Architecture Models for Inclusive Computational Applications, in the Treatment of Autistic Spectrum Disorder -ASD

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Abstract. This article seeks to present the initial advances found in the review of literature that analyzes the relationship between the development of skills inherent to emotional intelligence, and its usefulness in the improvement of Autism Spectrum Trash treatment-TEA, through the use of computer-human interaction techniques-IHC: In addition, a framework for the design of inclusive computational applications related to the achievement of emotional intelligence skills in children with ASD is proposed, therefore, the following are presented:- more relevant elements that could be included in the inclusive software architecture focused on people with this type of disability. It is expected that the design result will be applied in selected study cases, in order to provide rehabilitation and cognitive stimulation alternatives for this population, thus improving their quality of life.

Keywords: Inclusive applications · Emotional intelligence · Autistic spectrum disorder (ASD) · Computational solutions · MPIu+a

1 Introduction

The experience presented is part of the PhD project "Framework for the design of inclusive computational applications related to the achievement of emotional intelligence skills in children with autism spectrum disorder-ASD", in which the design of the models is contemplated Methodological and Technological for the psychoeducational intervention that allow the increase of the levels of emotional intelligence expected in the children with said disability.

Specifically, this article is related to the identification of models for the architectural design of computational applications that are inclusive and with the possibility of being used as didactic objects for training and, at the same time, provide the ability to adhere elements of autonomy that give validity the apprenticeship reached by those who use it.

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Therefore, the document proposes a framework that seeks to provide generalized parameters in the design of computational applications inclusive of the treatment of ASD, applied in a context of rehabilitation alternatives, compensation or cognitive stimulation for children with this type of disability, looking for in them the development of skills of emotional intelligence. The suggested computer model contemplates all the proposed implementation phases for Usability engineering and Accessibility in computer applications.

2 Antecedent

The project starts from the survey of the state of the art about the design of inclusive applications, where qualitatively it is found that this type of initiatives has been inclined mainly towards the construction of computational applications as support for motor, visual or auditory disabilities, but little has been done regarding other alterations or disorders, such as the autism spectrum, for example [1] (Fig. 1).

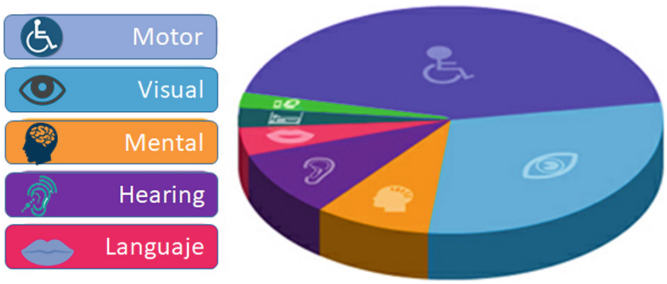

Fig. 1. Design of computer applications to support the disabled in Colombia

It is clear that technology is a great ally to help in the development of people with disorders such as autism and in this context, by deepening in the development of computer applications, there is a proliferation of initiatives tending to support of this population, but adjusted to particular cases that have generated the formulation of projects in many cases, and collections of mobile applications aimed at communities that work in the treatment of this disorder.

Taking into account various previous experiences related to pedagogical treatment interventions for cognitive stimulation, we will focus on the treatment of social story construction based on the ordered representation of pictograms to achieve sufficient stimulation in children with ASD. Lead to mental and emotional preparation that brings you closer to activities of daily life.

In this sense, we have explored the applications that are most mentioned in the therapeutic community that works with this syndrome and that has been consulted under the expression of Alternative and Augmentative Communication Systems (AACS).

3 Methodology

As it is an exploratory investigation of a mixed nature, we opt for a systematic review for the collection of information of interest in the topics considered important.

This methodology has been selected because it has all the necessary elements to carry out the search for information on the proposed topic. The importance of the mapping of the systematic review is found in the structure and in the steps it proposes to carry out the searches in an organized and methodological way, which helps to generate reliable results in the research [4].

