Tool to Help the Communication for Autists

Janaina Cintra Abib[1, 2], Luciana Rodrigues[3], and Reginaldo Gotardo[2, 4]

[1] Federal Institute of São Paulo – Araraquara/SP – Brazil
[2] Federal University of São Carlos – São Carlos/SP - Brazil
[3] Centro Universitário Barão de Mauá – Ribeirão Preto/SP – Brazil
[4] UNISEB; Cross Reality – Ribeirão Preto/SP – Brazil
janaina@ifsp.edu.br, lu_arodrigues@yahoo.com.br,
reginaldo@crossreality.com.br

Abstract. Communication is the main skill to interact in society, regardless of ability or level of cognitive development. Through the process of communication people can share feelings, desires, actions, thoughts and experiences. The communication process does not need to be expressed only through verbal language, but can happen with gestures, glances, body movements, signs and symbols. People with disabilities can use different forms of communication and some technological resources to facilitate the communication process. Inclusion of computational tools in school´s environment facilitates social relations between autistic and others in their learning environment enabling the use of appropriated educational software and communication techniques becoming part of natural process of social interaction. The goal of this research is the development of a medium fidelity prototype software to facilitate the learning and communication of students with autism in school, understanding their differences in learning, processing and organize information and everything should be conducted through the establishment of a daily routine.

Keywords: communication process, autists, communication tool.

1 Introduction

Computer is a valuable tool in the teaching-learning process of children with pervasive developmental disorder (PDD). These students process thoughts in images, they have difficulties in changing their routine activities, they need structured and organized environment to learn and they lack perception, comprehension and communication abilities; so this tool can make social relation between autist and real world easier [6]. The computer allows the learning through educational software properly used, because they can create situations which provide intellectual, social and affective development in individuals with or without the disorder.

This paper aims at using the computer as a tool to make the Reading, the socialization and the Independence easier for students with pervasive developmental disorder (PDD), through software that will be developed to make the learning process easier. PDD is understood as individuals who present global and severe damage in several areas of development: mutual social interaction abilities, communication abilities or

behavior, interests and activities stereotypes ([4], our translation). Students with PDD, like the autists, present a different way of learning, organizing and processing information, since everything must be taught following a routine to solve problems.

It is important to consider the 5 categories in which the PDD is divided according to the Diagnostic and Statistical Manual of Mental Disorders (4th Edition- Revised Text - DSM IV – TR) organized by the American Psychiatric Association and by the Classification of Mental and Behavioral Disorders (CID4 – 10) elaborated by the World Health Organization [8]:

- Rett`s Syndrome: this affects only girls. It is characterized by the progressive loss of motor and neurological functions after a period of apparently normal development during the first months of life;
- Autistic Disorder: it is characterized by alterations in communication and social interaction abilities, as well as restricted and stereotyped activities and interests;
- Asperger`s Syndrome: individuals with this syndrome are considered high-level autists and the autist manifestations are presented more moderately;
- Childhood Disintegrative Disorder: a very rare disorder which is manifested after a normal development period followed by regression of previously acquired abilities, specially communication and language skills.
- Pervasive Developmental Disorder Not Otherwise Specified: there is severe and invasive damage to the development. It is evidenced when Autistic Disorder, Asperger`s Syndrome, Rett`s Syndrome and Childhood Disintegrative Disorder hypothesis are excluded.

The development of educational software will provide a great help for individuals with PDD since the communication will allow wider accessibility and quality of life, making their general development easier.

This research approached the main characteristics of the autism; the importance of the inclusion and the technology as a facilitator in the learning-teaching process through an educational software. As bibliography, books from researchers in education, technology and special education were used. However, the development of the software counted with some programming tools like: Netbeans, Databank manager, edition software and image treatment.

The paper is organized as follow. Contextualization and motivations are presented in section 2. Section 3 presents the FECAUT prototype. Finally, the section 4 presents the conclusions and future works.

