Mobile Application for Language Learning in Children with ASD

Arlindo Elifio Aguedo Tafur [1], Jorge Isaac Necochea-Chamorro [1]

[1] *Universidad César Vallejo, Lima, Perú*

***Abstract* - Autism Spectrum Disorder (ASD) is a condition characterized by challenges in motor and communication skills. The objective of this study was to design and implement a mobile application as an alternative resource to support language development in children with ASD. The research adopted an experimental design with a quantitative approach, involving a sample of 20 children. The data were collected using standardized instruments, including the Melgar Test, the Peabody Picture Vocabulary Test, and the Monfort and Juárez Test. The results demonstrated improvements in receptive and expressive language, as well as in pragmatic communication skills. These findings suggest that mobile applications can serve as a valuable complement to traditional language therapy, offering engaging and accessible tools that contribute to language acquisition in children with ASD.**

***Keywords* – Mobile application, language learning, Autism Spectrum Disorder.**

DOI: 10.18421/TEM144-27
https://doi.org/10.18421/TEM144-27

Corresponding author: Jorge Isaac Necochea Chamorro, *Facultad de Ingeniería de Sistemas, Universidad César Vallejo, Lima, Perú*
Email: jnecochea@ucvvirtual.edu.pe

Received: 04 December 2024.
Revised: 18 June 2025.
Accepted: 26 June 2025.
Published: 27 November 2025.

1. Introduction

At present, a considerable number of individuals across the globe are living with Autism Spectrum Disorder (ASD), a neurodevelopmental condition characterized by challenges in communication and motor skills [1]. This predicament poses substantial challenges, including constrained access to in-person therapeutic interventions and a paucity of specialists' adept in ASD care.

According to the World Health Organization, approximately 1 in 100 children are diagnosed with ASD, and the number of cases continues to increase globally [2]. Peru's official records indicate that 15,217 individuals have been diagnosed with ASD and are therefore entitled to legal rights and social benefits designed to promote their inclusion [3].

Mobile applications have emerged as valuable tools to support individuals with autism, offering structured and engaging activities aimed at improving communication, behavior, and learning outcomes [4]. Despite the preponderance of research in the domain of care, diagnosis, and intervention strategies [5], there persists a dearth of accessible resources that directly support language development in children with ASD.

Mobile applications have been demonstrated to be advantageous for parents, educators, therapists, and children, as they facilitate social interaction and communication skills. The utilization of educational applications designed for individuals with ASD has demonstrated efficacy in enhancing various aspects of cognitive development, including vocabulary acquisition, reading comprehension, phonological development, and overall learning behaviors [6], [7]. These applications frequently incorporate multimedia elements, including text, images, and sounds, which have been demonstrated to enhance learning outcomes [8], [9]. For instance, image-based communication tools [10], video modeling [11], and parent-mediated speech articulation strategies [12] have been integrated into mobile platforms to support development [13]. Certain applications utilize Artificial Intelligence to personalize learning experiences, aiding children in the acquisition of educational and organizational skills [14].

In light of the aforementioned context, the primary objective of this research endeavor is to assess the extent to which the implementation of a mobile application contributes to the enhancement of language learning in children diagnosed with ASD. The specific objectives are as follows:

The objective of this study is to examine how the use of a mobile application impacts receptive language development in children with ASD.

b) To ascertain the manner in which it exerts its influence on expressive language.

The subsequent step involves the analysis of the effect on pragmatic language skills.

In addition to the study of children with ASD, prior research has also evaluated the role of family members and caregivers. The Kaufman Test [15] and interventions designed to enhance pragmatic skills [16] have been employed as instruments to evaluate language development. In addition, an analysis of behavior change strategies has been conducted [17], emphasizing the importance of employing evidence-based techniques in the development of applications.

Technology-based interventions, including mobile applications, have been identified as particularly beneficial for individuals with ASD. However, the quality and structure of these applications vary significantly. There is an expressed need for high-quality applications that integrate effective teaching methods and provide learning support not only for children, but also for families and educators.

This study employs a quantitative research approach [18], utilizing numerical data and statistical analysis to test hypotheses and elucidate behavioral patterns. The research design is experimental [19], and it considers the widespread daily use of mobile devices among families—surpassing laptops or desktop computers—as a key factor in implementation. These tools are distinguished by their capacity to execute interactive functions autonomously, encompassing verbal and visual outputs [20], [21].

