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Review article

# Communication systems in a population with cerebral palsy

## Sistemas de Comunicación alternativos y aumentativos en Población con Parálisis Cerebral

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**Conflict of interest:** nothing

**Abstract**

**Introduction:** Cerebral palsy (CP) is a pathology of motor origin, caused by brain injury, which has a significant impact on the development of language comprehension and expression. It notably affects communication, showing on some occasions, restricted vocabulary, poor syntactic structuring, unintelligible speech and a totally reduced exploration of the environment. Augmentative and alternative communication systems are one of the therapeutic strategies used by professionals in speech therapy, thus contributing to the development of linguistic-communicative skills in this population.

**Objective:** This research characterizes, based on a literature review, the communication systems used as a therapeutic tool for the population diagnosed with CP.

**Methods:** this was done through a literature review, considering articles from the databases: Google Scholar, Pubmed, Scopus and VHL. 266 articles were filtered from a matrix of own authorship, which was refined taking into account the eligibility criteria proposed from the critical reading of the title, abstract and keywords; Finally, a sample of 20 articles is consolidated.

**Results:** The results are expressed through the distribution of sociodemographic, methodological and thematic variables of the research.

**Conclusion:** In general, the communication systems used in the last 10 years by speech-language pathologists in the population with cerebral palsy are mostly high-tech, evidencing the use of software-hardware, interface and voice-generating devices (SGD).

**Resumen**

**Antecedentes:** La parálisis cerebral es una patología de origen motor, ocasionada por una lesión cerebral, que repercute significativamente en el desarrollo de la comprensión y expresión del lenguaje. Afecta notablemente la comunicación, evidenciándose en algunas ocasiones, vocabulario restringido, estructuración sintáctica escasa, habla ininteligible y una exploración del entorno totalmente reducida. Los sistemas de comunicación aumentativos y alternativos son una de las estrategias terapéuticas utilizadas por los profesionales en fonoaudiología, contribuyendo así, al desarrollo de habilidades lingüístico-comunicativas en esta población.

**Objetivo:** Esta investigación caracteriza, a partir de una revisión bibliográfica, los sistemas de comunicación utilizados como herramienta terapéutica para la población diagnosticada con parálisis cerebral.

**Métodos:** La presente investigación se llevó a cabo mediante una revisión de la literatura, considerando artículos de las bases de datos: Google Scholar, Pubmed, Scopus y BVS. Se filtraron 266 artículos en matriz de autoría propia, luego del análisis de los criterios de elegibilidad, título y resumen, se eligieron 20 artículos.

**Resultados:** Los resultados se dieron con base en las variables sociodemográficas, metodológicas y temáticas de la investigación, permitiendo caracterizar y describir los sistemas de comunicación implementados por los fonoaudiólogos en el marco europeo, asiático y americano.

**Conclusión:** Los sistemas de comunicación empleados en los últimos 10 años por los fonoaudiólogos en la población con parálisis cerebral son en su mayoría de alta tecnología, evidenciándose la utilización de software-hardware, interfaz y dispositivos generadores de voz (SGD).

## Key study facts

| | |
|---|---|
| **Objective** | Characterize and describe the communication systems implemented in rehabilitation processes from speech therapy worldwide |
| **Study design** | Exploratory review of the literature |
| **Source of information** | Google Scholar, Pubmed, Scopus, and BVS. |
| **Population / sample** | Twenty articles were studied, which, according to the objectives and eligibility criteria, were analyzed and answered the research problem question |
| **Statistical analysis** | N. A. |
| **Main findings** | The communication systems used in the last 10 years by speech pathologists in the population with cerebral palsy are characterized by their high technology, evidencing the use of software-hardware in 38% of the searches; interface and voice generating devices (SGD) in 33% of the sample. SAACs for image sharing, pointing, or button-pressing equal 25%; and the SAAC with boxes of everyday objects represented 5% of the fixed searches |

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## Introduction

Cerebral palsy (CP) is a complex and heterogeneous disorder that can have a major impact on all aspects of life (1). This integrates a series of motor disabilities, which means that there is a non-progressive disorder of movement and posture, due to brain injury or damage (2). With all of the above, a combination of these difficulties may occur, both at the level of speech and language that can significantly affect the communication process of individuals with CP. (1). For this reason, taking into account the evolution that technology has had, even the most basic resources with which the communication professional can adapt a communication system according to the specific needs of each individual and, as stipulated by various studies , where they implement an Augmentative and Alternative Communication System (SAAC) adapted to specific cases, the population with cerebral palsy can obtain significant results from the communication process, managing to potentiate facilitators and reducing barriers in the individual's environment (3).

