ASD Module: A Software to Support the Personal Autonomy in the Daily Life of Children with Autism Spectrum Disorder

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Abstract: Introduction: It was observed that technology developers expressed a clear interest to design programs that meet the needs of individuals with Autism Spectrum Disorder (ASD). Several authors indicate that any software designed for people with ASD has to include special requirements in the design. Methodology: This research study describes a software for children with ASD named Module ASD and describes the interactive process of design that it was followed. This research focuses on a software development and the design process, based on scientific evidence study, consultation and tests done by specialists, children with ASD and their families. The techniques used to formalize the collection of information from different groups of participants were: observation, interview, group discussions and field book. Results: The ASD Module is the result of the study and it is a free technological application that is made up of a set of virtual keyboards (or adapted interfaces), digital schedules and activities, especially designed and tested by and for children with ASD. The application is included in the In-TIC PC software. The software is available for the Windows operating system and was implemented with the Visual Studio development tool, .NET environment, C# programming language and Windows Form technology. Other materials used for content development were the Interactive Books Multimedia (LIM according to the Spanish acronym) software and the ARASAAC pictograms. Discussion and conclusions: The results show that the digital content can be oriented to promote independence in several daily activities (ADL, education, leisure and social participation). This technology design provides useful information for researchers, developers, social and healthcare professionals and families, with the aim of offering alternatives for children with ASD and facilitating the understanding of daily life.

1. Introduction

Nowadays, the virtual context and Information and Communications Technology (ICT) have an effect on our lives, in many cases facilitating the performance of daily activities (1). Likewise, technology is beginning to change the lives of many people with Autism Spectrum Disorder (ASD) to the extent that it is increasingly used in the intervention and research related to people with ASD (2).

The type of technology used in interventions with people with ASD is varied (computers, mobile devices, video recordings, robots and virtual reality). There has been an increase in the use of technology in this field for several reasons:

1. Reports and studies stating that people with ASD show interest and motivation for using visual technology devices;
2. Studies supporting the effectiveness of technology as an intervention tool;
3. Increased software development in this field.

Therefore, at present, the technology-based intervention for persons with ASD faces many challenges. The main challenges are related to the development of software which take into account the specific learning styles, abilities and needs of children with ASD (3, 4).

2. Results and Discussion

Results

The ASD Module is the result of the study and it is a free technological application that is made up of a set of virtual keyboards (or adapted interfaces), digital schedules and activities, especially designed and tested by and for this study group and included in the In-TIC PC software (5). In-TIC PC is the baseline software with which the specific block for people with ASD was created and whose purpose is to adapt the Windows environment by means of virtual keyboards that allow easy computer access and use and/or to facilitate social communication and participation. The software is available for the Windows operating system and was implemented with the Visual Studio development tool, .NET environment, C# programming language and Windows Form technology. Other materials used for content development were the Interactive Books Multimedia (LIM according to the Spanish

acronym) software (6) and the ARASAAC pictograms (7).

The ASD Module is based on the perspective of considering the person with autism as the central axis, and, around it, the activities of their life interests. To provide an example that can be adapted and customized to other people, let us consider the case of Arancha, a girl with ASD. When analyzing the main screen (Figure 1), Arancha is observed in the central part and, around her, the activities in which TIC can support her on a daily basis. There are 5 sections:

1. Schedule. This section refers to the basic daily activities. It was designed to make access to timetables, schedule and activity sequences easier, to help organizing a person's day and activities.
2. Education. This section includes activities necessary for learning and participation in the school environment (8). It is made up of contents about five basic categories: colors, numbers,

letters, parts of the body and feelings. Moreover, dynamic activities have been designed in the same line, with the LIM system, which are integrated with the keyboards of this module (see Figure 2).

3. Leisure. This section refers to leisure activities, that is, time spent away from compulsory activities (8). It includes resources classified as games, stories and documents about people with ASD (see Figure 3).

4. Communication. This section contains basic communication keyboards. Pictograms and/or pictogram writing are used, which, combined with speech synthesis resources, stimulate the communication of basic requests and needs. There are also other keyboards that favor the narrative discourse and the development of questions in order to encourage a person's social participation.

5. Computer access. This section refers to the access to several conventional programs from Windows environment; in this section both access and use are simplified. The programs used are as follows: Wordpad (text editor), Microsoft Paint (drawing program), Windows calculator and Windows Media Player.

