

Speech-generating devices: Cultural tools for communication

Dispositivos geradores de fala: Instrumentos culturais de comunicação

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Summary

Starting from the reflection about the concept of compensation for disability and the use of cultural tools proposed by Vigotski, the present study describes an investigation whose objective was to survey, in a virtual store, the applications developed for people with autism or with great difficulties in the language that characterizes them as people with complex communication needs. The applications available free of charge, developed for the iOS operating system, which associate the use of pictograms or images with a speech generator device, were used as a search criterion. In addition, we seek to know the main functions of these programs, in order to analyze and describe how they could contribute to the communication of these people. It was also decided to carry out a bibliographical survey about the subject associated with an exploratory research in the academic Google and ERIC databases. Regarding the available applications, a total of 241 were found, but only four met the criteria established by the research. Surveys like this can favor access and popularization of this resource type, highlighting the possible benefits of its use in the process of social and educational inclusion.

Keywords: Autism Spectrum Disorder. Inclusion. Augmentative and Alternative Communication. Speech-generating Devices.

Resumo

A partir da reflexão sobre o conceito de compensação da deficiência e o uso de instrumentos culturais, proposta por Vigotski, o presente estudo descreve uma investigação cujo objetivo foi fazer um levantamento, em uma loja virtual, dos aplicativos desenvolvidos para pessoas com autismo ou com dificuldades acentuadas na linguagem que as caracterize como pessoas com necessidades complexas de comunicação. Foi utilizado como critério de busca aplicativos disponibilizados gratuitamente, desenvolvidos para o sistema operacional iOS, que associam o uso de pictogramas ou imagens a um dispositivo gerador de fala. Além disso, buscamos conhecer as principais funções destes programas, a fim de analisar e descrever de que forma poderiam contribuir para a comunicação destas pessoas. Optou-se, ainda, por realizar um levantamento bibliográfico sobre a temática associado a uma pesquisa de cunho exploratório nas bases de dados do Google acadêmico e do ERIC. Em relação aos aplicativos disponíveis, foram encontrados um total de 241, porém apenas quatro cumpriram os critérios estabelecidos pela pesquisa. Pesquisas como esta podem favorecer o acesso e a popularização deste tipo de recurso, evidenciando os possíveis benefícios de seu uso no processo de inclusão social e educacional.

Unitermos: Autismo. Inclusão. Comunicação Alternativa e Aumentativa. Sintetizador de Fala.

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Introduction

Dainez and Smolka (2014) highlight that at the end of the 19th century and beginning of the 20th century there were two theoretical currents regarding compensation for disability: one that believed the child with a disability had a gift, of enigmatic and divine origin and that because of knowledge of this would compensate for your possible lack/loss, whatever it may be; and another that revolved around the biological issue that believed a certain loss would be compensated by another organ that would develop more exponentially, making up for a possible lack/absence, therefore focusing the idea on the impediments that the deficiency established. Both perspectives considered human development only through characteristics that could be measured, consequently reducing the child's capacity in the face of any deficit that he or she could present.

Vigotski (1995) did not agree with these ideas since such prescriptions for this "biological correction" came together with medical and therapeutic recommendations to the detriment of the pedagogical perspective, the focus of his research. Such guidelines disregarded actions that could be developed in the educational sphere and led them to reductionist behaviors, where the focus was on "cure or treatment". This thinker also argued that the function of education should be focused on thinking and proposing new ways of seeing the development of children with disabilities and strategies that could contemplate the diversity in the context of teaching and learning.

He did not notice education as something that could be prescribed as a complement or treatment to make up for a certain biological absence, on the contrary, it should be seen as an action that aims to favor the participation of this child in society. The social environment should, therefore, take responsibility for creating ways for this to occur fully and fruitfully. In our view today, ensuring the permanence of this child and their achievement in the school context must be a society responsibility.

Martins and Rabatini (2011) highlight that culture, according to Vigotski's conception, is that

manifested through signs (language) and cultural tools (objects) created by man. Based on this concept, that is, on the transformation of nature by man, and himself, culture is a fundamental element in the development of the human being.

Cultural instruments are characterized as any tool, symbol or system developed and used by a given society whose purpose is to mediate people's cognitive, intellectual and social activities. These, in turn, play a fundamental role in the development of human beings as subjects, citizens, as they directly influence how people will think, learn, interact and communicate.