Augmentative and Alternative Communication Systems (SAAC) are methods used to complement therapeutic language rehabilitation, and improve the communication skills of those who have communication deficiencies. In a broad sense, SAAC are the set of technological strategies or devices that promote the independence of individuals with communication disorders, as well as improve social skills, adaptive behavior and family relationships (4).

These communication systems can be classified into two categories, they can be assisted or unassisted systems. Helped systems require a tool or external support for the user, so that he can fulfill his objective, among them could be the Bliss system , PECS and pictographic symbols for communication. On the other hand, unassisted systems allow the user to communicate without any support, using their own means, for example, sign language, bimodal system, supplemented speech, dactylological alphabet, among other communication systems (5).

Currently, the use of SAAC is accompanied by technology, since then, users have had a more dynamic interaction, since their content is enriched with interactive components and more animated multimedia. At the same time, technology seeks to guarantee the accessibility and participation of users with motor disabilities in the culture of the digital society (2).

It is considered that infantile cerebral palsy is the main reason for disability in developed and underdeveloped countries, where the prevalence has remained stable in the last 10 years, affecting 2.1 children per 1,000 live births with similar figures in Europe. , United States, Australia and Asia (6). On the other hand, according to (7), in the country of Colombia, the figures are 1 x 1000 live births, with cerebral palsy. There is little scientific evidence regarding the SAAC implemented in this population, for this reason, it seeks to characterize and describe the communication systems, which allows knowing the therapeutic tools and strategies that are used for rehabilitation processes from speech therapy at the level world to This study aims to answer the research question : What are the characteristics of the communication systems used in the population diagnosed with cerebral palsy?

## Methods

### Eligibility criteria

In the inclusion criteria, articles in the Spanish, English and Portuguese languages were selected, with a publication range in the last 10 years (2011-2021). Free access articles were considered of the Google Scholar, Scopus, Pubmed and BV S databases. Additionally, that its content should show therapeutic processes using SAAC in a population with cerebral palsy. On the other hand, the exclusion criteria were taken into account to discard those articles that, in the title and abstract, had no relation to the research topic. Also, those that only had access to the summary or abstract, and documents that did not have a scientific rigor of publication were not considered. Finally, the articles that did not describe the communication systems used in this population were also excluded, because they did not respond to the research objectives.

### Search strategies

The investigation was carried out in the Google Scholar, Scopus , Pubmed and VHL databases. They were used as search equations; ((Cerebral palsy OR motor impairment OR communication method) AND NOT (physical therapy)) AND (alternative/ augmentative communication systems), communication AND system AND augmentative AND alternative AND cerebral AND palsy, Communication AND cerebral palsy , communication AND system AND augmentative AND alternative AND cerebral AND palsy and Alternative communication systems AND cerebral palsy.

Once the search was done, the articles were consolidated in an Excel matrix, taking into account those that in the title and abstract were related to the research topic. Later, with these The following filter was performed, where those that did not meet the inclusion criteria were discarded. Only articles that described the communication systems used in the rehabilitation process in the population with cerebral palsy were selected.

### Data extraction

The data extraction process was carried out through the construction of a self-authorship scheme, in which the space-time variables (year, country, database and language) were considered; methodological (sample size) and thematic (type of cerebral palsy, type of communication system, characteristics of the communication system and name of the communication systems implemented). With this, we sought to quantify and qualify the results obtained from each of the databases, performing the respective statistical analysis. Finally, 20 articles were studied, which, in accordance with the objectives and inclusion criteria, allowed them to be analyzed and gave an answer to the problem question of the investigation.

## Results

For investigation and inquiry, It will be explained for each database which search equations were taken into account, and the number of articles resulting in the first search , which were registered in a matrix of their own authorship. In this first filter , the articles that,

according to the title and abstract, were related to the research topic were considered . The articles were selected from the Google Scholar, Scopus, Pubmed and VHL databases.