Discussion

The results of the software development and design show that the digital content can be oriented to promote independence for several daily activities (ADL, education, leisure and social participation). The literature in this field shows that people with ASD have difficulty in performing these activities (9). Therefore, within this software, the person is seen as the central focus and surrounding them are the activities in which ICT can be a facilitator. However, so far, many of the software tools that have taken into account the perspective of people with ASD, have focused solely on promoting specific abilities (10, 11, 12, 13, 14, 15, 16, 17).

On the other hand, motivation is essential for learning in all areas of daily life. As stated previously, a high percentage of people with ASD have a predilection for technological devices. Therefore, an alternative to traditional interventions is proposed, based on the preference and motivation for the use of ICT.

The decisions made by the interdisciplinary team developing the ASD Module have been described and they have shown the need to involve both people with ASD and those within their immediate surroundings in these processes, as already described in several publications (18, 19)
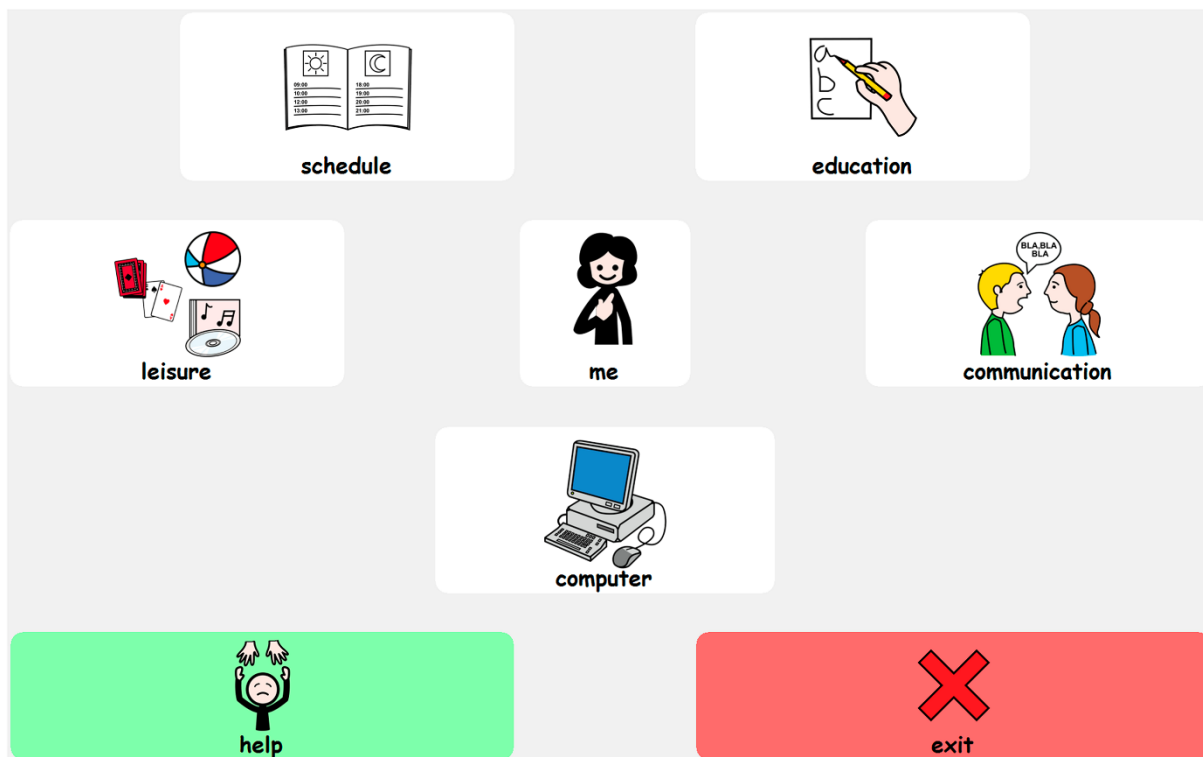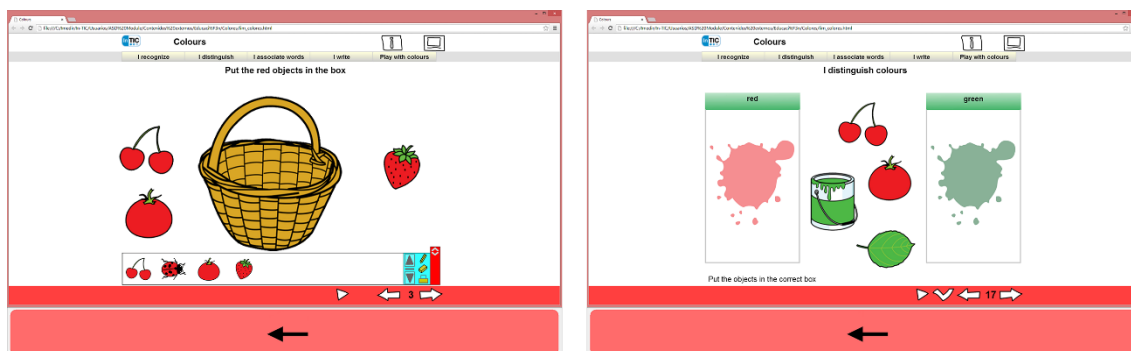
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Figure 1. Main screen of the ASD Module