In the case of people with disabilities, cultural instruments play a crucial role in the compensation mechanism which, for Vigotski (1995), is located in the social sphere, as it is related to cultural resources developed by the social group to expand the possibilities of participation of these people.

Autism Spectrum Disorder (ASD) began to be considered a disability for legal purposes after the enactment of Law 12,764 (2012). In the Diagnostic and Statistical Manual of Mental Disorders, DSM-5 (APA, 2014), ASD is considered a neurodevelopmental disorder whose main characteristics are impaired communication and social interaction associated with restricted and repetitive patterns of behavior and interests. Their level of involvement is measured based on the support needs that the individual presents, which can vary from level 01 – requires support; level 02 – requires substantial support and level 3 – requires a lot of support. These levels harm, in different ways, the subject's personal, social, academic or professional functioning (APA, 2014).

Neurodevelopmental disorders belong to a set of conditions that begin early in a person's life (APA, 2014) and, although the first characteristics can be identified before 12 months of age, they are most evident between 12 and 24 months. Data from the *Centers for Disease Control and Prevention* (CDC) indicate that in 2020 the prevalence rate of ASD in the United States was 1/36 children up to 8 years old, being 4 times more common in boys than in girls (Maenner et al., 2023).

The aforementioned Law No. 12,764 (2012), which deals with the rights of people with autism, guarantees them specialized educational assistance as they are the target audience for Special Education. It is the responsibility of this educational modality, according to the second paragraph of decree 7,611 (2011), to “guarantee specialized support services aimed at eliminating barriers that may obstruct the schooling process”. Therefore, the elimination of these barriers depends directly on the promotion of an effectively inclusive education and vice versa. Different types of technologies have been used as part of actions for this purpose.

The use of technologies in the children and young people education with markedly different learning and development conditions has been advocated since the first discussions about inclusive education (Giroto et al., 2012). One of the basic documents of this movement is the Salamanca declaration (1994), a landmark in Special Education for the countries that are signatories and proposed to have a different look at the inclusion of people groups who were marginalized and found themselves outside the environment school.

It is from its publication that the concept of Inclusive Education and attention to diversity are incorporated; one of its principles is to promote that children can learn regardless of their difficulties or differences, with the school being responsible for ensuring an appropriate curriculum for the student, organizing its structure in order to serve them appropriately, proposing diverse teaching strategies and the use of resources that enable their access to knowledge.

According to Galvão Filho (2011), promoting access for people with disabilities to available technological resources that contribute to their development is a matter of necessity and fundamental right, and it is essential to have policies that guarantee this right. Cruz and Nascimento (2018) state that, at school, the use of digital technologies has stood out as another strategy that can favor and support students considered a target audience for Special Education and for school inclusion in general.

People who have difficulties in their communication can use various resources that offer support to exercise their right to communicate: from the most common ones, such as personalized communication boards that will have images and their written meanings, as well as folders, books or binders where the user will be able to exchange messages with their interlocutor; even technology resources such as smartphones, tablets and iPads® combined with the use of applications and speech generating devices [SGD] that will transform text or images into vocalized information.

Wendt (2017) states that SGD is an interesting option for students with ASD who have difficulty with functional language. According to the author, studies indicate that there are positive effects when these devices are used in the clinical environment with the aim of developing skills or minimizing challenging behaviors. On the other hand, there are almost no studies that address the effects on speech production in a natural way and/or that describe the results on the socio-communicative students’ behaviors with this diagnosis. The author also highlights that offering the resource together with the device without implementing strategies for appropriating the material by the child and their group may not contribute to an effective increase in the act of communicating (Wendt, 2017; Schirmer, 2020).

The SGD is a tool used through high-technology resources capable of producing digitized or synthesized speech with the aim of assisting in the communication of people with impaired functional speech. This technology, associated with graphic symbols, can enhance and produce positive effects for the social communication of people who have complex communication needs [CCN] (Abdalla & Costa, 2018; Wendt, 2017; Xin & Leonard, 2015).

In general, applications that have SGD allow the output of electronic voice referring to letters, words and phrases of images combined or not, this voice output, in turn, can be synthesized, that is, generated automatically by the device that recognizes the image, pictogram or written word or can be pre-recorded by the user.

From this perspective, the SGD would be another resource to assist and allow people with language or speech impairment to become an active participant in their dialogic interaction. However, the high cost involved in this mechanism can make it difficult to use universally, even though the use of applications this device is becoming popular. Abdalla and Costa (2018) highlight that this type of application was initially created for people with sensory disabilities with language impairment, but is currently being used both by people diagnosed with autism and children who are just starting to learn to speak.