It started with the Google database Scholar for which two search equations were used: ((Cerebral palsy OR motor impairment OR communication method) AND NOT (physical therapy)) AND (alternative/augmentative communication systems); With this equation, 30 articles were obtained, of which 20 were selected. Next, the equation (communication AND system AND augmentative AND alternative AND cerebral AND palsy), which yielded 9220 research papers and of these, 170 articles were selected.

Scopus database was continued, using two search equations (Communication AND cerebral palsy), yielding 558 articles and taking into account and the filter 28 were selected and registered; the following equation (communication AND system AND augmentative AND alternative AND cerebral AND palsy), where the results yielded 92 articles and 33 were registered in the excel matrix.

The third database consulted was VHL, with the search equation, (Alternative communication systems AND cerebral palsy); the results yielded 62 articles and of these, 8 were registered according to the filter. The latest Pubmed database, where 75 articles were taken into account, of which they were estimated for the matrix 5 items (Figure 1).

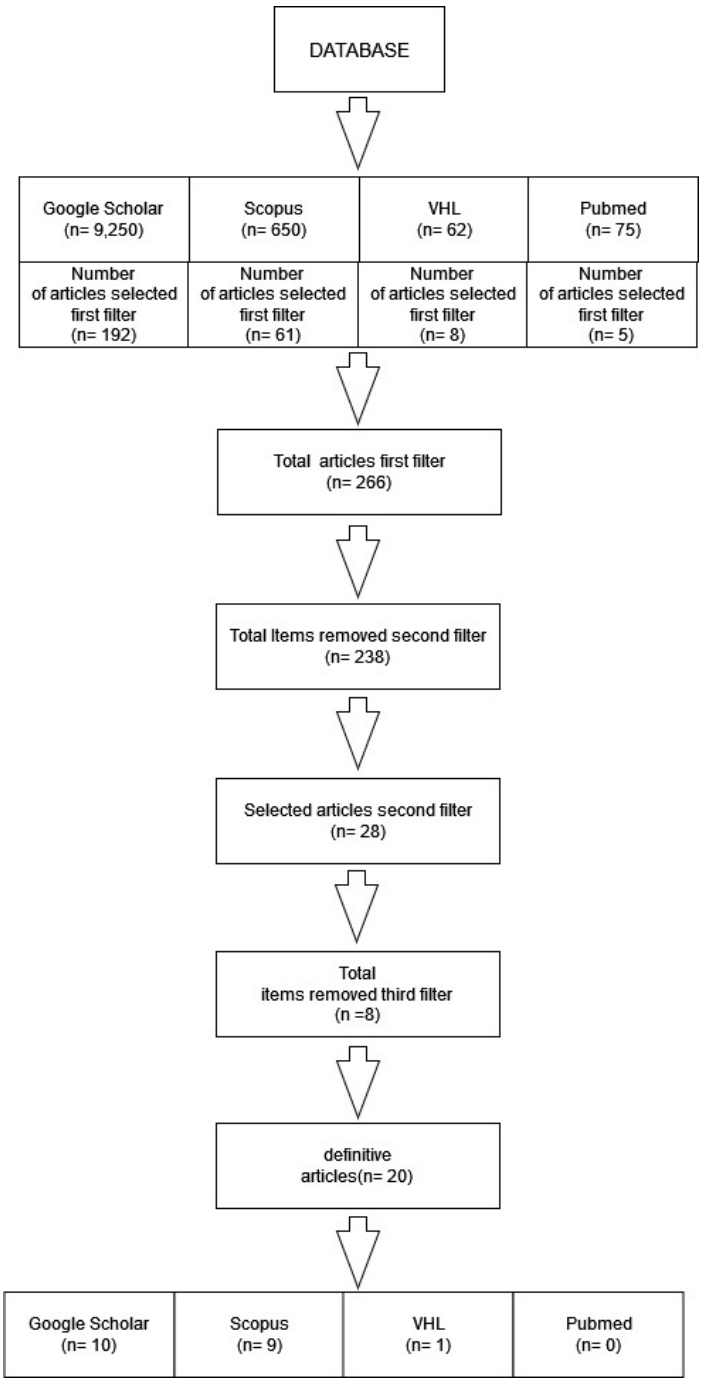


**Figure 1.** Item selection diagram

According to the above, the first filter resulted in 266 registered articles. After the first filter, we continued with the filtering of articles, with the aim of registering those that specifically met the inclusion criteria set out in the research. For this reason, of the 266 articles, 116 were discarded for not mentioning augmentative and alternative communication systems in their content, 73 for not having open access, 46 corresponded to other documents and 3 articles were repeated.