The acquisition of language entails both the generation and reception of sounds, which are indispensable for the development of vocabulary and grammatical structures [22]. In children diagnosed with ASD, these processes may exhibit an atypical trajectory; however, they still demonstrate stages of complexity and progression that are analogous to those observed in neurotypical children [23].

The initial phase of the study involved the use of clinical observation [24] for the purpose of identifying patterns within the study group. For the purpose of data collection, the present study employed tools such as the Melgar Articulation Test, which is a standardized instrument used to evaluate phoneme production and articulation progress in children [25].

2. Methodology

The following section delineates the experimental and quantitative design of the research. The study method is outlined, including the selection of participants, the assessment tools used, and the stages of app development and implementation. The objective is to evaluate the effectiveness of a mobile application on language development in children with ASD.

2.1. Method

It was developed with an experimental design, so that the type of research will be carried out in an applied way because a proposal for improvement is made through a technological approach. The research approach is quantitative that allows us to measure learning progress. This study will be developed in a single research with a single group in pre-test and post-test (see Figure 1), to evaluate the effect of the study variable before and after evaluating with the application and allow comparing the results statistically.

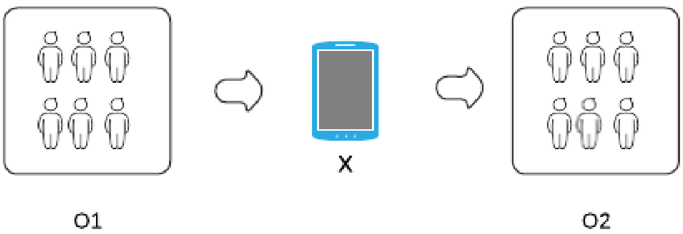

Figure 1. Experimental design

Where:

Experimental Group = Children with Autism Spectrum Disorder,

X = Mobile application to support language learning,

O1 = Treatment A,

O2 = Treatment B.

2.2. Participants

First, in the institution where this research was carried out, a filter of the records was made, where 20 patients who had been performing therapies on toddlers frequently for a long time and who had a range of 3 and 6 years of age diagnosed with ASD, with mild and moderate condition, were identified. In this way, the population was determined, the number of toddlers willing to be evaluated under the authorization or consent of the parents and with the help of a specialist in speech therapy who had been helping the infants continuously.

2.3. Instruments

To evaluate expressive language, as a support instrument, it was carried out through the use of the Melgar Test, where the infants were evaluated in a session of approximately 15 to 20 minutes, where it allowed the toddlers to demonstrate their ability to identify words and pronounce them correctly.

All this takes place in a closed environment and away from distracting objects.

To evaluate receptive language the research was carried out through the use of the Peabody Test, where the toddlers were evaluated in an approximate session of 5 minutes where they understood the ability to recognize images when mentioning the word on behalf of the specialist.

To evaluate pragmatic skills, the use of the Monfort and Juárez Test was implemented, which allowed toddlers to evaluate the ability to order words in a sentence in an orderly manner.

2.4. Procedures

Due to the purpose of this research, it was decided to build a mobile application called QUIZ TEA in Android version, where toddlers can be evaluated with a little help from parents. For this reason, a framework was developed for the advancement of the application, divided into 5 phases as can be shown in Figure 2.