Given this, the main objective of this study was to reflect on the concept of disability compensation proposed by Vigotski, analyzing the possibility of using the SGD as a cultural tool, an element created by society that can favor the inclusion of people with disabilities in the school environment and other social contexts by expanding communication possibilities. Furthermore, we had the specific objective of knowing the functionalities of applications that can be used by people with ASD, available for free on the *Apple Store*¹ platform, which associate the use of pictograms or images with SGD as a way of promoting alternative and expanded communication [AAC] and which are accessible on the iOS² operating system, proposing a dialogue about how they can help us in pedagogical and therapeutic practices.

Method

This study is an excerpt from a doctoral research and was approved by the Ethics and Research Committee of the educational institution (consubstantiated opinion from CEP no. 5.139.299) and consists of exploratory bibliographic research, that is, a qualitative review about the use of SGDs as an

AAC resource, which can be used as a compensatory cultural tool for children with ASD and who present CCN.

According to Gil (2016), exploratory investigations seek to clarify concepts and ideas about the chosen topic and would be those that least require rigor in their planning, nor do they imply an immediate intervention in reality. However, they are important and have a decisive character for planning the intervention that is intended to be carried out when the topic is little discussed or there is almost no knowledge about it.

Furthermore, we sought to carry out a survey to identify, in the iOS operating system, available AAC applications associated with a SGD as we understand that researching applications for use in mobile technological resources constitutes a path to be taken in times when, in society in which we live, practically everyone has a smartphone and is connected to the internet. It is worth highlighting, however, that given the speed of development of digital technologies, research will always need to be updated, running the risk of becoming obsolete every year, which does not make it any less necessary or important, considering the potential contribution of these devices to the social and educational inclusion processes of people with ASD.

The bibliographical research on the topic was carried out in the Google Scholar and ERIC databases in 2022. The survey of available applications was carried out on an iPad®, 9th. generation also in the same year. We proposed the following characteristics as inclusion criteria for analyzing these applications:

1. Promote AAC;
2. Use symbols, images or pictograms;
3. Contain a speech generating device;
4. Be available in Portuguese;
5. Provide a free version.

1 The App Store is the store of applications available for Apple® products. There, the user can find and download the applications that interest them. Applications can be free, paid or partially paid (with purchases made within the downloaded applications themselves).

2 iOS is software (operating system) developed exclusively to support devices created by Apple® such as iPhone®, iPad®, iPod®. Its creation concept is associated with direct manipulation using touchscreen technology, that is, interaction occurs by touching the finger directly on the screen.

For this search, we initially defined the descriptor “speech generating devices” as the keyword. Given the lack of results, we opted for the terms “autism spectrum disorder” and “autistic spectrum disorder”, in which case we only obtained one answer for both. In the Tismoo.me application, which appears to include a social network, with exclusive access to guests, filled with information and topics related to ASD.

As this application did not meet the criteria defined for this investigation, as it did not promote AAC, we decided to carry out a new search with the term “autism”. In the latter, 244 applications available for mobile devices compatible with the operating system iOS were catalogued.

The applications were cataloged by name and organized in a spreadsheet created in Excel and arranged according to the order available on the App Store. After completion, they were organized in alphabetical order to check possible cases of duplication. In the end, we reached a total of 241 applications available on the platform.

Results and Discussion

Of the total number of applications, four met our inclusion criteria, namely: Card Talk, Grid Player, Kids ToDo List and LetMeTalk: Free AAC Application, with three classified in the education category, and one in the medicine category according to Apple Store criteria. Furthermore, all of them are also available for the Android³ operating system with the exception of Grid Player. The description was made based on a summary of the information made available by the developer in the application store as highlighted in Table 1.

CardTalk

Card Talk was created with the aim of helping people with language and communication difficulties to communicate and express feelings, desires and names of objects through images associated with the use of digitized voice. The initial interface (Figure 1) of the application has at its bottom the categories corresponding to the available images,

distributed as follows: History (provides the historical collection of images used in the user’s last visits), Original (provides images created by the user⁴), Want (desires), Tools (everyday objects such as toys and cutlery), Food, People, Animals, Clothes, Vehicles, Places (different social spaces), Time, Feelings, Actions (verbs), Relationships (antonyms), and Questions. From this home page it is also possible to access the Menu screen, used to select the functions provided by the application.