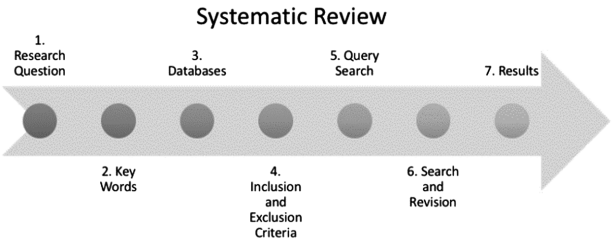

Fig. 2. Process for systematic review

3.1 Research Questions

RQ1: What current treatments have been more accepted and used by the international therapeutic community for the treatment of Autism Spectrum Disorder?

RQ2: What models of computational applications and especially HCI have been used for the treatment of Autism Spectrum Disorder?

RQ3: How does the use of HCI facilitate the design of computational applications that improve the current treatments of Autism Spectrum Disorder?

3.2 Basic Definitions

To have greater clarity in the terms used in the document, a definition of the concepts table was made. The concepts are related to the search queries used in the systematic review.

Word	Definition
ASD	Autism Spectrum Disorder. Is part of permanent neurological development disorders, in which the areas related to social interaction, communication, behavior, interests, and others are deteriorated

(*continued*)

(*continued*)

Word	Definition
Model	Graphic or verbal representation or simplified version of a concept, phenomenon, relationship, structure, system or an aspect of the real world. A representation of a system that allows the investigation of the properties of the system and, in some cases, the prediction of future results
HCI	Human-Computer Interaction. Is a discipline related to the design, evaluation, development and study of the phenomena surrounding computer systems for human use
Software architecture	It is a level of design that focuses on structural aspects of software applications such as the global control structure and general organization; communication protocols, synchronization and data access; assignment of functions to design elements; physical distribution, composition of design elements; fit and performance
Emotional intelligence	It is the ability to identify, understand and manage emotions correctly, in a way that facilitates relationships with others, the achievement of goals and objectives, the management of stress or overcoming obstacles

3.3 Key Words

For the systematic review, the search for the key words in English and Spanish was defined to include greater results of the searches and to allow a more complete revision in the databases (Table 1).

Table 1. Key words for consultations

Spanish	English
Habilidades	Abilities
Autismo	Autism
Tratamiento	Treatment
Emociones	Emotions
Modelo	Model
Arquitectura	Architecture

3.4 Data Bases

For the development of the research five (5) databases were defined to perform the information search according to the systematic review. They were chosen because they are the most internationally recognized in the area of engineering, informatics and education, in addition to having good indicators for the publication of articles, conferences, book chapters and others.

Table 2. Data bases consulted

BD Name	Link	Acronym
Google Scholar	https://scholar.google.com	GS
SCOPUS	www.scopus.com	SCOPUS
Web of Science	https://webofknowledge.com	WOS
IEEE Xplore	http://ieeexplore.ieee.org/Xplore/home.jsp	IEEE Xplore
Science Direct	www.sciencedirect.com	Science Direct

3.5 Inclusion and Exclusion Criteria

The inclusion and exclusion criteria of the systematic review were defined according to the topics found in the project and the research questions for the searches.

The inclusion criteria are:

1. Articles published between the years 2013–2018;
2. Articles published in congresses, journals and book chapters;
3. Articles written in English or Spanish;
4. Articles found in the databases detailed in Table 2, and
5. Articles related to emotional skills, autism spectrum disorder, interaction and human-computer interaction.

The exclusion criteria are:

1. Document not available for download;
2. Articles in languages other than English and Spanish;
3. Articles that do not focus on the use of computational applications for the treatment of autism, and
4. Gray literature.

Once the basic inclusion and exclusion criteria have been applied, the titles and the summary of each work are reviewed. With this initial review, it is decided if the article is initially included in the accepted articles. After this process, each article is reviewed in a general way to know if it helps to answer the questions posed in the systematic review.