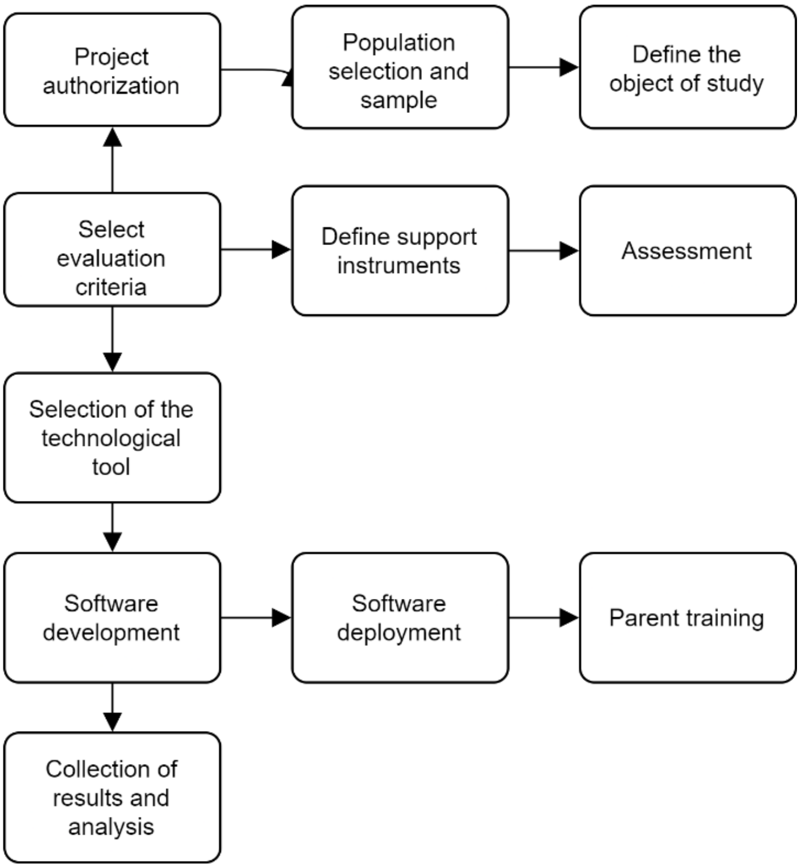

Figure 2. Graphical representation of the proposed methodology

2.4.1. Project Authorization

In the first phase, the permission of the manager of the entity where this study would be carried out was required and the solution of the same was applied.

A cover letter was made detailing the objective of this study and the execution of the mobile application in infants with ASD.

2.4.2. Select Evaluation Criteria

In the second phase, evaluation criteria were proposed that support the good resource in the exchange of images, through the use of pictograms that allow the child to identify and express verbally. To obtain the results, some ways of collecting data were taken into account with the use of support instruments, including the Melgar Test, Peabody Test and the Monfort and Juárez Test.

2.4.3. Selection of the Technological Tool

In the third phase, the technological tools were selected and the family situation has been taken into context where a default mobile device with an Android system is more accessible and lower cost in each of them.

2.4.4. Software Development

In the fourth phase, in the development of the software together with the help of the language therapy specialist and with her feedback on what could add value in the mobile application.

Main Screen: There are three categories in which it contains many pictograms depending on each instrument that served as support, as can be shown in Figure 3**.**

Figure 3. Main screen

Images: There will be 4 levels shown, that will be appropriate for the age, in each level there will be 12 questions with an option to choose from as soon as the word is played, as in Figure 4.

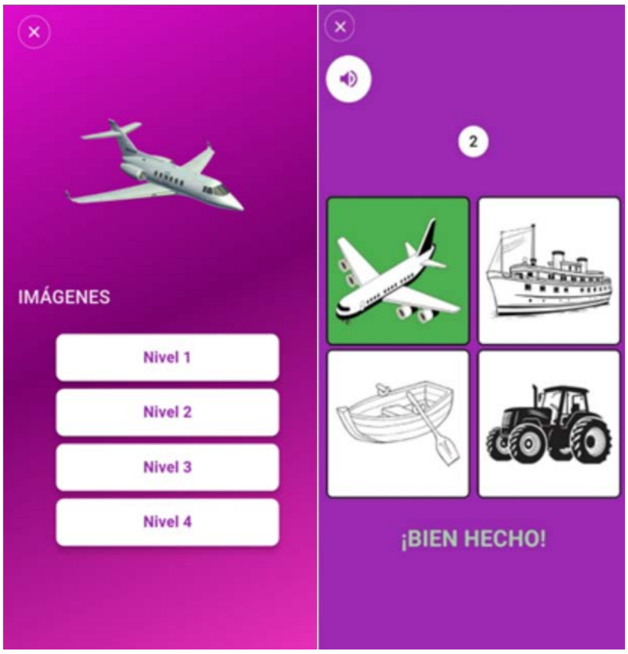

Figure 4. Imagery

Phonemes: A list of level images will be displayed and at the top there will be a button to support the child for each word verbally and at the bottom there is a microphone button where when pressed you can pronounce the word and it will automatically detect the word pronounced, as in Figure 5.