It didn’t seem difficult to use, just follow the step-by-step instructions available. It is still possible to create new cards by customizing the application. The instructions for using this feature by selecting an image from the file and for recording voice and completing the process are intuitive and easy to follow. The synthesized voice available for Portuguese is close to the pronunciation of the language spoken in Portugal.

Kids To Do List

The application was created with the aim of organizing everyday tasks so that the person using it can view them in a chronological arrangement, thus being able to associate the sequence in which they can be carried out.

Its initial interface (Figure 2) has a list of tasks that already includes two activities related to daily life (Morning task and Changing clothes). By clicking and pressing the “pencil” button, located in the top right corner, for about three seconds, the user will be able to organize, in ascending order, the tasks according to their interest. It is also possible to delete the task, rename them or add more actions by determining a time for them to be carried out.

3 Android is an operating system developed by Google and used on mobile devices from other tablet and smartphone manufacturers except Apple*.

4 From this excerpt, when we use the word user, we will be referring to the person who will monitor, guide and/or customize the resources available in the application for the child or person who will use the device, if they do not have the autonomy to do so.

Table 1

Applications selected based on the criteria established by the research.

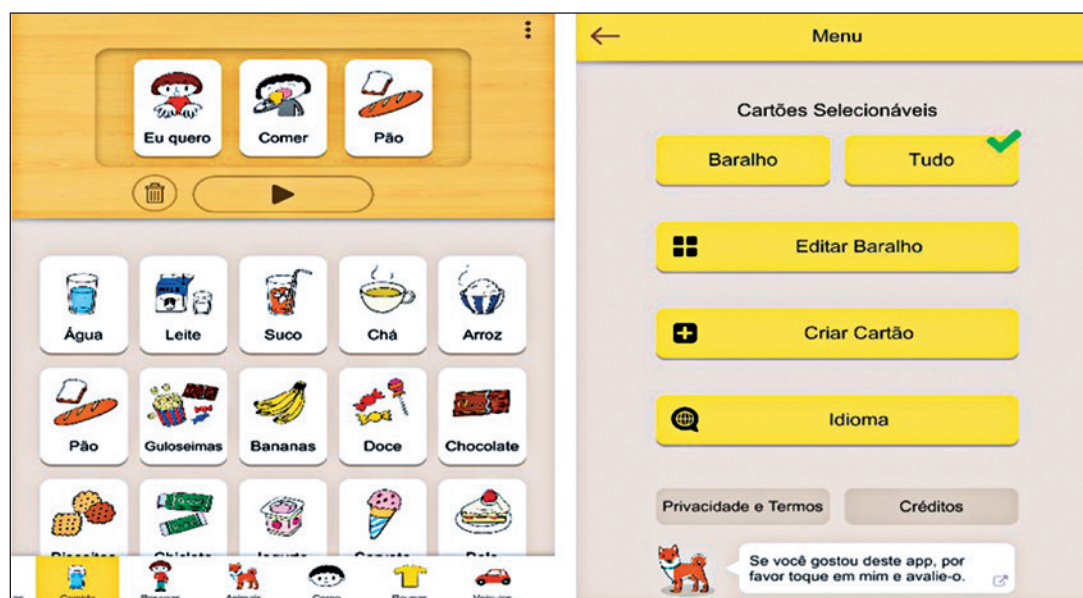
Application	Category	Description	Grade ¹ (ranging from 0 to 5)	Developer
Card Talk	Education	It serves to express emotions through cards. It has 200 types of cards for everyday use with digitized voice for each one in 10 languages	4,3 (Evaluated by 20 users)	LITALICO Inc.
Grid Player	Medicine	Aimed at helping AAC for people who lack speech or are unable to speak clearly. Uses synthesized male and female voice. Contains more than 12,000 symbols. Available in 16 languages.	3,0 (Evaluated by 1 user)	Sensory Software International
Kids ToDo List	Education	Used to create and keep everyday tasks in order. Contains 100 types of cards. Available in 11 languages. Uses speech device. The user can create their picture cards and record voice.	4,5 (Evaluated by 82 users)	LITALICO Inc.
LetMeTalk: Free Aplicattion CAA	Education	Offer CAA and voice support to your users. Contains 9,000 images from ARASAAC ² . You can add other images to the device. It contains voice support for images and phrases and is available in 16 languages (some with and others without voice support).	3,0 (Evaluated by 34 users)	AppNotize UG (haftungsbeschraenkt)