3.6 Search Strings

A general search query was defined based on the general concepts of the search title and which allowed answering the research questions posed. For each of the databases, we reviewed how to perform advanced searches and defined the search query for each of them, allowing more specific results according to the key words.

((“methodolog*” OR “methodological”) OR (“model*”)) AND (“treatment”) AND (“autism*” OR “ASD” OR “syndrome”)

3.7 Search Process

A general search query was defined based on the general concepts of the search title and which would allow answering the research questions posed. For each of the databases, we reviewed how to perform advanced searches in each database and defined the search chain for each of them, allowing more specific results according to the key words.

Once all the information of the searches in the databases was unified in a spreadsheet, 542 items were found in the databases and with them the review process is initiated. In the first place, a general review is carried out to find the articles, book chapters, etc., 75 articles were repeated, originated by the different searches in the databases and by different search queries.

Then, a revision of the titles and the summary of the works was carried out. This review took into account the inclusion and exclusion criteria, all the information relevant to the planned search and that will help answer the questions initially raised. The general summary of the accepted works is detailed in Fig. 3.

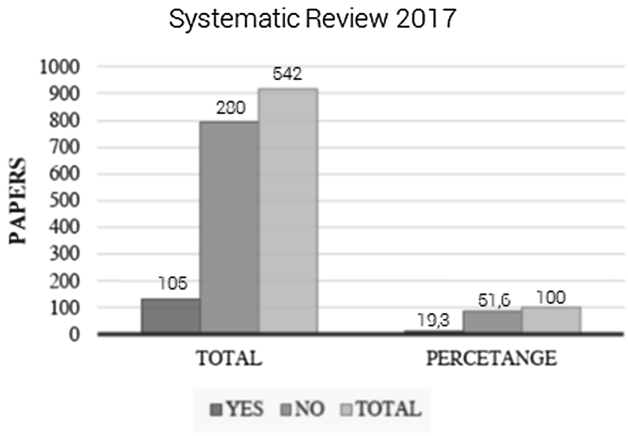

Fig. 3. Papers accepted in the systematic review

4 Partial Results Found

4.1 Related to Autistic Spectrum Disorder -ASD

The Autism Spectrum Disorder (ASD) is part of permanent neurological development disorders, in which the areas related to social interaction, communication, behavior, interests, among others, deteriorate [12] (Fig. 3).

According to [6] in the educational environment importance is given to the affective dimension of learning processes. However, this author explains that the emotional aspects in education continue to be a complex challenge in our present.

Similarly, [7] explains that emotion is composed of three components: Neurophysiological, Behavioral and Cognitive. The neurophysiological component is manifested in aspects such as respiration, sweating and hypertension, which, although they are involuntary responses that the individual cannot control, clarifies that if they can be prevented by appropriate techniques. The behavioral component is related to facial expressions, non-verbal language, and tone of voice and movements of the body, among others. Unlike the neurophysiological component, these expressions are controllable and provide fairly accurate signals about the emotional state of the person. The cognitive component is the one that is related to the feelings, because the fear, the anguish and the rage, among other emotions are expressed in this component.

The author distinguishes the cognitive component of the neurophysiological, in terms of emotion and feeling. That is, the body state (neurophysiological) expresses emotion and is a sensation that occurs unconsciously, while the mental state (cognitive) expresses the feeling and does so consciously.

If we transfer the components proposed by [7] to a scenario where the learner is a person with particular characteristics of physical and cognitive development, such as a child with ASD, the landscape of identification and work of the neurophysiological, behavioral and Cognitive appears in a more complex way and requires a more detailed understanding of its nature and particular conditions.

The diversity of hypotheses about the nature of the autistic disorder that has existed during the last decades, all of them focused more on the cause than on the underlying mental processes, has greatly limited the efficacy of the different treatments applied for their "rehabilitation" [8].

Fortunately, in recent years, the advances made in research on the mental and cognitive aspects of people with ASD, together with the personal communications made by many of these people about how they saw and see the world around them, they have allowed us to approach their minds [8]. The above allows to have a more accurate idea of how a child with ASD sees the world around him, and what are the difficulties that appear in his relationship with him.