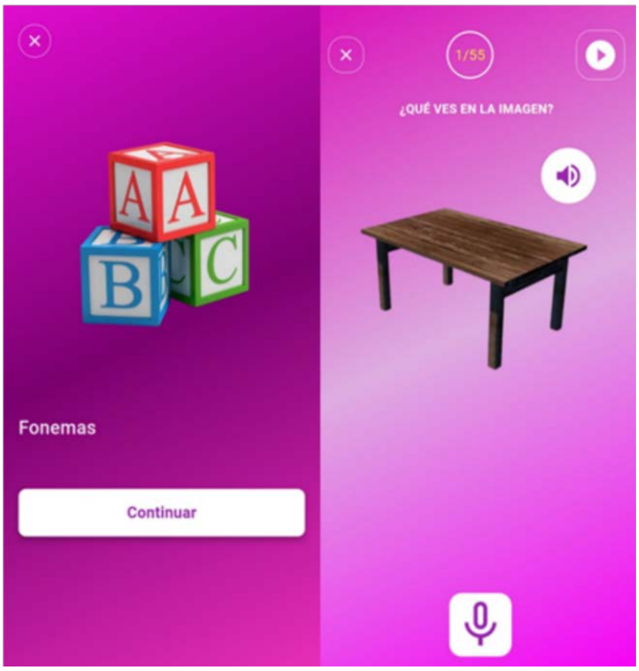

Figure 5. Phonemes

Sentences: A number of sentences to be completed in an orderly manner will be displayed, in addition there will be a button to repeat the sentence pronounced automatically at the beginning, as in Figure 6**.**

Figure 6. Prayers

3. Results

This section presents the findings of the pre-test and post-test evaluations conducted on the participants. The text provides a detailed exposition of the descriptive statistics pertaining to receptive, expressive and pragmatic language skills. Moreover, it employs a visual comparison to illustrate the observed enhancement in each language dimension subsequent to the intervention facilitated by the mobile application.

First, a pre-test was applied in order to obtain initial information on the indicators worked on in the research. Subsequently, after the use of the application by the study group, a new evaluation was carried out to obtain the results of the post-test, considering the previously defined indicators.

3.1. Descriptive Analysis for Receptive Language

In relation to the descriptive measures of the receptive language indicator, the following results were shown in Table 1.

Table 1. Descriptive results of the receptive language indicator

	N	Minimal	Maximum	Mean	Standard deviation
PRETEST	20	17	48	38,15	8,210
POSTEST	20	28	48	42,25	5,129
N valid (per list)	20				

Thus, the dispersion showed a rate of variation of 8.2 in the pre-test and 5.1 in the post-test (see Table 1).

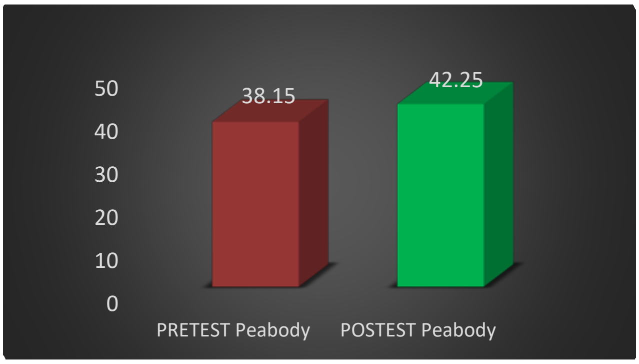

Figure 7. Average percentage: receptive language (pre and post-test)

In the result of the Receptive Language indicator (Figure 7), it can be seen the mean obtained in the post-test was 42.25 after having carried out the evaluation through the application in language learning and the average of the pre-test was 38.15, that is, he had an improvement in his language learning by 10.75%.

3.2. Descriptive Analysis for Expressive Language

In relation to the descriptive measures of the expressive language indicator, the following results were shown in Table 2.

Table 2. Descriptive result of the expressive language indicator

	N	Minimal	Maximum	Mean	Standard deviation
PRETEST	20	25	56	47,05	7,850
POSTEST	20	41	56	49,50	5,346
N valid (per list)	20				

Thus, the dispersion showed a rate of variation of 7.85 in the Pre-Test and 5.34 in the post-test (see Table 2).