2   Contextualization and Motivation

Today, before talking about autism, it is necessary to clarify the Pervasive Developmental Disorder (PDD). The terminology PDD is a psychiatric classification from the Diagnostic and Statistical Manual of Mental Disorders – DSM-IV-TR, elaborated by the American Psychiatric Association. This manual contains the classification and the phenomenological description of mental disorders through neurobiological conceptions. The following categories of PDD are in this manual: Autistic Disorder, Rett`s Syndrome, Childhood Disintegrative Disorder, Asperger`s Syndrome and the

Pervasive Developmental Disorder Not Otherwise Specified (including the Atypical Autism). The Classification of Mental and Behavioral Disorders (CID – 10) elaborated by the World Health Organization (WHO) is also mentioned, and eight categories of Pervasive Developmental Disorder are included in this classification: Autism disorder, Atypical autism, Rett`s Syndrome, Another Childhood Disintegrative Disorder, Overactive disorder associated with mental retardation and stereotyped movements, Asperger`s Syndrome, Another Pervasive Developmental Disorders and Pervasive Developmental Disorder Not Otherwise Specified.

Therefore, by observing the categories, it is possible to see that current Special Education Policies are based on the DSM-IV-TR to talk about individuals with Pervasive Developmental.

After these concepts, Autism, a Greek word meaning "by itself", can be defined according to Orrú [7] as a term used in psychiatry to understand human behavior related to the individual himself.

According to ASA - American Society for Autism, autism is defined as:

> *[...] an inadequacy in the development which manifests itself in a serious way along all life. It attacks about twenty in ten thousand new bourns and it is four times more common among boys than girls ([13], our translation).*

The World Health Organization (WHO), according to the International Classification of Disease (CID – 10), states:

> *[...] the autism is treated as a Pervasive Developmental disease, in which there is an abnormal development and/or psychological damage pattern manifested before 3 years old. The child`s abnormal abilities would be related to three areas: social interaction, communication and restrictive and repetitive behavior"* ([10], our translation).

The DSM - IV – Diagnostic and Statistical Manual of Mental Disorders, elaborated by the American Psychiatric Association, makes use of six criteria or more to diagnose the syndrome.

The causes are already known. In the past, it was believed that the hardness and rejection by the mother caused autism, but it was considered a myth because this syndrome is not triggered by emotional reasons as some academics used to defend.

Moraes and Oliveira [9] state that, according to ASA, many are the causes and they can be related to diseases like phenylketonuria when they are not treated, viruses during the first three months of pregnancy including cytomegalovirus, rubella, toxoplasmosis, anoxia, traumatism during birth. Genetic heritage and research also show evidences in the syndrome outbreak after the MMR vaccine.

According to Mello [1], autism is a syndrome defined by alterations before the age of three and it is characterized by quantitative deviation in communication, social interaction and imagination. Communication difficulties can be verbal or non-verbal and includes gestures, facial expressions, body language, language rhythm and modulation. The difficulty in social interaction means the difficulty of relating with others, lack of capacity to demonstrate feelings and emotions and the difficulty in discriminating people.

The individual with autism can also cry or laugh uncontrollably, they may not interact with the outside world, they may not recognize real danger like height and depth and they can even hurt themselves. They also present difficulty in using their imagination and it can be exemplified by obsessive and ritualistic behavior, literal comprehension of the language, lack of acceptance in changing and difficulty in creative processes [1]. All these characteristics can make the educational as well as the social inclusion process difficult, since the communication is very restricted in these individuals.

The word autist was first used by Prouller in 1906, in psychiatric literature. At that time he studied individuals with dementia which he called schizophrenia. In1943, the Austrian Doctor Leo Kanner described 11 cases of children in his article Autistic Disturbance of Affective Contact. As a common characteristic, this group was not able to relate with people and, in 1947 he created the terms Primary and Secondary Autism. In 1944, another Austrian doctor Hans Aspeger wrote an article entitled Autistic Psychopathy in Childhood, in which he described children with characteristics very similar to Kanner´s, but it took a long time to be read because it was written in German [1].

During ages people with any kind of disorder were considered unable to perform any activity and they were excluded from social environment.

The starting point people`s education related to the necessity of some kind of special education was in 16th century, when professional in health area joined in order to teach those who till then believed to be unable to learn [10].

It is necessary to remember that before the 16th century, there was a phase of exclusion and negligence; these people were mistreated and even sacrificed as they were considered demons. In 18th and 19th centuries this rejection is substituted by protection and these people receive help from professionals, but without an educational tone, they continued excluded from society, but then they had specific places to live like asylums and other institutions [14].

