to them but also to participate in various activities at home (Fteiha, 2017).

The effectiveness of ICT is essentially based on their predictable and stable nature. Plus, they often lack various external distractions and thus contribute to maintaining these students' attention to the activity they are engaged in (Silva & Rodríguez, 2018). For this reason, an important element for the cultivation of their language skills can be considered that most of the information is provided visually, making it easier for students to understand (Fernandez-Batanero & Colmenero-Ruiz, 2016). This finding is fully in line with Domínguez (2019) and Knight & Sartini (2015), who maintain that visual supports are the first of the two evidence-based practices with a variety of forms, while using them is one of the most recommended practices in language teaching to adolescents with ASD.

Addressing language learning difficulties through ICT for adolescents with ASD

As evidenced by the plethora of research, ICT's contribution to the language teaching of adolescents with ASD is significant, due to the potential of ICT to adapt teaching materials to students' needs (Jelínková, 2019). For adolescent students with ASD it appears especially helpful the fact that they can access material that mixes image and sound during the vocabulary process, while when learning foreign languages, they practice pronunciation in their own rhythm. Cognitive awareness of adolescents with ASD is viable and meanwhile it is observed that through word processing in electronic media, writing skills are not only enhanced, but even accelerated (Jelínková, 2019).

The computer is a technological tool capable of adapting to the specific needs and special characteristics of these students. Technology works positively for adolescents with ASD, as it facilitates the compensation of their functional limitations and simultaneously provides them with the required opportunity for learning, for independent work and for autonomy. In this way it is argued that a language lesson can be restructured to the specific requirements of a teaching intervention for adolescents with ASD (Vega-Gea, 2021; Riga, Ioannidi & Papayiannis, 2021).

Based on Boucenna et al (2014) ICT tool interventions in adolescents and adults with ASD focus their interest, in addition to language expression and comprehension, in the following areas:

- workplace related skills

- skills of everyday life

- social skills

- communication skills and recognition of different emotions

Adolescents with ASD can implement the activity at their own pace, without the need to try to follow the pace of other students. Moreover, it is argued that it is possible to adapt the level of difficulty to their knowledge and needs (Ching-Hsiang et al., 2014). ICT applications for adolescents with ASD, regarding the development of language skills, most often involve avatars, interactive environments, teletherapy and virtual environments (Boucenna et al., 2014).

Furthermore, students' listening skills are developed and their involvement during the learning process becomes more active, and these factors largely determine the processing of reading function and comprehension (Weiss et al., 2017). The effectiveness of the use of ICT for language learning in adolescents with ASD is based on the fact that most interventions for people with ASD use communication-facilitating applications, encouraging the use of language (Gallardo-Montes, Caurcel & Rodríguez, 2021). Adolescents with ASD seem to respond better to the process of conceptualization when material is provided to them through images or videos, as opposed to cases where they are forced to read instructional material (Hussain, Mkpojiogu & Okoroafor, 2021).

In recent decades, a large amount of research has been conducted to determine the benefits of interventions based on new technologies in language teaching, in the context of improving the educational process for people on the ASD (Acevedo, 2018). It is found that using ICT and the application of interventions based on new technologies from an early age in the process of educating a child with ASD, result in a significant improvement of literacy skills, in the completion of phonological awareness and consequently in the successful construction of words, phrases and sentences, in the development of expressive language skills and in reading ability, as well as in the enrichment of the vocabulary (Anagnostopoulou, Lorentzou & Drigas, 2021). These essential supplies can help minimize the learning gaps for an adolescent student with ASD in the upper classes of secondary education, helping with their language teaching, as deficiencies in the above skills lead to delays in language readiness (Aguilar & Marín, 2015; Janke & Perovic, 2017).

Especially from the time of the pandemic onwards, a period during which e-learning was also used, there is an intense debate about the role of social media. Social media can be conceived as a tool that could offer a major supplement to the improvement of students' digital reading skills, leading adolescents with ASD to possibly benefit in many ways from their use, through social networking, both with the aim of improving reading as well as developing social skills (Silva et al., 2021). Yet, this field needs further research in order to clearly identify its' educational extensions (Hu & Yu, 2021).

Results

From the literature review 2014-2022: we extracted 54 articles; usage mostly of the database Google Scholar; 41 articles are in English, 12 articles are in Spanish and one in Greek. In Table 1 the results obtained from the databases used are presented.

Table 1. Results obtained in the databases used.

YEAR OF THE STUDIES	DATABASE	RESULTS
2014	Google Scholar	2 articles in English, 1 article in Spanish
2015	Google Scholar	2 articles in English, 1 article in Spanish
2016	Google Scholar	3 articles in English, 3 articles in Spanish
2017	Google Scholar	4 articles in English, 1 article in Spanish
2018	Google Scholar	3 articles in English, 4 articles in Spanish
2019	Google Scholar (9), IATROTEC (1)	9 articles in English, 1 article in Greek
2020	Google Scholar (5), PubMed (1)	6 articles in English
2021	Google Scholar (9)	9 articles in English, 2 articles in Spanish
2022	Google Scholar (2), PubMed (1)	3 articles in English

Regarding the themes of the article: language learning and ASD, 6 articles were used referring to 2016-2021; Is ICT essential for addressing the language deficits of adolescents with ASD?, 6 articles were used referring to 2015-2020; the contribution of ICT to education, 7 articles were used referring to 2015-2020; ICT's role in educating adolescents with ASD, 17 articles were used, referring to 2014-2022; addressing language difficulties through ICT for adolescents with ASD, 11 articles were used, among 2014-2021. In Table 2 the list of the articles and documents used are presented.