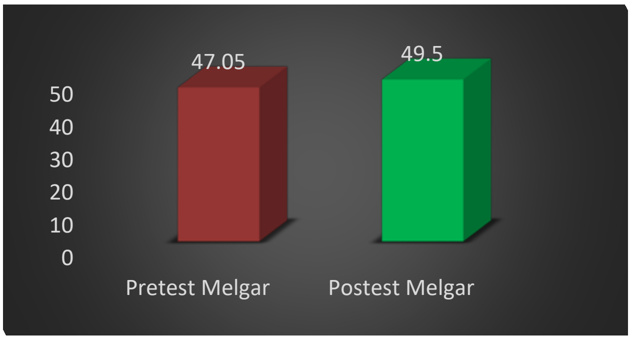

Figure 8. Mean percentage: expressive language (pre and post-test)

In the result of the Expressive Language indicator (See Figure 8), where the mean obtained in the post-test was 49.50 after having carried out the evaluation through the application in language learning and the average of the pre-test was 47.05, that is, he had an improvement in his language learning by 13.23%.

3.3. Descriptive Analysis for Pragmatic Skills

In relation to the descriptive measures of the pragmatic skills indicator, the following results were shown in Table 3.

Table 3. Descriptive result of the indicator pragmatic skills

	N	Minimal	Maximum	Mean	Standard deviation
PRETEST	20	30	43	34,20	4,213
POSTEST	20	36	43	39,35	3,407
N valid (per list)	20				

This way, the dispersion showed a rate of variation of 4.2 in the pre-test and 3.4 in the post-test (Table 3).

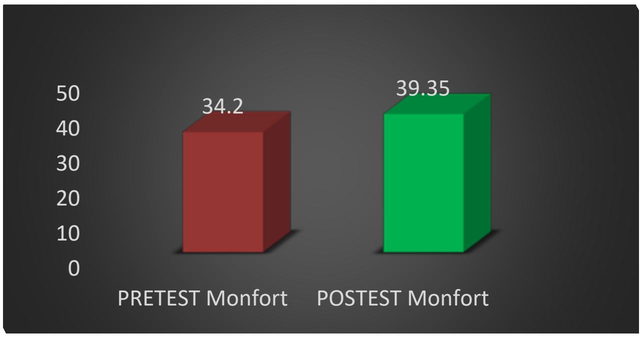

Figure 9. Average percentage: pragmatic skills (pre and post-test)

In the result of the Pragmatic Skills indicator (see Figure 9), where the average obtained in the post-test was 39.35 after having carried out the evaluation through the application in language learning and the average of the pre-test was 34.20, that is, he had an improvement in his language learning by 15.06%.

4. Discussion

The ensuing discussion seeks to interpret the results obtained in the context of the study's overarching objectives. The present study evaluates the influence of the mobile application on the development of receptive, expressive and pragmatic language skills in children diagnosed with ASD. The findings of the study are compared with existing literature in order to validate the outcomes and highlight the effectiveness of the intervention.

First, the first specific objective was to examine how the implementation of the mobile application impacts the development of receptive language in children with ASD, the results of the evaluation were shown in the pre-test where it was an average of 38.15 and for the post-test it was an average of 42.25, achieving an increase between both times of 10.75% in the learning of receptive language.

Finally, in [10] was shown that their social skills progressively improved by 11.96%. In this way, it can be stated that the referenced research evaluated toddler behavior, the present study focused on the comprehension and identification of words represented through pictograms.

Second, it was proposed as a second specific objective to identify how the mobile application influences the progress of expressive language in infants with ASD, the results of the evaluation were shown in the pre-test where an average of 47.05 was obtained and for the post-test an average of 49.50 was obtained, achieving an increase between both times of 13.23% in the learning of expressive language. However, in [7] it was carried out with a pilot test to 3 participants and was applied through an AB design, during the beginning and the intervention together with the application, as a result on the first participant in a previous test obtained 50% (12 of 24 correct answers) and a subsequent test obtained 66% (18 of 24 correct answers). Although in the present research it was developed through a design within the subject in a single measurement in a standardized way, it is possible to show that expressive language is positively involved in verbal communication skills, because in the institution carried out in this study, they require a better way to reinforce pronunciation, vocalization and intonation of the words over the images associated with a test that serves as an evaluation guide.