Particularly, one of the aspects of greatest difficulty in the development of the state of the art related to this project has been to discover the diversity of manifestations that the autistic disorder presents. This diversity is reflected in terms of the chronological age of the person, their mental age and the level of severity of the disorder presented, finding as a first element that each case of autism identified is completely different from the others, that is, that a treatment for several cases of diagnosed autism could not be generalized but that a specific one should be designed for the case studies that are selected for the experimental phase of the investigation. This circumstance has been sometimes so disconcerting that the previous experience of dealing with a person with ASD, without the accompaniment of a non-specialized professional, in some cases has prevented the recognition of this disorder in another person.

Some peculiarities [8] of people with ASD are used to identify the characteristics that must be taken into account for the design of computer solutions that contribute to the treatments currently used. Among these characteristics we have:

- Visual thinking
- Difficulty in anticipation

- Sensory alterations
- Difficulties in central coherence (Find differences between objects or people)
- Executive functions (impulse control)

4.2 Development of Emotional and Social Skills in Children with ASD

Communication is one of the most important goals in the work process of a person with autism [9], so the development of this skill must be present in all situations of their treatment. We must take advantage of any situation to promote communication, whether in a work or leisure context. The important thing is to create multiple situations to encourage the person to communicate, attending at all times to their acts and communicative reactions.

According to [10] "All autistic subjects have, to a greater or lesser degree, a failure to adequately develop their communicative and linguistic abilities." The language disorders can vary, from the total absence of speech to its late acquisition and that is accompanied by the wrong characteristics of the language.

Every communicative act consists of several components:

Table 3. Components of the communicative act

Modality	Function	Content	Context
Nonverbal:	Petition	Object	Place
Instrumental acts	Rejection	Action	Person
Natural gestures	Answer	Person	
Alternative Communication	Question		
Systems (ACS)	Commentary		

According to the components presented in Table 3, the behavior of the child with ASD is analyzed and according to the results the particular comprehensive educational intervention program is elaborated. It must be borne in mind that a person with ASD usually manifests profound and complex alterations in the area of communication, both verbal and non-verbal, presenting absence of communicative intent and/or alterations in the use of the language [10]. Therefore, within non-verbal communication, it is necessary to distinguish between instrumental acts, natural gestures and SAC (alternative communication systems).

The treatment programs that are expected to work within the research will focus mainly on alternative communication systems that are designed by computer applications under the approach of accessibility and human computer interaction.

4.3 Current Treatment and Education Programs

There are different intervention models for ASD according to the conditions of the case and the age of the sufferer. Among the most used intervention models are:

1. Denver Model: focused on children of nursing or preschool age who already have ASD or are at risk of suffering from it. It aims to acquire specific behavioral-looking

skills and invites families to use those strategies in their environment. It is effective in language, cognitive abilities, adaptive behaviors, and decreases the symptoms of autism [20].

2. Lovaas Program: is a comprehensive and structured entertainment program that improves attention, obedience, imitation and discrimination. He is criticized for problems in generalization for natural environments, for basing the results on the IQ and for not representing natural interactions [21].
3. Applied Behavior Analysis (ABA): Program that promotes behaviors through positive reinforcement and reduce unwanted behaviors through extinction, thus increasing behaviors, learning new ones, maintaining and generalizing and reducing disruptive behaviors [21].
4. Alternative communication systems: Help to understand and understand the language, for example:
   a. Complementary oral: bimodal system (combines oral language and gestural signs), and the word complemented (sounds are accompanied by hand movements).
   b. Gestural: Sign language, which uses visual transmission to express itself, and sign language that unites gestures, words and signs.
   c. Mixed, which simultaneously use oral language, signs, sign language and resources that encourage communication.
5. TEACCH Method: It has turned out to be a very effective intervention program for cases of ASD that involves the families of those who suffer from it, managing to help children to function autonomously, offer those services and transmit theoretical and practical knowledge [22].

