

Assistive Technology Utilization for Autism An Outline of Technology Awareness in Special Needs Therapy

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ABSTRACT

The work carried out in this study is focused on examining the current and future uses of assistive technology by parents and special needs centers for the therapy and rehabilitation of children with special needs, with a focus on autism. The study provides results from two surveys that examine the use of assistive technology by a group of six families having children with autism and by one of the leading centers for special needs in Dubai, United Arab Emirates. The surveys were developed to determine the level of awareness and utilization of assistive technology. Results also reflect the strength of parental and professional awareness of those technologies, taking into mind that parents of those children are usually experts in seeking and trying the best to help their children. The availability of these technologies and the challenges facing centers and families in gaining information or exposure to those technologies is discussed. Additional work in this study relates to my interdisciplinary research focusing on investigating the use of high level computer assistive technology for autistic impairments therapy. This paper provides a detailed study of the practices of embracing assistive technology considering the financial and technical challenges which might be faced. The study provides a framework for gaining social support and awareness of the value of those technologies and provides an approach to motivate information technology specialists and special needs professionals to work together to develop reasonably affordable and more relevant technologies, against the mainstream of commercial general-purpose so-called "assistive technology." In addition, this paper looks at the potential for new technologies yet to be explored in further research on autism.

Keywords: Special Needs, Assistive Technology, Autism, computer assistive technology, CAT, Virtual Reality.

1. INTRODUCTION

There has been a great development in the past few years on the infusion of technology in the life and curriculum of people with special needs. A technology that enables an individual with a learning disability to compensate for specific deficits [1] is indeed an assistive technology. Technology to incorporate would usually range between the simple low-level technologies to the robust emerging technologies. As technology is meant to help humanity, assistive technology relates well to those with special needs.

Research on assistive technology will need to target a variety of people's categories. It will target the subjects with special needs, their parents and families, professionals, policy makers, corporate executives, and the government sector. Successful research will require the cooperation of parental groups, academic institutions, international organizations, non-government organizations, universities, and private centers. The aim of using technology in special needs is to contribute to the possibilities of adoption of assistive technologies in specialized centers or to the preparation for inclusive education. A joint work between schools, centers, corporate and the government would generate a stream for the creation of the hoped for technology based remedial rooms. There is a need for the help of specialists and professionals to train the other trainers on the best practices. Collaboration of the families and proper coverage of the media are major factors in the success of the process.

2. SELECTING THE APPROPRIATE ASSISTIVE TECHNOLOGY

Many researchers will agree that selecting the most appropriate technology for individuals with learning disabilities, requires a careful and systematic plan. It is important to stress that not all assistive technologies are appropriate for all individuals in all situations. People with learning disabilities have their own unique set of strengths, weaknesses, special abilities, interests, and experience [2]. It will become obvious that there is no such "general purpose" assistive technology. Disability requires careful analysis of the interplay between the individual; the specific task/functions to be performed; the specific technology; and the specific contexts of interaction [2].

A real risk now persists from the flow of the general-purpose assistive technology toys and tools, making it harder for professional to recommend the actual tools due to the very competitive price of the general purpose ones. Each child with special needs is a unique entity with very detailed descriptors that distinguishes him from the others. Only professionals are able to determine those differences and therefore satisfy the need for proper assistance. Robust technologies require the designer to be involved with the world he/she is designing for. The gap between humanities and science needs to be bridged to get the scientists to innovations with human use and nature.

3. FUNDING ASSISTIVE TECHNOLOGY

A strategic and organized approach to the process of funding is vital for the continuation of research or support. That approach can yet be simple and achievable [3]. To accomplish such a task, a collaborative team must be assembled to guarantee that an individual receives appropriate devices and service recommendations. It is important to present sufficient documentations and evidence on activities. The process of raising money includes funding of services and devices for centers or individuals. A team of professionals together with parents and families should be in charge of seeking collaboration. Some important facts about raising funds include the facts that it is not easy frequently, it can be very frustrating, but it can be done.

4. SCOPE OF ASSISTIVE TECHNOLOGY

Because assistive technology applications are intended to decrease the functional limitations of a person with a disability [4], there is a wide spectrum of technologies and toys which will fit under the assistive technology definition. Some of those toys are for general purpose and could be used with normal or challenged children, and some are specialized toys. In an overview of the different categories, Bud Rizer et al. [4] identify six categories within the low-level to high-level assistive technologies, which are:

- Adaptive toys: This includes the use of commercially available battery operated toys to allow infants and toddlers to experience control over their environment despite severe physical restrictions or motor control deficits.
- Switches: Single and potentially multiple switch access methods can allow the person with even the most severe disability to achieve control over many different aspects of their environment, including play, communication, education, environmental control, mobility, and perhaps employment.
- Environmental controls: Devices and technologies designed specifically to allow a person to experience better control of their environment can increase one's independence and the ability to perform routine tasks.
- Augmentative and Alternative Communication (AAC): AAC includes any technology application that results in the improvement of a person's communication with individual, in groups and even by way of telephone. AAC involves maximizing of specific language

concepts and strategies to enable the non-verbal person to more actively interact with their environment.