In 1600 in the first school for physically disabled people was opened with "Santa Casa da Misericórdia", in São Paulo. Two centuries later, in 1854, the first teaching institution for disabled was created. It was called "Meninos Cegos" (Blind Boys) and was supported by the royalty, and in1891 its name changed to Benjamin Constant Institute. In 1931, Helena Antipoff opened "Sociedade Pestalozzi", and created the term "exceptional" to refer to the disabled ones and she believed it was possible to have teachers able to deal with these students. The first qualified professionals came out of this institution in 1948 [5].

In the 19th century, an integration phase took place and students with difficulties to follow an ordinary class were oriented to attend special classes in the same school. In the end of the 20th century, a new framework is proposed in which the school adapts to the children needs and attends all the students with special educational difficulties in the regular classroom. Autist people have always had specialized institutions and have always related with children with the same difficulties.

According to Orrú [7] children submitted to this position in the classroom cannot overcome their difficulties because they relate with children who have the same characteristics. Thus, the best environment for an individual with autism to learn is the regular classroom, relating with other individuals with other characteristics.

According to Mello [1], before including an autist in the regular school environment, he must have a specialized attendance so the individual can know himself, and know about his abilities in order to prepare him for the inclusion. According to the author a multidisciplinary team must support each child according to their specific needs.

Then, Mantoan [11, 12] states that the school inclusion changes the teacher and makes him recognize the different cultures, the social, intellectuals and affective manifestations.

According to Martins [10], since the constitution of 1988 there was the guarantee of some rights to disabled people like the social integration, qualification and rehabilitation besides specific educational attendance. The constitution guarantees education for all, so as each individual can develop and became a conscious citizen, so these individuals cannot learn in segregated environments [11, 12].

Salamanca Statement summarized the position of 92 countries about the reception of the diversity. In this inclusion process, the school must guarantee modifications in the course, physical and environmental organization which ensures the continuity and quality in the teaching-learning process of these students.

In Brazil, the National Educational Bases and Guidelines Law (Law 9394/96) – in chapter V articles 58 and 59 foregoes specialized service to people with special needs, adjustment of course and qualified teachers.

All these studies motivated us to think about a free tool that helps the communication of autistic children in school environments, allowing them to communicate and express their needs, and facilitating their socialization.

3   FECAUT to Supporting Communication

The tool to aid autistic child (in Portuguese "Ferramenta de Auxilio à Criança Autista" - FECAUT) was developed to help autistic children in their teaching-learning process, improving the communication and reading skills, socialization and the independence of the autistic in classroom, using technologies and audiovisual resources.

The prototype was developed using techniques of medium fidelity prototyping and it was evaluated using usability inspection techniques. Initial prototypes were produced on paper based on low-fidelity prototype, to collect and validate functional requirements.

According to Gomes and Silva [3], auditory and visual stimuli are used to get attention and, if they are used properly, it can help the autistic establish some day-by-day routines. Considering these aspects, we were looking for a model to develop FECAUT tool using images and sounds to improve memory development skills and to facilitate the coordination of autistic, observing how they process information.

FECAUT tool was divided into different categories with different screens for interaction. All interactions can be performed through touch and the users can also active sound´s mechanisms. Interactions are represented by images and symbols to facilitate cognitive recognition. Some controls, such as buttons, with default actions were introduced: start the tool, exit, go back/return, and others. In addition to symbols, a word or phrase that indicates the action - for these actions is also available the sound

system. This mechanism helps the learning process through word´s recognition and identification. The categories of the tool are: toiletries, school supplies, games, emotions, colors and food. These categories were informed by teaches in a Brazilian school that have autistic students in their class, and in a future work we can complement the categories with others categories that may be appropriated. The categories are subdivided in items that containing the actions related to each category.

We have been using an integrated development environment to create and develop FECAUT prototype. The prototype was evaluated through inspections conducted by usability experts and, at the end of this evaluation, the requirements have been validated.

Considering the issues highlighted in studies of [3], we´ve pursued to develop FECAUT tool with the adoption of images and sounds to help and to facilitate the memorization and autistic´s coordination, observing how they process informations.