Finally, it was proposed as a third specific objective to analyze how the mobile application favors the learning of pragmatic language skills in infants with ASD, the results of the evaluation were shown in the pre-test where an average of 34.20 was obtained and for the post-test an average of 39.35 was obtained. Achieving an increase between both times of 15.06% in the learning of expressive language. Therefore, based on the contributions of [26], who maintain that the objective is to encourage verbal communication to be handled in a more natural way, by supervising the activities in the construction of simple sentences from a list of long sentences, as a result obtain results on more complex questions. In a study with a number of 20 participants who had different diagnoses of ASD, from 16 years to 40 years old, where it provides significant benefits to users at the time of communication. They consider that between 15% and 25% of those who are diagnosed with ASD can have a personal life and work independently.

5. Conclusion

This section offers a synopsis of the collective impact of the mobile application on language acquisition in children diagnosed with ASD. The study restates the improvements observed in receptive, expressive, and pragmatic skills and concludes that the mobile application serves as a meaningful support tool for language acquisition.

In relation to the general objective of the research, it was possible to evaluate to what extent the implementation of a mobile application contributes to improving language learning in children with ASD, an improvement of 10.75% was achieved in receptive language, 13.23%, in expressive language and 15.06% in pragmatic skills. In such a way, the application will significantly influence their communication skills with everything related to their environment.

On the other hand, in relation to objective 1, it was concluded that the application helped to analyze how the implementation of the mobile application influences the improvement of language learning in receptive language in children with ASD, through the identification of images.

In relation to objective 2, the application in order to determine how to improve expressive language learning in children with ASD, which allowed mentioning words through images in so-called pictograms.

In relation to objective 3, it was concluded that the application in order to determine how the implementation of the mobile application in the improvement of language learning pragmatic skills in children with ASD, which allowed ordering sentences through small scenes.

References:

[1]. Alcalá, G. C., & Ochoa Madrigal, M. G. (2022). Trastorno del espectro autista (TEA). *Revista de la Facultad de Medicina (México)*, *65*(1), 7-20. Doi: 10.22201/fm.24484865e.2022.65.1.02

[2]. Consejo Nacional para la Integración de la Persona con Discapacidad (CONADIS). (2023). *Niñas, niños y adolescentes con autismo tienen derecho a recibir una educación inclusiva y de calidad*. Gobierno del Perú. Retrieved from: https://www.gob.pe/institucion/conadis/noticias/737695-conadis-ninas-ninos-y-adolescentes-con-autismo-tienen-derecho-a-recibir-una-educacion-inclusiva-y-de-calidad [accessed: 10 November 2024]

[3]. Culquitanta Aguilar, A. C., & López Pérez, H. O. (2023). *Impacto de la implementación de un aplicativo móvil con tecnología de realidad aumentada en el proceso de aprendizaje de niños con capacidades especiales de la I.E.P. Personitas, Cajamarca 2022* [Tesis de licenciatura, Universidad Privada del Norte].

[4]. Guzman Condor, R. J., & Huayna Dueñas, A. M. (2022). Mobile tool to develop skills of communication in children with autism spectrum disorder. *Revista peruana de computación y sistemas*, *4*(1), 37–50. Doi: 10.15381/rpcs.v4i1.24126

[5]. Condor, R. J. G. (2022). *Implementación de un sistema de comunicación por intercambio de imágenes en dispositivos móviles como soporte de ayuda para infantes con trastorno de espectro autista*. [Doctoral dissertation, Universidad Nacional Mayor de San Marcos].

[6]. Hanna, N., et al. (2022). Apps to teach social skills to individuals with autism spectrum disorder: a review of the embedded behaviour change procedures. *Review Journal of Autism and Developmental Disorders*, *9*(4), 453-469. Doi: 10.1007/s40489-021-00271-w

[7]. Ruiz Cerna, J. A., & Angeles Lliuya, P. V. (2024). *Aplicación móvil con uso de realidad aumentada para mejorar el aprendizaje en niños con trastorno del espectro autista.* Universidad Peruana de Ciencias Aplicadas (UPC).