After this filter, 28 articles were selected, where the need arose to carry out a final filter, since some of the reviews were proposals or models that were not validated or implemented from speech therapy, which is why 8 articles were discarded. Finally, there are a total of 20 studies, which meet the inclusion criteria of the research and respond to its objectives.

**Space-time bibliographic variables**

In relation to the year, the range in which the most articles were found corresponds to the 2014-2015 period, with a percentage of 40 %, followed by 20% in the 2018-2019 period and another 20% in 2020-2021. In the years 2016-2017, an equivalent of 15% of articles was obtained and, in 2012-2013, fewer results were obtained, with a percentage of 5% of the total articles analyzed. On the other hand, the results obtained in the country variable, it was found that Brazil is the country with the highest number of investigations, equivalent to 30% of the articles. Subsequently, India and Spain were the countries where an article equivalent of 15% was obtained for each. On the other hand, in the nations of the United Kingdom and Malaysia, articles relevant to this research were found, being 10% for each country. Finally, in the countries of Australia, China, Pakistan and Sweden, articles related to the objective of this research were published, with a percentage of 5%, for each of the countries mentioned.

The database with the largest number of articles was Google Scholar, belonging to 50%; Scopus was the second with more articles found, having a percentage of 45%; VHL was the third database used, with an extraction of articles of 5% of the total reviews analyzed. The Pubmed database did not meet the search inclusion criteria, resulting in 0%.

Finally, the language in which the majority of the articles were published is English, with a percentage of 85%; 10% of articles were obtained in Spanish and 5% of articles in Portuguese.

**Methodological variables**

95% of the participants who were part of the studies carried out were between the age range of 2 to 55 years. No participants were found between the ages of 56 and 70 years. In one of the selected articles, they did not specify the ages of the participants, for this reason, they were distributed by age groups, thus giving 5% in this variable.

**Thematic variables**

The type of cerebral palsy where the greatest SAAC were implemented was spastic, with 35% of the selected articles. Next, there is dyskinetic and dyskinetic-spastic cerebral palsy with 10% of the total of the chosen studies; in flaccid cerebral palsy, it showed a percentage of 5%. None of the articles mentioned the type of ataxic cerebral palsy, corresponding to 0%. Finally, 40% of the selected studies do not specify the type of cerebral palsy, this being the predominant percentage. It is concluded that the types of communication systems that were most implemented in the investigations are high-tech, corresponding to 70%, and 30% implemented low-tech devices.

According to the characteristics, the SAAC were divided into 4 large groups. In the first place, it was found that most SAACs are software (applications) equivalent to 38%, followed by SAACs of interface-methods / voice generating devices (SGD) and hardware, at 33%. Subsequently, SAAC by exchanging images, pointing or pressing buttons, yielding a percentage of 25% and SAAC with boxes of everyday objects, which represented 5% (Table 1).

## Discussion

Augmentative and alternative communication systems are tools that complement and reinforce speech, aiming to recover and improve the encoding, decoding and transmission of communicative information of users. In people with cerebral palsy, communication is limited and affected, taking into account the variability, i.e., each person may have different characteristics in terms of language, for this reason it is necessary to adapt these systems to meet their communication needs, promoting the understanding and expression of language. Currently, through technology, advances have been evidenced that allow greater accessibility, being these classified into high and low technology (27). In high-tech communication systems, you can find electronic devices, smart devices, and devices that integrate hardware and software to meet the user's communication needs. In low-tech communication systems, books and bulletin boards can be found with extended lexicons of images and phrases to aid in the communication process (28).

Previously, one of the communication systems used and that corresponds to low technology, were the pictograms and ideograms, which were created from the different needs that were present in the sociocultural and religious environment of the users, these were satisfactory, since they managed to respond to the communication needs of patients with cerebral palsy (29).