The tool has the following functionalities: On the Initial Screen (Figure 1 - Initial Screen), the user has the option to exit the tool by clicking the button <Close> (Figure 1 - A) or start using FECAUT selecting the <enter> button (Figure 1 - B), in this case the program redirects the user to the Home Screen of the tool, shown in Figure 2 - Options from Home Screen.
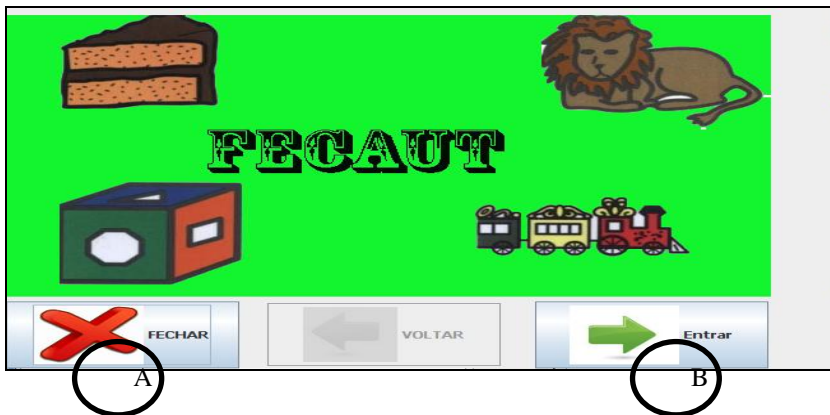

Fig. 1. Initial Screen

Based on the initial screen of FECAUT, the user can choose which activity he/she desires, by clicking on button that correspond to wanted action.

When the user makes this selection/action, by positioning the mouse over the button, the sound of the word written in capital letters will be reproduced. If the user pushes the button, the tool opens the next screen containing all items in the selected category.

It is important to notice that we have been followed the principles of good design, maintaining consistency between screens of the tool, proper use of metaphors, use of a good mapping and correct use of action´s objects. It can be observed, in Figure 2 - A, the <Enter> button was disabled, since the user is already using the tool and this action is no longer needed.
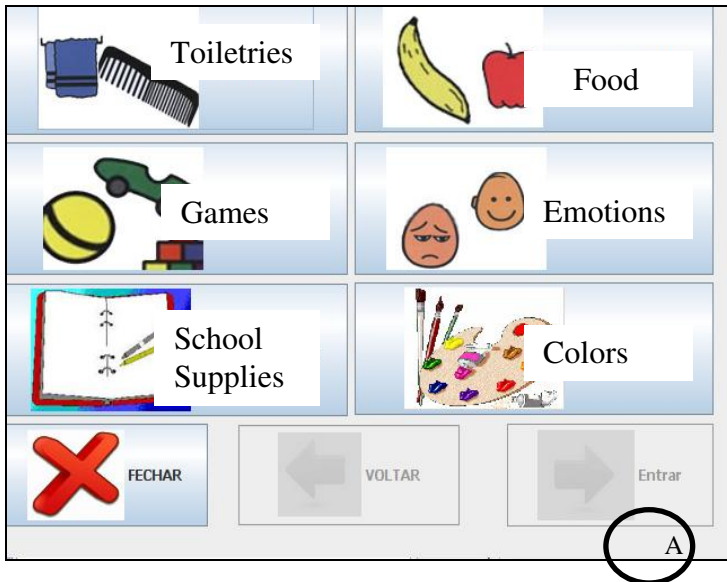
Fig. 2. Options from Home Screen

When the user chose one category, the tool displays a number of items related to the selected category. For example, the category Toilets has six items: soap, towel, hairbrush, toothbrush, toothpaste and shampoo. All icons consisting in the selected category are detailed and when the user positions the mouse over the picture a sound is played. Still, the user has the option to close the screen and return to the previous one. This process is similar for all categories of FECAUT tool.

It is recommended that parents and teachers observe the autistic child during use of the tool, if he/she is having some difficulty or not handle it. These observations are required because autistic may need help at the beginning of the use of FECAUT and also as the communication process involves the sender and also the receiver of the message, it is important that parents and teachers understand how child is using the tool to convey your wishes, feelings and needs.

3.1   Usability Inspection Applied to FECAUT

For the evaluation of FECAUT tool the validation technique was used, focusing on functionality and usability. According to Rocha and Baranauskas [2] evaluation aims to " [...] know what users wants and the problems they have been experimented, because if the designers are informed about what users want and need, they can do better products. "

To evaluate the FECAUT´s usability it was executed a usability inspection. Rocha and Baranauskas [2] define usability inspection as a technique that checks usability experts to evaluate the usability and functionality of an interface, focusing at the software. It can be done at any stage of development. Thus, this type of technique has become suitable for the work, at prototyping phase.