[8]. Lagos, P., et al. (2021). L-PECs: Application for inclusive work environments. *Procedia Computer Science*, *184*, 396-403. Doi: 10.1016/j.procs.2021.03.050

[9]. Lim, K. C., et al. (2019). Usability measures in mobile-based augmented reality learning applications: a systematic review. *Applied Sciences*, *9*(13), 2718. Doi: 10.3390/app9132718

[10]. Liu, X., et al. (2023). A survey on autism care, diagnosis, and intervention based on mobile apps: Focusing on usability and software design. *Sensors*, *23*(14), 6260. Doi: 10.3390/s23146260

[11]. Loayza Palomino, C. M. (2023). *Aplicación móvil para el aprendizaje en niños con Trastorno por Déficit de Atención e Hiperactividad*. Universidad Cesar Vallejo.

[12]. López Palma, A. E., et al. (2019). La observación. Primer eslabón del método clínico. *Revista Cubana de Reumatología*, *21*(2).

[13]. Gernsbacher, M. A., Morson, E. M., & Grace, E. J. (2016). Language development in autism. *Neurobiology of language*, 879-886. Academic Press. Doi: 10.1016/b978-0-12-407794-2.00070-5.

[14]. García Mora, M. E., Schwartz Orellana, S., & Freire, G. (2021). *Inclusión de las personas con discapacidad en América Latina y el Caribe: Un camino hacia el desarrollo sostenible*. Banco Mundial.

[15]. Medina, Y. (n.d.). *Instructions for applying the Melgar test*.

[16]. Ntalindwa, T., et al. (2021). Development of a mobile app to improve numeracy skills of children with autism spectrum disorder: participatory design and usability study. *JMIR pediatrics and parenting*, *4*(3), e21471. Doi: 10.2196/21471

[17]. Organización Mundial de la Salud. (2023). *Autismo*. OMS. Retrieved from: https://www.who.int/es/news-room/fact-sheets/detail/autism-spectrum-disorders [accessed: 15 November 2024]

[18]. Ousley, O., & Cermak, T. (2014). Autism spectrum disorder: defining dimensions and subgroups. *Current developmental disorders reports*, *1*, 20-28. Doi: 10.1007/s40474-013-0003-1

[19]. Panda, P. K., et al. (2024). Effectiveness of IMPUTE ADT-1 mobile application in children with autism spectrum disorder: An interim analysis of an ongoing randomized controlled trial. *Journal of Neurosciences in Rural Practice*, *15*(2), 262. Doi: 10.25259/JNRP_599_2023

[20]. Primera, H. & Álvarez, O. (2020). *Aplicativo móvil para mejorar la dislexia en niños de primaria.* Corporación Universitaria del Caribe - CECAR

[21]. Sanromà-Giménez, M., et al. (2021). Design and validation of an assessment tool for educational mobile applications used with autistic learners. *Journal of new approaches in educational research*, *10*(1), 101-121. Doi: 10.7821/naer.2021.1.574

[22]. Saul, J., & Norbury, C. (2020). Feasibility of an app-based parent-mediated speech production intervention for minimally verbal autistic children: development and pilot testing of a new intervention. *Pilot and feasibility studies*, *6*, 1-17. Doi: 10.1186/s40814-020-00726-7

[23]. Somerton, M. (2022). Developing an educational app for students with autism. In *Frontiers in Education*, *7*, 998694. Frontiers Media SA. Doi: 10.3389/feduc.2022.998694

[24]. Susanibar, F., Dioses, A., & Chicaiza, D. (2022). *Adquisición, desarrollo y aprendizaje de los sonidos del habla del español en niños de 2 años y medio a 6 años 11 meses: un estudio transversal normativo.* Franklin Susanibar.

[25]. Wali, A., Alfrihidi, M., & Alasiri, N. (2023). Aawn: An Interactive Mobile Application for Improving the Communication Skills of Arab Children with Autism. *TEM Journal*, *12*(3). Doi: 10.18421/tem123-10

[26]. Zamry, A. A., Abdullah, M. H. L., & Zakaria, M. H. (2022). A guideline for designing mobile applications for children with autism within religious boundaries. *International Journal of Advanced Computer Science and Applications*, *13*(11). Doi: 10.14569/ijacsa.2022.0131133