- Alternative Learning Strategies: Somewhat similar to sensory disabilities, alternative learning strategies can be developed for individuals with specific learning deficits. By capitalizing on the strengths of the individual, computer based adaptive learning hardware and software can enhance the overall learning experience.
- Adaptive Computer Access: Computers can be adapted through a variety of methods to enable alternative input control or output required by the person with a disability. These adaptations may be in the form of additional hardware, software, or a combination of the two. Most computer operating systems today allow for customization of the computer control process to accommodate nearly any special needs of the individual with a disability.

Some new technologies and devices have emerged in to the market which can be added as a category under the robust assistive technology. This category will include technologies such as touch screen monitors, head mounted devices, new pointing and control devices, special purpose rich graphics, and virtual reality (VR) applications. Those technologies can be used for both assessment and therapy.

5. ASSISTIVE TECHNOLOGY AND AUTISM

Autism is identified with the following impairments

1. A difficulty with social interaction (impaired relationships)
2. A difficulty with all aspects of communication (verbal and non-verbal)
3. Rigidity of thought (also called theory of mind)

Attwood [5] recommends the use of Social Stories and Comic Strip Conversations for different levels of communication. Similarly, regarding the 'reading' of non-verbal messages, people with autism tend to have a difficulty in facial expressions and gestures. Pictures have been proven effective and helpful for them. People with autism tend to be visual learners, and visual way of communication can help them to understand the context of communication [cp 6]. Trepagnier, as suggested by Fein [7], mentions that the social deficit appears to be the most significant of the core deficits of autism. Deficiencies in face gaze may play a role in children's social impairment [8]. A number of studies by Hobson, Tantam, and others [7] have revealed differences and deficiencies in looking at and interpreting faces on the part of persons with autism. In tasks of identifying people and identifying expressions of emotion, non-disabled controls did best when they could see the upper face. In contrast, the performance of most persons with autism did not show that effect [9]. Individuals with autism fail to interpret the meaning of others' gaze direction [10].

The importance of assistive technology for children with autism has been established with the fact that it can be used in rehabilitation to the daily activities. Hetzroni and Tannous [11] have developed a program ("I Can Word It Too") based on daily life activities in the areas of play, food and hygiene. The study was conducted on five children with autism between the ages of 7 and 12, of the effects of using the program on the use of functional communication. They found that use of the program was effective in improving the communication of all participants, and that the participants were able to transfer the lessons learned to their natural setting in the classroom.

6. AUTISM AND COMPUTERS

Most computer applications designed for people with autism focus on the relationship between one user and one computer, and aim to help with specific behavioral problems associated with autism [6]. Hileman [12] claims that computers are motivating to children with autism due to their predictability and consistency, compared to the unpredictable nature of human responses. When it comes to social interaction, the computer does not send confusing social messages. Research on the use of computers with students with autism revealed the following [13]:

- Increase in focused attention
- Increase in overall attention span
- Increase in in-seat behavior
- Increase in fine motor skills
- Increase in generalization skills (from computer to related non-computer activities)
- Decrease in agitation
- Decrease in self-stimulatory behaviors
- Decrease in perseverative responses.

7. VIRTUAL ENVIRONMENTS AND AUTISM

A virtual environment can be defined as a computer-generated three dimensional simulation of a real or imaginary environment [14]. Two forms of virtual environment (VE) can be distinguished – a single-user VE (SVE), and a multi-user, collaborative VE, (CVE) [cp. 6]. The user in a virtual environment is represented as an avatar which could be abstract or humanoid. The value of virtual reality comes from the fact that children with autism may have difficulty understanding 2D visual representations, so they require the actual object or a stronger representation like a 3D animated humanoid avatar. The use of animation is also in line with research indicating that children with learning disabilities prefer programs which include animation, sound and voice [15].

The user of a CVE is represented by an avatar, which is an abstract or humanoid representation of their identity within the virtual environment. It has been argued that the use of CVE technology has great potential for people with autism, in both an assistive and an educational role [6]. A study by Moore et al. [14] suggests that the use of collaborative virtual environments (CVE) has great potential for people with autism, as an assistive technology, as an educational technology and as a means of helping address any Theory of Mind impairment. An empirical study [6] of the ability of children with autism to understand basic emotions, as represented by an animated humanoid avatar in a (non-collaborative) single user computer system. It explores their capacity to recognize the expressive avatars and to predict and infer other people's emotions.

As autistic children exhibit high interest in letters and words, the value of written words could support the potential use of them in a form of “thought bubble”, which have shown some success as a method of teaching conceptual understanding for people with autism [16]. Written words can be presented in thought bubbles to add an extra value to collaborative virtual environments as communication is possible by thought bubbles.

A recent study for the purpose of exploration and validation of a proposed rehabilitative technique addressing attention deficits [9] have work aimed at the design and implementation of a gaze contingent therapeutic virtual environment for autistic children. The results indicate the need to expose the subjects to the procedure long enough for outcomes to become tangible. Thus, it is evident that gaze contingent content needs to be sufficiently varied in order to sustain its engaging quality. The results of this work are very important as they reflect the technical, logistic, and operational challenges of developing and testing new technologies on children with autism.