In agreement and according to the results of this research, the PECS low-tech communication system is currently used, which is based on the exchange of information through images, in some cases the materials are cards addressed according to the interests of the user, these are presented in a size that allows a correct visualization by the beneficiary. In other cases, the PECS system is adapted like the previous one, where the cards are presented on a board and the words and images that are included are established according to the context and the user's daily life (9).

Another low-tech communication system that is used is that of Reference Objects, in which the caregiver or the person who spends most of the time with the user is included and has an important role, since it is he who allows a communication to be achieved. effective and satisfactory communication; This system seeks to generate alternative answers of yes or no in users, through a series of objects that are presented to them, these being as real as possible to the daily life and context of the person (15).

Thus, it is evident that at the beginning, speech therapy professionals made use of low-tech pictograms, using printed cards and files from the immediate context of the individual, to carry out the rehabilitation processes with them. In contrast to this research, it is found that approximately 5 years ago, pictograms have been digitized in software and interface systems, which favor and facilitate the communication of the population with cerebral palsy and their interlocutors. It is important to bear in mind that SAACs articulated with high technology are currently being used more widely, since they have had better adherence and therapeutic results in users with cerebral palsy.

Regarding high-tech SAACs, a study carried out on two cases of spastic cerebral palsy with marked dysarthria, in which they sought to verify whether it was possible to convert the device known as Makey-Makey ( Mk-Mk ), initially conceived as an interface for video games, in a communication support device within a single alternative and/or augmentative communication system, where they showed that there was an increase in communicative competence in both subjects thanks to the use of the Mk interface (23).

In this sense, twelve of the articles analyzed implement a brain - computer interface (BCI) communication system in users with cerebral palsy , which, through electrodes, transmits brain signals to a computer in order to select an option, this being the message or communicative need that arises in the user at a certain moment and that he wishes to communicate (8). In turn, there are pre-recorded audio communication systems; in these systems the user must also select an option and emit the message by means of an auditory stimulus . These systems present benefits such as personalization, that is, the user or caregiver can incorporate words, phrases and images into the system that adhere to their daily context (12). Also, composite applications were found, providing the user with both systems mentioned above, both the BCI system and the pre-recorded audio system, with the same customization benefits (14).

Thus, the interface communication systems have had an evolution, which has allowed a greater participation of the population with cerebral palsy in different communicative contexts, the tastes and interests being paramount, for these to incorporate them into the system and that it be of greater pleasure for the user the use and application, also, achieving more satisfactory results, as mentioned