Nascimento (2023)

1. Application rating considering its classification according to the number of users who evaluated it, with the maximum rating being 5.0.
2. The Aragonese Center for Augmentative and Alternative Communication [ARASAAC] is a project funded by the Department of Culture, Sports and Education of the Government of Aragon, in Spain. It is a portal that offers graphic resources and adapted materials, which aim to promote AAC and assist in accessibility. <https://arasaac.org/>

Figure 1

Application screens



Card Talk App (2023)

The application offers options for the user to choose the images available on the device or create their own images using pictograms or photos. We highlight that, as the developer is the same as Card Talk, the sound of the synthesized voice for Portuguese is close to the language spoken in Portugal. The absence of “Brazilian” Portuguese in the voice device can cause some strangeness in relation to intonation and, sometimes, vocabulary.

As a last resource in its initial interface, there is a game (image of a book with a fish on the cover), which can be customized with figures of aquatic animals. The purpose of the game is to click on underwater bubbles to make them burst.

LetMeTalk: Free AAC App

The app was created with the aim of offering a voice-supported AAC feature for people with CCN. Its initial interface (Figure 3) has central buttons/folders that show the categories of words available in the application: General (words using

the first person singular – which represent basic desires), Food, Drink, Clothing, Diseases, Feelings, Tools (objects used in everyday life), Toys, Colors, Numbers, Alphabet, Shapes (geometric shapes). The software offers the options to rename, delete and/or add new categories.

It is possible in the settings to choose the language, activate or not the voice device, create a profile, activate modifications, show or not the words in the pictograms, speak or not the name of the categories, remove the phrases, and define the size of the images to be shown on the display.

By clicking on the icon with the image of an arrow (play/start) the user will hear the sound of the words of the respective symbols according to the chosen order, thus suggesting the formation of a sentence, or they can hear each word individually by clicking on each of the arranged symbols.

It also offers the option of customizing its interface by changing the background color (of the folder), changing its position (location on the initial

Figure 2
Application screens



Kids To Do List App (2023)

Figure 3
Application screens



LetMeTalk: Free AAC App (2023)

display) and renaming any image. Unlike the other two applications mentioned above, it is not necessary to record the name of the objects, the application automatically generates the sound corresponding to the chosen symbol/word.

Grid Player

In its initial interface (Figure 4) there are five folders that can be used independently by the user: Information, Symbol Talker A and Symbol Talker B, Talking Photographs and Text Talker Phrasebook. The Information folder contains explanatory presentations about the potential of each available resource and a help folder, with suggestions and explanations about the use of AAC.

The two Symbol Talker folders provide resources for constructing short sentences using symbols visually. In option A the user can use short and objective sentences and in option B there are, in addition, two folders/links: one with words classified into

categories and the other with short sentences. Both can be used by users who want to build slightly more elaborate sentences or to expand vocabulary.

The Talking Photographs folder has images of objects, divided into categories and subcategories, that are part of everyday life; and finally, in the Text Talker Phrasebook option, it's possible to access a collection of short phrases, divided into topics, to build short sentences/dialogues.

It is necessary to consider that the application contains incorrect or inadequate translation of some words and small exclamatory and interrogative sentences, when spoken, do not have the appropriate intonation, which can make understanding difficult when constructing a sentence, for example. Furthermore, the display does not provide symbols corresponding to the chosen words, showing only the written words or phrases.

Based on this description, we propose in Table 2 a summary of the main functionalities of each of the applications raised by this study.