Figure 2. Examples of LIM activities about using colors for the Education section

Figure 3. Example of the application browser to locate the videos of interest

3. Materials and Methods

Participants and settings

This research study involved four groups of respondents, meeting the following criteria:

1st Group: Professionals with experience in the intervention with people with ASD

The study involved 20 professionals who were recruited from centers of direct care for people with ASD, such as two schools of special education, specific for children with ASD diagnosis, an ASD-specialized clinic for psychological intervention, and an association that provides support for families living with an adult with ASD. The selection criteria for these professionals were as follows: (a) having a degree in education sciences or health sciences or representing the interests of organizations that serve people with ASD; (b) being able to prove work experience of at least one year in the intervention with people with ASD. Finally, a heterogeneous group was obtained, made up of 3 representatives of organizations, 3 psychologists, 11 schoolteachers, 1 social worker and 2 speech therapists.

2nd Group: Professionals with experience in the development and design of technology for disabled people

The project involved 13 professionals recruited from two centers that make use of the technology applied to social and/or health context. Participants also met the following criteria: (a) having a degree in the field of technology or health sciences or promoting social projects; (b) being able to prove work experience of at least one year in the design, development and/or testing of accessible technology related to health and quality of life for disabled people. The group involved the collaboration of 4 experts in the implementation of social projects, 1 doctor, 5 engineers in computer science and 3 occupational therapists.

3rd Group: Family members of people with ASD

Participants were 3 direct relatives of people with ASD and who, in turn, were part of the organizations for people with this diagnosis.

4th Group: Children with ASD

In the final phase, 3 children (two boys and a girl) participated, aged between 10 and 13 years old. All of them were selected from a special education center and met the criteria described below: (a) having a diagnosis of autism disorder according to the Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV); (b) presenting learning difficulties; and (c) not having used the specific software prior to testing.

The protocol was approved by the Autonomous Ethics Committee of Research in Galicia. The project participants signed the informed consent to participate in the study and, in the case of children with ASD, their guardians were responsible for authorizing their participation. In addition, in the cases of the 1st, 2nd and 3rd Groups, a specific authorization for interview recording was signed.

Procedure

During software development and design, a search for scientific evidence was performed, in addition to consultation and testing by specialists in ASD, and/or technology, and by children with ASD. To this end, research has been based on user-centered design and has followed an iterative procedure. This is a cyclical process, divided into the following phases:

1.   Study and analysis of the recent scientific evidence on the design of technology for people with ASD. Participants: 2nd Group.

2.   Study and analysis of the recent scientific evidence on the skills and ways of processing information of people with ASD. Participants: 2nd Group.

3. Observation, analysis and discussion on the skills and ways of processing of this population and their influence on the design of technology. Participants: 1st, 2nd, 3rd, and 4th Groups.

4. Design and development of the application. Participants: 2nd Group.

5. Software Testing by professionals and family members of people with ASD. Participants: 1st and 3rd Groups.

4. Conclusions

The ASD Module has been developed based on the learning styles, abilities and needs of children with ASD and has been integrated into the free In-TIC computer software. This block includes virtual keyboards, schedules and activities to promote independence in everyday activities.

The ASD Module is provided as an example available to families and professionals assisting people with ASD so that, through the customization of the necessary aspects, it could be turned into a functional tool.

The basic ideas used for the development and design of the application have been explained,

6. Software quality improvement. Participants: 2nd Group.

After this iterative process, the resulting application was tested by the 4th Group, that is, children with ASD.

Information collection techniques

The techniques used to formalize the collection of information from different groups of participants were: observation, interview, group discussions and field book.

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including scientific evidence and considerations set out during the iterative process of the software.

This list of rules for technology design provides useful information for researchers, developers, social and healthcare professionals and families, with the aim of offering alternatives for children with ASD and facilitating the understanding of daily life. Moreover, the need to research and develop studies for analyzing the responses and opinions of people with ASD and those within their immediate surroundings was demonstrated herein.Main text paragraph.

Conflicts of Interest

   The authors declare no conflict of interest.

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