Table 1. Characterization and description of communication systems

| Communication system | Characterization | Description |
|---|---|---|
| Row-column communication board of a switch based on BCI (8) | High technology. - Brain-Computer Interface. - Materials: Laptop based on Windows operating system (OS) for EEG acquisition and signal processing. | For the operation of this communication system, a brain-computer interface is needed, which allows the user, through electrodes, to translate some action and/or message.<br>The system makes use of a grid, which is made up of rows and columns. Initially, the user is placed with electrodes, which allow the brain signals to be transferred to the computer. The screen is divided into two parts; on the left side are the rows and columns; the idea is that the user makes a scan that allows him to reach the word or element, located in a row and that at that moment the person needs or wants to communicate, is then selected by pressing a switch. On the right side there are comments about that element or word that the user selects (8) |
| Bondy and Frost Picture Exchange Communication System (PECS) (9) | Low technology, -image exchange, - Materials: Boardmaker software, Picture Communication Symbols (PCS), and CSA shapes. | For the development of this communication system, the computer program Boardmaker , Picture Communication Symbols, was used; Through this, the images that allow the exchange of user information are created. The content of the images is directed according to the interests of the user; for example, children's music, painting, storytelling and drawing. Regarding the size for the visual perception of the images, these have measures of 6x6cm, they are printed and laminated (9) |
| The Gaze Controlled Computer (EGCC) (10) | High technology, - Software, - Materials: Special software and a camera, usually built-in or mounted on the screen, that emits a beam of infrared light and tracks eye movements. | It is a communication system in which people control a computer, through their eyes; This is possible by means of an infrared light incorporated in the computer that manages to detect eye movements. Using the cursor, the user can customize this software where daily tasks are included and can select their wishes and needs effectively and allowing them to make their own decisions, providing autonomy; for example, symbols for communication, homework, control of the environment, among others (10) |
| Make me talk (11) | High technology, -Software, - Mobile app | In this communication system, the user through an application can express and manifest their needs; in this you must select an image and through a pre-recorded audio, what the user wants to communicate will be heard. In the case of children, the application provides an access that allows parents to customize the images and audio and that they adhere to the context in which they are. (11) |
| AACVOX (12) | High technology, - Brain-Computer Interface, - Materials: Laptop | This communication system allows users to communicate through the audio playback provided by the application, you can also edit and build the phrases and include subtitles; pictographs can be added through the camera and also this system includes the brain-computer interface system. Finally, this system can be customized, adapting it to the user's context. (12) |
| PECS-Adapted, associated with Boardmaker images (9) | Low technology, - image exchange **Materials:** Cardboard paper of different cuts (communication cards); various figures (graphic symbols - PCS and Boardmaker ); hot glue; transparent glue; scissors; binder type folder; contact paper, to cover the figures. | This communication system is based on the exchange of images and for a better understanding, they are presented to the user on a board; the words and images are established according to the context and the daily life of the user (9) |
| Bolta chai (13) | High technology -Free mobile app Software, - Only in English language, - It has images and audios (they can be your own) | It is a mobile application that adapts to various forms of intervention; whether through cell phones, tablets or computers, which favor and complement the functionality of the software, being much more efficient in the rehabilitation process in this population (13) |
| Tap to Talk (14) | High technology, - iPad Software, - web-based application | Web application that allows the creation of personalized and integrated phrases; It is presented in the form of an electronic board, where there is auditory and visual feedback. Finally, the user through this manages to have more independence when communicating (14) |

Table 1. Continuation

| Communication system | Characterization | Description |
|---|---|---|
| Reference objects (15) | Low technology, - real objects, - Cash register | This communication system seeks to generate alternative responses of yes or no in users, through a series of objects that are presented to it, these being as real as possible to the daily life and context of the person and that are in a box. The idea is that the mother, father or caregiver shows the object to the user, stares at it and waits for a response; for example, cleaning the face or not cleaning the face (15) |
| Pictorial communication board(s) (15) | Low technology, - communication panels, - Images, - Signaling | In this system, two panels are presented, which include photographs and a personalized vocabulary adjusted to the patient's context; Words such as mom, dad, names of family members, food, drink, among others are included. The user, through their limbs and/or gestures, must indicate which photograph communicates their needs and allows them to have an interaction with the environment (15) |
| Virtual keyboard with word prediction (16) | High technology, - Graphic interface | According to the range of movement required for the operation of this system, the user does not require much effort, due to the design of the keyboard and the size of the keys. To select the keys, the user can do it through three options; auto click, click and scan. The keyboard is made up of 40,329 words (7,066 different Portuguese words) and is classified as contemporary and written type (16) |
| Communication board (17) | Low technology, - Wood board (24 inches long, 18 inches wide), - Signaling. - Photos on printed cards from semantic categories such as; Nominations, actions, greetings and frequently asked questions. - Two methods of unassisted communication: natural gestures (pointing), MAKATON language | This low-tech communication system was designed for a child with cerebral palsy whose residence is in PAKISTAN, where communication professionals implemented a wooden communication board 24 inches long, 18 inches wide, and had photos on cards of the various semantic categories such as; greetings, actions, questions, and nominations of objects in the environment. This was adapted to the user's eye level, it moved easily; locating in places such as the table or walls so that the child could visualize it. The objective of this board was for the child to satisfy his basic needs through pointing out the various images to make his message known, likewise, this allowed him to internalize concepts and notions of his daily life so that communication was increasingly effective with its environment (17) |
| Picture Communication System (PCS) and Voice Output Communication Aid (VOCA). (1) " Let Me Talk "; (2) "Tell Me" and (3) " Alexicom " (18) | High technology, - Mobile apps Software, - Voice generating device (VOCA) | In this communication system, various tools were taken into account to ensure that the user could communicate their needs. In the first instance, PECS was used, by exchanging photographs of the girl's context until she was able to build a sentence with them. Subsequently, they used voice output communication aids (VOCA), where 3 free applications were used to favor this process, these are: |
| | | **Let me talk:** it is an application that is available for Android, and it is totally free. It consists of selecting various images and this generates a voice according to them. |
| | | **Tell me** - is a free download application that consists of an alphabetic and numerical board with the voice output. |
| | | **Alexicom:** This free application consists of a series of pictorial writing functions, which allow the user to combine phrases and create sentences (18) |
| MAAC Application (19) | High technology, - Mobile app Software, - can be customized | It is a mobile application, which provides the individual with an interface so that they can structure phrases/ sentences that transmit the message and can be easily read by the recipient of the message. Additionally, it can be customized according to real images or photographs of the patient's context. The user forms the sentence through images, and what the application does is that it generates a voice that emits the message that the user selected (19) |