The TEACCH program ("Treatment and Education of Autistic and Related Communication Handicapped Children") provides different services for people with autism and associated disorders, as well as for their families [11]. Its founder, Eric Schopler, has developed, through numerous publications in "The TEACCH Division", various programming and a methodology of enormous influence in the work with people with serious communication difficulties and therefore applicable to the students that are framed within the autistic spectrum [10, 11] (Fig. 4).

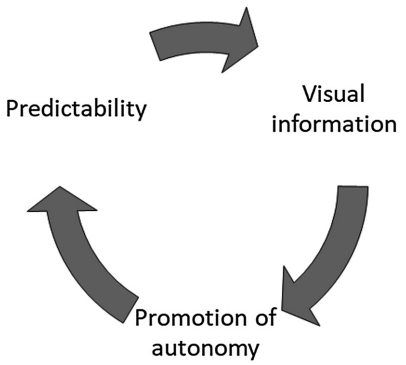

Fig. 4. TEACCH model

The use of TEACCH as a treatment model seeks to achieve, through the application of prepared activities, the child with ASD achieve an improvement in their autonomy, while avoiding communication difficulties and language comprehension [12]. The tasks for children with ASD who begin to work on this methodology are those tasks that are manipulative and that teach the principles of the task: the idea of complement, of looking for instructions, use of materials and everything that is defined for the emotional or social competences that you want to work. It is noteworthy that those who work with people with autism should know that motivation is key to learning. Attention and motivation increase when activities are clearly designed. Any activity that you want to do, you have to design it as if it were an activity with TEACCH characteristics.

Consequently, TEACCH allows the accompaniment in the treatment of ASD through specific activities such as:

- Structured learning.
- Learning without error.
- Chaining backwards.
- Incidental teaching.
- Encourage communication behaviors.
- Visual supports.
- Work systems.

For this, the physical structure of the interaction environment with the child with ASD is important. The most accurate space arrangements are:

- Face to Face: more demanding and requires student attention.
- Side by side: allows imitation and focuses on materials and instructions.
- Behind: with less adult control, encourages independence (Fig. 5).

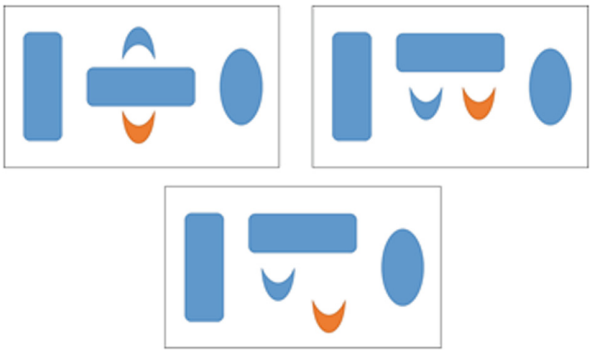

Fig. 5. Arrangement of the TEACCH method: face to face, side by side and behind

4.4 Computational Models to Support the Treatment of ASD

Children with ASD, as well as other children who do not suffer from this disorder, have an affinity for ICT information and communication technologies [13]. Taking into account this characteristic, within the treatment of ASD, the use of Natural User

Interfaces should be considered, where the user interacts without using command controls or input devices such as the mouse, keyboard, touchpad, joystick, and others [14, 15]. Instead of these controls, gestural movements such as hands or body are used, which become the command control of the application. Augmented reality is another concept that has been useful in some cases for the treatment of ASD, used to define a vision through a technological device of a physical environment of the real world, whose elements are combined with virtual elements for the creation of a mixed reality in real time [16].

In the school environment there are children with special educational needs, within these are students with ASD, with characteristics to take into account to carry out a successful and efficient intervention. Since in the school an important part of the life of the children is developed; to favor the personal and social development of these people, it is necessary that the psychoeducational intervention offers answers to individual needs, providing the necessary support in academic instruction and also favoring the integration in their peer group [17].