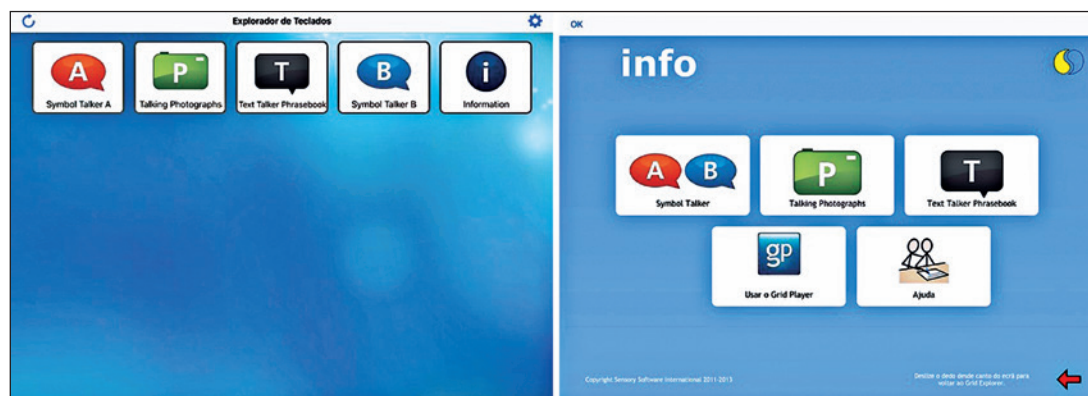
For Vigotski (1995), cultural tools go beyond material goods created by man (such as a comb for combing hair, a plate for serving food) as they also involve symbolic elements such as language, writing, cultural practices, and why not, computer technologies.

Such instruments play an important role in what we know as the zone of proximal development (ZPD). In this case, these tools can contribute to

providing the necessary support so that the person can advance in their development, favoring their autonomy and allowing them to carry out actions or carry out activities that they previously needed help to complete, that is, activities that I wasn't able to do it alone.

Culture has the imperative function of developing resources and strategies that compensate for the deficits caused by the disorder, dysfunction, or

Figure 4
Application screens



Grid Player (2023)

Table 2
Summary of features

Application	Visual resource	Sound resource	Customization	Disadvantages
Card Talk	The symbols available are from the application itself.	Synthesized voice (Portuguese from Portugal). Female voice.	It's possible add photos or images from user. Is it possible to use recorded voice.	The application offers a limited number of symbols.
Kids to do list	The symbols available are from the application itself	Synthesized voice (Portuguese Portugal). Female voice.	It's possible add photos or images from user. It is possible to use recorded voice.	The application offers a limited number of symbols. The screen can only be used vertically.
LetMe Talk: Free application by AAC	The symbols available are from ARASAAC.	Synthesized voice (Portuguese - Brazil). Female voice.	It's possible add photos and images from user. It's possible to add pictograms of the application collection.	It's not possible record voice.
Grid Player	The symbols available are the application's.	Synthesized voice (Portuguese - Brazil). Female voice.	Cannot customize.	Cannot customize. The screen can only be used horizontally.

Nascimento (2023)

marked difference, motor, intellectual or sensory, to expand and equalize the opportunities for social participation of these people (Vigotski, 1995).

From this perspective, we can consider the SGD as a cultural tool created by man that can promote learning, but mainly allow children with severe language difficulties due to ASD and/or who have CCN to communicate and express themselves through it.

Schirmer (2020) carried out a systematic review study in which he sought to analyze what research on alternative and expanded communication (AAC) revealed about the use of high-tech resources for people with ASD, among these resources was the use of SGD. In one of the studies (Flores et al., 2012) we sought to verify the functionality of the iPad® as a SGD. One of the conclusions was that teachers preferred to use the iPad® instead of exchanging pictures due to its ease of use. In another study (Genc-Tosun & Kurt, 2017), an iPad® was used as a resource to teach children the skills of requesting something. The results showed that the participants learned both this skill and the ability to discriminate symbols, even without having ever used such a device for this purpose. Furthermore, social validity data suggested that their interlocutors had positive opinions about its use.

The researches show that the use of mobile technology resources such as tablets and smartphones has advantages over the use of notebooks and laptops for children with ASD, as movement from touching the screen of equipment that supports touchscreen technology occurs more natural (Santarosa & Conforto, 2015; Aragão et al., 2019; Cruz & Nascimento, 2018).

Furthermore, it is evident that the use of applications, on mobile resources, can present another tool for the development of learning, and consequently, for inclusion in different environments, including school, and for communication between peers, depending on of the choice and the way in which this use is made (Fonseca & Schirmer, 2021).

Xin and Leonard (2015) evaluated the use of a SGD developed for iPad®, *SonoFlex*, by three ten-year-old students diagnosed with autism and

intellectual disability, for six weeks in a special education school. The authors observed that, when learning to use the application, the three children showed a higher incidence of social interactions characterized by making requests, answering questions and making social comments, both in the classroom and at recess. None of the three students had verbal expression skills before the intervention.

These authors highlight the importance of exploring and knowing the available applications in order to highlight their use, thus enabling teachers (and therapists) to choose and work with the one that best suits the student's profile in a school context.