Table 1. Continuation

| Communication system | Characterization | Description |
|---|---|---|
| i speak (20) | Low technology, - Voice and controller board.- Electrical materials (circuits, cables, etc). Printed images. - button press | The device was developed using color images, of basic lexicon, such as categories and verbs in the form of 2B size stickers. Six images were added on the board. This, in turn, was set with 8 buttons for each stimulus presented. Additionally, each button corresponded to the stimulus presented, which was linked to the voice output of the name of the image. It, in turn, had a microphone that allowed any other stimulus to be recorded orally (20) |
| ECO, under a UCD approach (21) | High technology, Software Mobile app, - Free customizable language | Easy Communicator is an application that facilitates users' communication regardless of the capabilities they preserve. This takes as a central base the UCD approach which is centered on the user, and allows a more comprehensive intervention of the patient, in relation to the needs, capacities, expectations and desires that the individual has, using this information to adapt the software to what the user really requires. This App is designed as a game, and includes the ability to create and share information in a personalized way. The communication elements can be photos, pictograms, videos in sign language, texts and voices . For example, the concept "house", if desired, a photo of the user's house can be added so that it is adapted to the user's reality (21) |
| PD4CAT method, DP approach (22) | High technology, - Method for building an interface SAAC Speech Generating Device (SGD) | It is a method used by various professionals who participate in the construction of an SAAC, among them we find speech-language pathologists, who have a great responsibility in the elaboration of an interface SAAC for individuals with CP, who present serious limitations at the level of speech and mobility . This method is the key piece for the optimal construction of an interface SAAC, which allows the user with a PC to carry out a communicative act, through the implementation of hardware , software and a voice generating device. The PD 4 CAT method is a set of interactive systems, which was built in 5 phases based on the conventional structure of a software development cycle , especially the Sommerville incremental model, and on a simple model of the design process (cycles). analysis of needs and requirements, (re) design, construction of interactive version, evaluation, final product) (22) |
| SCAA with Makey - Makey (23) | High technology, - Interface | An SCAA was developed using the Makey - Makey device which is designed to be used in video games. This device is a recently appeared interface that allows converting any object that conducts electricity, such as; paper, plasticine, kitchen utensils, etc , in a computer mouse or keyboard that allows the physical and functional connection between two devices, in this case the computer and the energy-conducting material. In that order of ideas, a third element appears, which is called "crocodile clips" which are connected to the individual's body to close the structured circuit. To carry out the implementation of the SCAA, the MK device was used, where a play-doh plasticine was used as a conductive material for electricity, and the Windows 8 operating system , where they adapted its keyboard, to predict and form words that were previously written, and according to the initial letters, the computer threw a word for the construction of a sentence that the individual wanted to emit (23) |
| SCAA: Communication Sheet and Symbol Player (24) | High technology, - Interface Electric communication sheets (battery operated), - Symbol Recorder/Player System (SRP) Low cost. | The communication system is divided into two large blocks: electronic communication sheets, which are the interface with the individual, are cheap, and allow symbols and vocabulary to be adapted according to the user's environment. On the other hand, the recording system/SRP, which controls the network, identifying the leaves and symbols of these, to reproduce and record all the sounds. Both parts work as a complement to carry out the emission of messages, according to the images or symbols embodied in the sheets (24). |