Regarding the use of applications of this type in the treatment of cases of ASD, it is found that there is no general intervention methodology for an objective evaluation with respect to the level of ease of use of the applications with which it has been experienced, and these must be adjusted in a particular way for each selected case of study. This means that conclusive results must be collected by running tests that evaluate usability in each case.

This is consistent with the experiences obtained by [17–19], who assess the usability of the natural user interface through tests conducted through touchless interactions oriented towards the most common actions in children with ASD. Such as clicking, dragging, moving or zooming a series of images (pictograms) on the screen. The usability level is defined by a rating scale divided into a grade of ten where the score of 9 (nine) represents the intuitive experience and no requirement for learning and the score of 0 (zero) represents the worst experience when the Interactions are not usable at all [17].

For the purposes of our research, it is important to know the results found in other experiences where it is of great value to obtain a set of guidelines applicable to the development of digital applications for people with ASD, where the context of use of the applications made through digital games based on the manipulation of pictograms with the possibility of being printed so that they can be used as learning chips in real environments.

4.5 Technological Models and Emotional Intelligence

The identification of emotions in people with ASD is a complicated task, so it has been strategic to address the issue from the treatment of the skills that are expected to strengthen. Their emotions provide us with very relevant information about their preferences in relation to people or activities and they are also an important source of information on the variables and conditions that cause them anxiety or stress and can therefore facilitate the appearance of problematic behaviors of varying degrees. It is necessary, then, to find other sources of information for the identification of emotions in these people.

Although emotion is usually understood as a multidimensional experience that encompasses three response systems: cognitive, behavioral and physiological [23], little research has been done on the physiology of emotions in people with intellectual disabilities and severe development.

The behavioral expression of emotions has been investigated more in these people [24, 25] although limitations are also found in these studies. The behavioral approach could ideally be complemented with another approach such as the physiological one, as pointed out in several pioneering studies such as those in [26, 27].

People with intellectual disabilities and severe development can have significant difficulties managing and communicating their emotions. These people can logically live situations in which they enjoy and are comfortable and situations that can cause anxiety and stress.

Due to their communicative limitations, they may have difficulties to communicate their discomfort and, in addition, they can show this in problematic ways (aggressions, self-harm, destructive behavior, etc.) for themselves and for other people. Even for the support professional it can be difficult to know in what situations the person enjoys and what situations cause discomfort or anxiety [28].

In this sense, it is very interesting the support of a system that evaluates and communicates the emotional state of the person in order that the support professional can intervene and help her to modify her emotional state or avoid situations of risk.

Among the experiences consulted, we have found options for verifying the effectiveness and usability of software solutions implemented to support TEA therapies where the same application could be used to know the emotional state of children with these characteristics in various situations, and find out which of these activities are preferred and which of them may cause anxiety or discomfort. With this knowledge you can increase the preferred activities and decrease or modify those that generate anxiety.

The study carried out by [28], was based on the use of physiological systems of emotion detection to recognize and quantify emotional values (positive, negative and neutral emotional states) using signals such as heart rate, temperature or skin conductivity, signs that have previously been used in studies of emotions in people with intellectual disabilities [27].

The information on heart rate variability was acquired using a pulsimeter (Zephyr HxM). These non-invasive and portable devices can transmit information via Bluetooth up to a distance of 30 m. Thanks to this the child with ASD could carry the sensors in the body and did not need connected cables. The data of the physiological signals were processed remotely in a mobile (in this case a HTC Nexus 1, and a Samsung Galaxy Mini) with the intention of discovering patterns that correlate with the different emotions. The mobile processor performs signal processing and uses the algorithm to measure the polarity and intensity of the person's emotional reaction at the time it occurs. The support professional of the participating child can monitor the emotional state values in real time through the mobile screen. The application for the mobile also allows the caregiver to keep track of the number of times in which the response of the system has a conflict with the user's own experience (they do not coincide). This is done through the graphical interface of the mobile.