The act of communicating involves the desire to speak, express oneself, structure a message, whether questioning and exposing ideas, desires, feelings; which consists of a dialogue with the other. Thus, AAC resources, including those that use pictographic symbols, symbols and images, as is the case with these applications, have proven to be important resources to be used in social spaces, including schools, aiming to promote communication and dialogical interaction for people diagnosed with ASD with CCN with their interlocutors.

The SGD, as studies show, has the advantage of aiding communication through the production of recorded or synthesized speech. These applications offer a practically unlimited vocabulary, with the possibility of inserting photos and new pictograms from the user's private collection. This insertion favors the contextualization of the language according to the universe of each person who will use it.

It is also important to highlight that even though these applications have intuitive navigation characteristics, the work of a professional, such as a teacher, or an adult/family member guided by the clinical professional cannot be underestimated or minimized, so that the person with ASD learns to use SGD, taking advantage of the benefits that these applications can offer and developing their communicative potential to the maximum.

Considerations

Vygotski valued in his discussion the importance of the sociocultural environment in shaping human development. Based on this premise, it is possible to say that the use of the SGD is a cultural tool that can expand the people's communicative skills with ASD who present with CCN. This technology can be seen as a mediation resource so that these people can express themselves and participate with more engagement in the activities proposed in different social environments. In this sense, the applications analyzed in this research offer resources that can promote communication, as they provide, in addition to vocabulary, other activities, such as the organization of routine activities and the use of written language.

Therefore, we consider that having applications available that can help, develop, or supply language and communication for people who have difficulties in this area is quite interesting, however this subject is still little explored in scientific circles, which justifies research like this.

In this sense, we recommend that research that addresses this topic be stimulated and developed so that we can find different alternatives, approaches and paths to promote the people's inclusion and development with this profile. Investigations like this can even support and enable the choice of professionals from the multidisciplinary team in their clinical practices and teachers in the school environment, about the most appropriate resources for their patients or students.

Finally, we hope from this analysis to contribute to the professionals' work who seek information about resources and materials that can promote mediation aimed at promoting the development of skills (in this case, communicative), independence and autonomy, which favor relationships interpersonal and mainly for educational and social inclusion.

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References

- Abdalla, P. M., & Costa, R. M. R. (2018). Dynamic Display: Uma ferramenta para Comunicação Aumentativa e Alternativa. *Caderno de Estudos em Sistema de Informação*, 5(1), 1-17. <https://seer.uniacademia.edu.br/index.php/cesi/article/view/1454>
- American Psychiatric Association. (2014). *(DSM-5): Manual diagnóstico e estatístico de transtornos mentais* (5ª ed.). Artmed.
- Aragão, M. C. M., Bottentuit Junior, J. B., & Zaquero, L. C. C. (2019). O uso de aplicativos para auxiliar no desenvolvimento de crianças com transtorno do espectro do autista. *Olhares & Trilhas*, 21(1), 43-57. <https://doi.org/10.14393/OT2019v21.n.1.46088>
- Brasil. Decreto Nº 7.611 de 17 de novembro de 2011. (2011, 17 de novembro). *Dispõe sobre a educação especial, o atendimento educacional especializado e dá outras providências*. Presidência da República. https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2011/decreto/d7611.htm
- Brasil. Lei Nº 12.764, de 27 de dezembro de 2012. (2012, 27 de dezembro). *Institui a Política Nacional de Proteção dos Direitos da Pessoa com Transtorno do Espectro Autista; e altera o § 3º do art. 98 da Lei nº 8.112, de 11 de dezembro de 1990*. Presidência da República. http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12764.htm
- Cruz, M. M., & Nascimento, F. F. (2018). Acessibilidade ao currículo através do uso do computador para estudantes com autismo. *Revista Interinstitucional Artes de Educar*, 4(1), 43-65. <https://www.e-publicacoes.uerj.br/riae/article/view/30041>
- Dainez, D., & Smolka, A. L. B. (2014). O conceito de compensação no diálogo de Vygotski com Adler: desenvolvimento humano, educação e deficiência. *Educação e Pesquisa*, 40(4), 1093-1108. http://educa.fcc.org.br/scielo.php?pid=S1517-97022014000401093&script=sci_abstract
- Fonseca, J. T. R., & Schirmer, C. R. (2021). Tecnologia Assistiva: aplicativos para dispositivos móveis, uma contribuição tecnológica para aprendizagem de crianças autistas. *Revista Educação e Cultura Contemporânea*, 17(51), 155-175. <http://periodicos.estacio.br/index.php/reeduc/article/view/7039/47967531>
- Flores, M., Musgrove, K., Renner, S., Hinton, V., Strozier, S., Franklin, S., & Hil, D. (2012). A comparison of communication using the Apple iPad and a picture-based system. *Augmentative and alternative communication (Baltimore, Md.: 1985)*, 28 (2), 74-84. <https://pubmed.ncbi.nlm.nih.gov/22263895/>
- Galvão Filho, T. (2011). Favorecendo práticas pedagógicas inclusivas por meio da Tecnologia Assistiva. In L. R. O., Nunes, M. B, Pelosi, & C. C. F. Walter (Orgs.), *Compartilhando experiências: ampliando a comunicação alternativa* (pp. 71-82). ABPEE.
- Genc-Tosun, D., & Kurt, O. (2017). Teaching multi-step requesting to children with autism spectrum disorder