Table2. List of articles and documents for the study

TITLE OF THE ARTICLE	THEME	YEAR OF PUBLICATION
ICTs in inclusive education for learning disabilities	Addressing language difficulties through ICT for adolescents with ASD	2021
The Personal Agency of Modern Adolescents: Developmental Opportunities in a Socially Enriched Environment	ICT's role in educating adolescents with ASD	2020
Interactive technologies for autistic children: A review	Addressing language difficulties through ICT for adolescents with ASD	2014
A contemporary view on online and web tools for students with sensory & learning disabilities	The contribution of ICT to education, ICT's role in educating adolescents with ASD	2019
The co-occurrence of neurodevelopmental problems in dyslexia	Language learning and ASD	2021
The lifetime social cost of autism	Is ICT essential in addressing the language deficits of adolescents with ASD?	2020
The effect of ICT on emotional education and development of young children with Autism Spectrum Disorder	Is ICT essential in addressing the language deficits of adolescents with ASD?, The contribution of ICT to education	2015
Teaching two teenagers with autism spectrum disorders to request the continuation of video playback using a	ICT's role in educating adolescents with ASD, Addressing language difficulties through ICT for adolescents with ASD	2014

touchscreen computer with the function of automatic response to requests		
Occupational Therapy Interventions Using New Technologies in Children and Adolescents with Autism Spectrum Disorder: A Scoping Review	ICT's role in educating adolescents with ASD	2022
Advancing literature review methodology through rigour, generativity, scope and transparency	Methodology	2022
ICT and inclusive education: attitude of the teachers in secondary education	The contribution of ICT to education, ICT's role in educating adolescents with ASD	2016
Digital generations, but not as we know them	ICT's role in educating adolescents with ASD	2019
Variability in verbal and nonverbal communication in infants at risk for autism spectrum disorder: predictors and outcomes	The contribution of ICT to education	2018
Effectiveness of assistive technology in enhancing language skills for children with autism	Is ICT essential in addressing the language deficits of adolescents with ASD?, ICT's role in educating adolescents with ASD	2017
Technologies in the education of children and teenagers with autism: evaluation and classification of apps by work areas	Addressing language difficulties through ICT for adolescents with ASD	2021
ICT and autism care: state of the art	ICT's role in educating adolescents with ASD	2018
The effects of ICT-based social media on adolescents' digital reading performance: A longitudinal study of PISA 2009, PISA 2012, PISA 2015 and PISA 2018	Addressing language difficulties through ICT for adolescents with ASD	2021
Assisting Children with Autism Spectrum Disorder with Educational Mobile Apps to Acquire Language and Communication Skills: A Review	Addressing language difficulties through ICT for adolescents with ASD	2021
Identification, evaluation, and management of children with autism spectrum disorder	Language learning and ASD, ICT's role in educating adolescents with ASD	2020
Interaction design principles for edutainment systems: Enhancing the communication skills of children with autism spectrum disorders	Language learning and ASD	2016
The state of user experience design practice in Malaysia	The contribution of ICT to education	2019

Advanced syntax and primary pragmatics in children with ASD	Addressing language difficulties through ICT for adolescents with ASD	2017
ICT as an enhancing tool of foreign language teaching children with autistic spectrum disorders	Addressing language difficulties through ICT for adolescents with ASD	2019
A comprehensive literature review of comprehension strategies in core content areas for students with autism spectrum disorder	ICT's role in educating adolescents with ASD	2015
The use of behavior modeling training in a mobile app parent training program to improve functional communication of young children with autism spectrum disorder	Language learning and ASD, Is ICT essential in addressing the language deficits of adolescents with ASD?, ICT's role in educating adolescents with ASD	2018
Technology-facilitated diagnosis and treatment of individuals with autism spectrum disorder: An engineering perspective	Is ICT essential in addressing the language deficits of adolescents with ASD?	2017
Autism spectrum disorder	Language learning and ASD, Is ICT essential in addressing the language deficits of adolescents with ASD?	2020
Information & communication technologies use by children & youth with autism spectrum disorder: Promise and perils	ICT's role in educating adolescents with ASD	2021
The use of information communication technologies among children with autism spectrum disorders: Descriptive qualitative study	ICT's role in educating adolescents with ASD	2019
Systematic review of level 1 and level 2 screening tools for autism spectrum disorders in toddlers	Is ICT essential in addressing the language deficits of adolescents with ASD?	2020
To screen or not to screen universally for autism is not the question: Why the task force got it wrong	Language learning and ASD	2016
Social stories and digital literacy practices for inclusive education	Addressing language difficulties through ICT for adolescents with ASD	2021
Digital interventions for autism spectrum disorder: a meta-analysis	ICT's role in educating adolescents with ASD	2021
Stress, Hormones & the role of ICT in autism	ICT's role in educating adolescents with ASD	2022
Distance learning during social seclusion by COVID-19: improving the quality of life of undergraduate dentistry students	Addressing language difficulties through ICT for adolescents with ASD	2021