It is common to use communication cards to make the child with autism understand (visually) what is meant to be communicated to him. This could be a transition rule (such as going somewhere), behavior rule (such as do or don't, give a hug, take a walk), alternate behavior rules (such as raising hand for help, close eyes and take deep breath to relax), and functional communicative exchange rule, which is valuable for expressive communication skills development [17]. A sophisticated visual representation system based on an adjusted approach to the above will be prominent to the child. An investigation of the use of single and collaborative virtual environments in an intervention program on the communicative functions of children with autism is a possible hypothesis for study.

8. PARENTAL SURVEY ON USE OF ASSISTIVE TECHNOLOGY

Six families of four nationalities having children with autism participated in this study. Children were between 4 and 15 years old, all diagnosed to have skills impairments due to autistic traits. Families were aware of the condition and have been active seeking therapy and help with their children. Participants received the survey forms and written explanations of the purpose and aims of the study. The survey questions (Appendix 1) were all related to parents' awareness and use of assistive technology with their children.

Four of the families who have returned the survey have indicated knowledge of assistive technologies with variant degrees of awareness of the developments in the field. Those four families had computers at home with Internet access. Answers provided by participants indicate that computers were used mainly by the family to gather information, resources, or shareware applications. Two families have indicated serious efforts in helping their children use the computer. According to their data, children have been identified as highly functioning autistic children. Families have indicated experiments which incorporated the use of software applications with strong visual interfaces and multimedia features to help expressive communication skills and self-help.

With regards to the questions about special devices or hardware, two families indicating having large touch-screen monitors for the computers. The other two had normal 17 inch monitors. There is an indication of some benefits of the touch-screen monitors as one family indicated that its presence reduces the anxiety happening when using the mouse. Software applications were all downloaded from the Internet. No evidence in any investments in off-the-shelf or custom made software was found. One of the difficulties mentioned related to the reluctance in purchasing products over the Internet. As for the awareness of technologies, parents have indicated fair amounts of knowledge about robust assistive technologies which might be available, though no evidence of specialized or professional advice given to them. That includes: special pointing devices for computers, audio books, enhanced board makers, track ball, language boards, and variety of computer software. Lower awareness has been noticed among two families who favored general-purpose games and toys. The survey has indicated strong level of awareness among families of the need for assistive technology. Lacks of resources, decision, or belief in usefulness of such technologies were the major impediments indicated. Shortage of professionals who can be consulted is a challenge to families who need help in technology acquisition.

In summary, the study shows fair levels of awareness of low-level and mid-level assistive technologies for autism, in addition to some modest awareness of high-level technologies. Internet is proving to be the best friend of families with autistic children. There is a serious intent among families to acquire new assistive technologies for their children, though the concern about the effectiveness and cost of those technologies is slightly high. All participants in the survey have shown enthusiasm to participate in any future studies including experimental work. This is good news to researchers and people who wish a career in the field of disabilities.

9. THE AUTISM CENTER SURVEY

The survey (Appendix 2) was sent to four major centers for special needs in the United Arab Emirates. Only one center has returned the completed survey, possibly due to the short notice before summer holidays. The answers provided by the center which participated in this survey were analyzed and the analysis has revealed high level of interest by professional as well as good exposure to resources. The findings have indicated that:

- The center has no technology room, despite the fact that they have been using some low-level and mid-level assistive technologies for over a year.
- The center has mature plans for establishing assistive technology room within one year.
- The center has 9 computers for a total of 40 students.
- The center has acquired and tried wide variety of off-the-shelf and shareware programs.
- The center relies to a very large extent on the Internet as a source of information, research, and exposure to assistive technology.
- The center has successfully utilized some programs to target impairments particularly in speech and emotions recognition.

In summary, the center has proven ability to plan to be in sync with the developments of assistive technologies. Lack of financial resources and funding is a major challenge to the upgrade process.

10. CONCLUSION AND FURTHER WORK

The findings from the two surveys performed indicate fair level of awareness of the benefits and value of assistive technology in the field of special needs. They also indicate the keenness to acquire those technologies, both by parents and by professionals in the field. Challenges are related to lack of access to information about the latest developments, lack of sufficient funding to pursue the leaders in this field for consultancy and acquisition of technology, and the shortage of professional staff who can provide valuable consultancy and support to family at an intensive level. There are indications of rapid growth of awareness and self-development among families and professionals and that all is in the benefit of the children. There is a need for learner-oriented training programs to training the trainers and families on the use of technology and to achieve the goal of increasing the child's independent functioning. Technology should aim to achieve that as it has to meet the unique needs of each child.

There is an excellent potential for robust technologies such as Virtual Reality to emerge and play a major role in the assistive technology field. There is a need for rapid investment in information technology experts to get closer to other fields in humanities and collaborate with the professionals to attain human-oriented achievements, for the benefit of the humans.

Further investigation of means of using CVE in an intervention program on the expressive communication skills development and emotions recognition functions of children with autism is planned.

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