- using systematic instruction and a speech-generating device. *Augmentative and alternative communication (Baltimore, Md.: 1985)*, 33(4), 213-223. <https://pubmed.ncbi.nlm.nih.gov/28969454/>
- Gil, A. C. (2016). *Métodos e técnicas de pesquisa social* (6ª ed.). Atlas.
- Giroto, C. R. M., Poker, R. B., & Omote, S. (2012). Educação Especial, formação de professores e o uso das tecnologias de informação e comunicação: a construção de práticas inclusivas. In C. R. M. Giroto, C. R. B. Mosca, R. B., Poker, & S. Omote (Orgs.), *As tecnologias nas práticas inclusivas* (pp. 11-24). Cultura Acadêmica.
- Maenner, M. J., Warren, Z., Williams, A. R., Amoakohene, E., Bakian, A. V., Bilder, D. A., Durkin, M. S., Fitzgerald, R. T., Furnier, S. M., Hughes, M. M., Ladd-Acosta, C. M., McArthur, D., Pas, E. T., Salinas, A., Vehorn, A., Williams, S., Esler, A., Grzybowski, A., Hall-Lande, J., Nguyen, R. H. N., ... Shaw, K. A. (2023). Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2020. *Morbidity and mortality weekly report. Surveillance summaries (Washington, D.C.: 2002)*, 72(2), 1-14. https://www.cdc.gov/mmwr/volumes/72/ss/ss7202a1.htm?s_cid=ss7202a1_w
- Martins, L. M., & Rabatini, V. G. (2011). A Concepção de Cultura em Vigotski: contribuições para a educação escolar. *Psicologia Política*, 11(22), 345-358. <http://pepsic.bvsalud.org/pdf/rpp/v11n22/v11n22a11.pdf>
- Organização das Nações Unidas para a Educação, a Ciência e a Cultura (UNESCO). (1994, 10 de junho). *Declaração de Salamanca: Sobre Princípios, Políticas e Práticas na Área das Necessidades Educativas Especiais*. <http://portal.mec.gov.br/seesp/arquivos/pdf/salamanca.pdf>
- Santarosa, L. M. C., & Conforto, D. (2015). Tecnologias móveis na inclusão escolar e digital de estudantes com transtornos de espectro autista. *Revista Brasileira de Educação Especial (Marília)*, 21(4), 349-366. <https://www.scielo.br/pdf/rbee/v21n4/1413-6538-rbee-21-04-00349.pdf>
- Schirmer, C. R. (2020). Pesquisas em recursos de alta tecnologia para comunicação e transtorno do espectro autista. *Educação Temática Digital*, 22(1), 68-85. <https://periodicos.sbu.unicamp.br/ojs/index.php/etd/article/view/8655470>
- Vigotski, L. S. (1995). *Obras Escogidas - V. Fundamentos de Defectologia*. Editorial Pedagógica.
- Wendt, O. (2017). AAC in autism: challenges and practices. In D. Deliberato, & M. J., Gonçalves (Orgs.), *Trilhando Juntos a Comunicação Alternativa* (pp. 47-62). ABPEE.
- Xin, J. F., & Leonard, D. A. (2015). Using iPads to Teach Communication Skills of Students with Autism. *Journal of Autism and Developmental Disorders*, 45(12), 4154-4164. <https://pubmed.ncbi.nlm.nih.gov/25294648/>



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