Verbs with Alternating Transitivity in Children with Developmental Language Impairment	Language learning and ASD	2019
Speech-language pathology and the youth offender: Epidemiological overview and roadmap for future speech-language pathology research and scope of practice	Introduction	2019
Literature review as a research methodology: An overview and guidelines	Methodology	2019
Evaluation of mobile apps effectiveness in children with autism social training via digital social stories	The contribution of ICT to education, ICT's role in educating adolescents with ASD	2020
Mobile apps the educational solution for autistic students in secondary education	ICT's role in educating adolescents with ASD	2019
Assistive Technologies, Active Participation	ICT's role in educating adolescents with ASD	2019
Challenges in developing new technologies for special needs education: a force-field analysis	Addressing language difficulties through ICT for adolescents with ASD	2017
Presentación: Educación inclusiva y tecnologías de la comunicación	The contribution of ICT to education, Addressing language difficulties through ICT for adolescents with ASD	2018
Desarrollando la competencia digital desde la educación inclusiva	Language learning and ASD, Is ICT essential in addressing the language deficits of adolescents with ASD?, Addressing language difficulties through ICT for adolescents with ASD	2015
Las TIC como recurso pedagógico del docente inclusivo	Is ICT essential in addressing the language deficits of adolescents with ASD?, The contribution of ICT to education, ICT's role in educating adolescents with ASD	2016
El Trastorno del Espectro Autista (TEA) y el uso de las Tecnologías de la información y comunicación (TIC)	The contribution of ICT to education, ICT's role in educating adolescents with ASD	2019
Uso de las TIC en el Trastorno de Espectro Autista: aplicaciones	Is ICT essential in addressing the language deficits of adolescents with ASD?, The contribution of ICT to education	2016
Las TIC inclusivas o la inclusividad de las TIC	The contribution of ICT to education, ICT's role in educating adolescents with ASD	2018
Percepción y uso de las TIC en las aulas inclusivas: Un estudio de caso	The contribution of ICT to education	2018
Potenciar las capacidades de las personas. Modelo para	Introduction, Language learning and ASD	2016

facilitar la comunicación con estudiantes del espectro autista		
Una mirada hacia las TIC en la educación de las personas con discapacidad y con trastorno del espectro autista: análisis temático y bibliográfico	The contribution of ICT to education, ICT's role in educating adolescents with ASD	2018
Requisitos, retos y oportunidades en el contexto del desarrollo de nuevas tecnologías con niños para niños con discapacidad	Introduction	2017
Presentación: Estudios bibliométricos y TIC	ICT's role in educating adolescents with ASD, Addressing language difficulties through ICT for adolescents with ASD	2021
Percepción docente del uso de las TIC en la Educación Inclusiva [Teacher perception on the use of ICT in Inclusive Education]	The contribution of ICT to education	2021

Conclusions

Based on the data of this literature review it becomes clear that in Special Education the use of ICT can yield quite positive results. In short, and taking into account the objectives set, we conclude several aspects. Regarding the objective detect the language deficits of adolescents with ASD and the utilization of ICT in their language learning, we conclude that comprehension, expression and communication skills in ASD adolescents can be improved with the utilization of ICT. ICT can contribute in the educational process through the differentiated presentation of information, aligned with the way ASD adolescents' work out the information procedure. As these adolescents live in the age of technology, ICT methods create ideal conditions of their inclusion in schools.

As for the objective investigate the resources offered by ICT tools in addressing the language deficits of adolescents with ASD, a variety of them is offered like mobile phones, computers and other innovative applications. The education of ASD adolescents through ICT tools is independent and on their own pace, while it is identified that these resources lead to a noticeable improvement in their literacy skills.

With respect to the final objective of the study, research literature on the effects of the use of ICT in education to address ASD's adolescents' language learning, we conclude that the cultivation of their linguistic and communicative skills is evitable through: the completion of phonological awareness; the successful construction of words, phrases and sentences; the development of expressive language skills; the enhanced reading ability; the enrichment of their vocabulary.

Future research should focus on: the perceptions of the teachers themselves as to whether they have the appropriate training for the utilization of ICT in the language teaching of adolescents with ASD; the way teachers could choose innovative applications that will aid adolescents with ASD in developing their linguistic and communicative abilities; the possibility

of using ICT in a more efficient way to enhance language and communication skills for adolescents with ASD, closing the gap with their deficiencies; the teaching mode of adolescents with ASD on the use of ICT, in order to further cultivate their language and communication skills; raising parents' awareness on their co-operation inside home, through the use of ICT, to reduce their adolescents' language deficits and to enhance their linguistic competence.

Conclusively, it is imperative to investigate this issue further, in the light of the views of teachers and parents of adolescents with ASD. Besides, without the equal effort of all parties during the pedagogical process, progress would not have been possible.

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