In relation to its usability, although the pulsimeter used was designed to minimize discomfort, in some cases the sensors' bearers felt some type of discomfort when carrying the device in the chest. This is particularly important in the case of the type of children with ASD sensitive to physical contact who are expected to work and who could react adversely to the use of the system. For this reason, the study to be carried out should seek the use of non-invasive devices for data collection in selected case studies.

4.6 Alternatives of Application Design Proposed for Support from Usability Engineering

The use of computational technologies as a complement to the clinical treatment of ASD intervention brings advantages such as learning at a particular rhythm, the increase in focused attention, and behavioral changes due to the affinity of children to the development of social interactions based on digital interfaces. Facing the same process done face to face in real life.

This computational component is developed under the Usability and Accessibility Engineering Process Model MPIu+a, which seeks to cover the aspects related to the Design of Interactive User-Centric Systems (DCU) contemplating all its phases of Realization: Analysis, Design, Implementation, Launching, Prototyping and Evaluation [2] (Fig. 6).

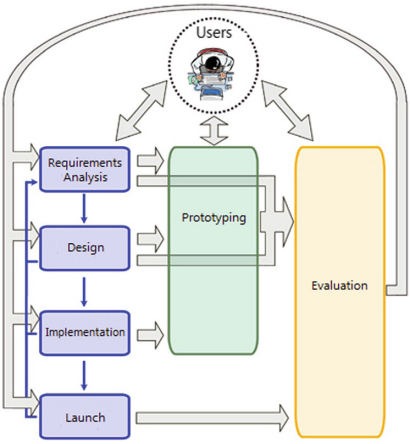

Fig. 6. MPIu+a design model

Initially, the development of the model of inclusive computer applications is framed from the concepts related to the disability linked to the ASD and specifically in the development of intrapersonal skills (motivation) and interpersonal skills (social skills) related to emotional intelligence [17]. This has to do with the conceptual organization of the project within the aspects of Software Engineering with the basic principles of Usability Engineering and Accessibility, providing a methodology that is able to guide

the development teams during the process of implementation of a specific interactive and inclusive system.

Thinking about the final user of the project, it is intended that usability is a determining factor for inclusive applications that are carried out under this approach, so that the interfaces, communicative capacity and functional structure of the software developed, have to be as simple as possible. Therefore, for the design of the technological model that defines appropriate software architectures, the ISO/IEC 25010 standard must be taken into account.

The application of this model is linked to the design of processes centered on the user and the evaluation of usability in each step carried out, which guarantees that both functional and non-functional requirements are met from the beginning of the design of the applications and not until the end that the tests are carried out.

According to the above, the design of computer applications interfaces that support the treatment of ASD must adapt the social histories according to the individual needs, interests and learning style of the children, for example, using the image of his favorite cartoon character, all this through collaborative construction options between the same child and his therapist, or even his own family members, thus increasing his motivation and achievement of the expected social skills.

The design of the application that builds stories with pictograms is achieved by analyzing the functionalities and the necessary tasks that allow them to be carried out, as well as modeling at a conceptual level, seeking an approximation to the mental model of the users previously analyzed to incorporate their particularities as usable elements in the same design. The design of the activity covers the space between the defined functionalities and the user interface (Fig. 7).

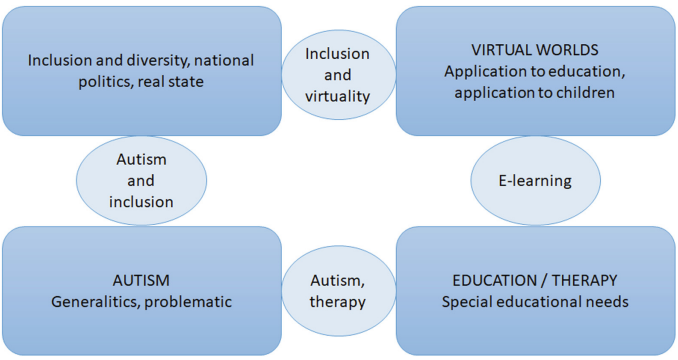

Fig. 7. Overview of story-generating application based on pictograms

Finally, the aspect of the evaluation of the solution to be obtained must be considered. In this phase, the necessary techniques will be applied to receive the necessary feedback from the users and/or expert evaluators, which will be reflected in the design of the interfaces, improving their interactive processes. Therefore, for research we will talk about evaluation as: The activity that includes a set of methodologies and

techniques that analyze the usability and/or accessibility of an interactive system that seeks to rehabilitate the abilities of children with ASD.