Table 1. Continuation

| Communication system | Characterization | Description |
|---|---|---|
| AVAZ (25) | Speech Generating Device (SGD) High technology, - Hardware Laptop, - It incorporates a communication keyboard. | This hardware is one of the most used commercially in India by various communication rehabilitators, since it is a portable SGD that uses images, symbols and voice synthesis to construct a message and develop linguistic skills. This system incorporates a powerful communication keyboard that allows the transition from text to individual. This device has a fairly solid scientific rigor, since it has been implemented in various cases of users with cerebral palsy and the results have been positive in relation to their communication process (25) |
| SCAA: communication boards and iconographic symbols (26) | High technology, - Software Communication board on computer screen, - iconographic symbols | It is based on communication boards and iconographic symbols. It is a program adapted to a computer, which has in its structure iconographic symbols that allow the user to form a sentence in a coherent way. This system allows you to build phrases according to specific categories, such as; objects of the house, mathematics, greeting, etc , depending on what the individual wants to express. The user must choose the symbols and when he selects the desired symbol, it will be added to a special area, on the left side of the computer interface. In this way, it can be customized for each user according to their specific needs (26) |

(2) in the book Education and Psychology in the 21st century, who states that augmentative and alternative communication systems are accompanied by technology, from then, users have had a more dynamic interaction, since its content is enriched with interactive components and more animated multimedia. At the same time, technology seeks to guarantee the accessibility and participation of users with motor disabilities in the culture of the digital society. (30) affirm that the use of information and communication technology favors the development of communication skills and offers potential in the learning process in the classroom. Like (31), they mention that expressive, interactive and informative intentional communicative acts and their effectiveness between the user and their interlocutors in family contexts, mediated by a high-tech SAAC in a software application as a communication alternative, have greater effectiveness of communication with your immediate interlocutor.

According to (18), it states that some applications, such as; " Let Me Talk ", "Tell Me" and " Alexicom ", favored the expressive and comprehensive language process of a child with cerebral palsy and in contrast to this research, these mobile applications continue to be used, which improve the communicative processes of individuals with cerebral palsy, and allow accessibility to the new technologies currently used, through mobile devices, tablets, computers, and other technological devices. In this way, it is concluded that this new immersion within the technological world in therapeutic rehabilitation interventions has contributed to the linguistic-communicative processes in these users, providing a better quality of life in everyday life.

In this sense, the authors who previously investigated the use of SAAC coincide with the results of this study, since they affirm that the use of technology has benefited and caused a great impact on the population with cerebral palsy, allowing greater autonomy, communication of their needs and finally, improve their quality of life.

## Conclusions

The communication systems used in the last 10 years by speech therapists in the population with cerebral palsy are mostly high-tech, showing that they generally use software-hardware, interface and voice generating devices (SGD), that are specifically adapted to the needs and peculiarities of each of the users with cerebral palsy, favoring the development of the linguistic-communicative skills of these individuals , in different contexts, such as; school, family, social and individual. In turn, these communication systems stimulate sensory skills such as vision, hearing and touch, which help enhance cognitive development, thus contributing to language processes, at a comprehensive and expressive level, which will also contribute to basic devices learning, such as; attention, memory and motivation, benefiting learning and therefore language, in the acquisition of notions, phonological awareness, syntactic structuring and lexicon increase.

The limitations for the development of this research were focused on little evidence of implementation of these systems in the rehabilitation processes by communication and language professionals and on the little published information that exists on the communication systems used specifically in individuals. with cerebral palsy, that is, many studies present the communication system as a design, prototype or proposal, but have not been adapted to this population. Consequently, to this, they do not allow obtaining information with a scientific rigor that guarantees and argues before the application and adequacy of a certain system.

For this reason, research focused on validating and implementing SAAC should continue to be carried out, which provide information and tools to other professionals in relation to the population with cerebral palsy, and in this way, begin to scientifically demonstrate the relevance of the speech-language pathology role from the construction to the applicability of SAAC

in these individuals. To conclude, this article provides information and tools so that communication and language professionals have a baseline in terms of background for future research, thus achieving the implementation and application of these systems in their therapeutic rehabilitation processes. , considering a global perspective, thus improving the quality of life of individuals with cerebral palsy.

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