The Heuristic evaluation, a leading usability inspection method, it is consisting of a set of evaluators examining the interface and looking for usability problems, according to some pre-defined heuristics. In the present study the usability heuristics defined by Nielsen and reported in [2] were used. Heuristics are rules that aim to describe common properties of usable interfaces. To perform the heuristic evaluation were selected ten Nielsen heuristics that suit this type of developed tool. They are: (1) Visibility of system status; (2) Match between the system and the real world, user control and freedom, (3) Consistency and standards, (4) Recognition rather than remembrance, (5) Flexibility and efficiency of use, (6) Aesthetic and minimalist design, (7) Easy to operate; (8) Logical and sequential grouping of fields, (9) Agility in cursor movement and (10) Location information quickly.

After heuristic evaluation we could realize the following results.

- Visibility of system status: whenever the user chooses an option, the tool responses immediate, showing what is happening. This ensures that the user knows if the executed action is the chosen one;
- Match between system and the real world: to facilitate the use of the tool by people with autism it was used simple language and several images, consistent with representations of real objects;
- User control and freedom: the user can return to a previous state by clicking on the buttons that can be found on the bottom of all screens, and he/she has the feeling that controls the entire environment;
- Consistency and standards: to maintain the user´s daily routine, an important item for autistic people, a model was created to access the information by the same way anywhere when using the tool. Colors, menus and buttons were also standardized;
- Recognition rather than remembrance: FECAUT is simple to use and the user can recognize where he/she is without having to remember the path he/she have been navigating. Furthermore, the use of metaphors and patterns provides greater ease in recognition of the objects to interact;
- Flexibility and efficiency of use: This tool was developed for both the users who are accessing the system for the first time and more experienced users. But there are no keyboard shortcuts to experienced users that they can quickly perform the functions - it is a heuristics recommendation. It is also not allowed to customize the tool´s items, for example, to group categories and most used items. This heuristic was partially fulfilled because the needs of the group of users were fully met, even without the flexibility to tool´s customization;
- Aesthetic and minimalist design: The FECAUT does not contain error message, to not intimidate the user or make him feel guilty for an error or invalid selection. The interface of the tool was developed allowing the user do not make mistakes, working with enabling/disabling of the object´s action;
- Ease of operation: This tool minimizes number of click´s (actions) to perform an task, based on user´s needs who have deficits in motor coordination;
- Logical grouping and fields sequencing: FECAUT used groups of similar items, creating categories for grouping the information, making it easier to find the items by the users;

- Agility in cursor movement: To make more agile the tool´s manipulation was created buttons to interact with the tool, which have large sizes to facilitate the movement of users who do not have fine motor coordination;
- Find information quickly: The interaction´s buttons facilitate the information´s location and the user becomes independent after a period of use the tool.

FECAUT tool was developed observing the recommendations of software engineering for system development and usability engineering for interface´s development. Heuristics were used in the validation of the tool, especially for evaluated the usability, so that the tool is easy to use, easy to learn and motivates users to use it. It is required to perform an evaluation with users, both teacher and students, and it will be done in a future work.

4   Conclusion and Future Work

The communication process is essential in the school environment, especially among age children literacy to exchange information, clarify doubts and their socialization. Informal communication often helps children to perform tasks and solve problems more quickly and, therefore, it is important that autistic children are able to express themselves clearly in school environments.

This project presents the FECAUT tool that reaches the features proposed to facilitate communication, socialization and autistic´s independence in the school environment because it uses sounds, text and images for ease of symbolic thought. Given everything that was analyzed, it was found that the developed tool has no usability problems from the point of view of concepts and the tool is consistent with the Nielsen´s Heuristics, providing benefits not only for autistic children, but also for other children with communication problems, especially for children with temporary disabilities, those acquired for a short period of time. Besides this advantage, the system has practically no cost compared to existing programs on the market that have the same purpose.

As future work we have to make some improvements like inserting images in the database made by users, field research and adaptation for operation in mobile devices such as phones and tablets. Even though simple, the tool is important for the inclusion of the autistic, both in social environment as educational environment , providing knowledge and autonomy, since autistic children can indeed learn from the tool, and they are encouraged to express themselves.

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