According to the above, the most appropriate method of inspection of results could be the heuristic evaluation that is used to find usability problems in an interface and can be carried out by a small group of evaluators, verifying the degree of compliance with the principles of usability and design that have been specified in the initial requirements analysis.

5 Discussion and Conclusions

Currently in countries such as Colombia is more evident the number of people with some type of disability, especially autistic spectrum disorder (ASD), which require a psychoeducational treatment adapted to their condition and especially configurable according to the progress of their cognitive stimulation therapy. The mental profile of a person with ASD is that of someone who has serious difficulties to deal with everything that is complex, subtle, ephemeral and variable, that is, the socio-mental. It is not possible to generalize a treatment for several cases of autism that have been diagnosed, therefore, a specific treatment should be designed for each case and in this sense, specific adjustments should also be made to the computational application that is designed from the perspective of the principles of interaction and accessibility. The design of computer applications to support people with disabilities in Colombia is still incipient and the software community requires greater conceptual tools that allow the design of inclusive applications in an orderly and quality manner.

The design of computer application interfaces that support the treatment of ASD should be based on the use of their own models, such as MPIu+a, for development adapted to the appropriate solutions in each particular case. Taking into account the characteristics of children with ASD and their affinity with the management of pictograms in computer applications, it is proposed to design an application that builds stories (sequence of images), where functionalities, emotional skills and necessary tasks are analyzed. in your treatment. That would be destined to be carried out by the child, through a conceptual modeling, looking for an approximation to the real life of these people.

The systematic review of computational applications for the treatment of ASD shows an initial quantity of software programs evaluated qualitatively, however, it is not easy to identify the software architecture used for these purposes. The documents that were selected in the first part of the state of the art, allow to discover that the current treatments have been more accepted and used by the international therapeutic community at present for the treatment of the Autism Spectrum Disorder [2, 4, 5]. Consequently, the TEACCH model is a didactic model for the formulation of new therapeutic initiatives and has originated programs such as the use of mobile devices with NFC technology or even the use of animals to support treatments. Notwithstanding the foregoing, no research or projects have been found related to the combined application of the above elements, that is, the use of software tools that use NFC technology for the presentation of animated pictograms of animals, as well as the inclusion of elements of serious games that support the current treatment of children

with ASD or even with other functional diversity, so it would be a contribution to the new practices of inclusive education in this area of knowledge.

With respect to the model for the design of computational applications that support the treatments of ASD, although in the selected literature there is the use of applications within some treatments with important results for improving the behavior of children with ASD [3, 9], it is evident that it is not possible to generalize a treatment for several cases of autism that have been diagnosed, therefore, a specific treatment must be designed for each case and in this sense, it will also have to make specific adjustments in the computational system, application that is designed from the approach of the principles of interaction and accessibility [7]. Consequently, it is found that the design of computer application interfaces that support the treatment of ASD must be based on the use of their own models, such as MPIu+a integrated to serious game models for the development of customized and appropriate solutions in each case particular [16, 17].

A new literature review should contain the identification or design of a framework for the design of inclusive computational applications based on the use of specific software architecture standards; however, these should be adjusted to the extent that the therapeutic and technical conditions for the autistic disorder. The MPIu+a model continues to be a guide for the process of usability and accessibility engineering par excellence, however, in particular cases of disability it may require some methodological adjustment to achieve the desired objectives.

Finally, it should be taken into account that the design of computer applications to support the treatment of children with ASD should include the design of adequate interfaces (preferably non-invasive), functional diversity and guarantee an appropriate game interaction for cases of ASD. In this, the use of usability models and human-computer interaction would be of great help.

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