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## Mobile applications for autism

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**Abstract.** The rapid development of technology in recent years has increased the interest of educators, researchers, families and therapists of children with autism in the possibilities that digital technologies offer regarding the treatment, education, support and remedy for the plethora of difficulties they face. This particular interest is further enhanced by the need to provide these children with effective interventions through the use of applications that will engage and significantly assist them. For this reason, empirical studies concerning assistive technology products have been constantly increasing; such products promise that they can make up for all the deficits and meet the needs that people in the autism spectrum have in diverse areas, such as communication, social integration and skill acquisition. According to all the above, this research aims to present the mobile applications used in autism. Thus, in the first chapter, there will be a definition of autism and a presentation of its key features. Furthermore, in the second chapter, assistive technology in the context of autistic disorders will be discussed as well as the possible advantages of portable applications. Finally, in the third chapter, there will be various examples of such applications.

**Keywords.** Mobile, Robotics, AI, Games, Autism

### 1. Autistic Spectrum Disorder (ASD)

#### 1.1 A definition of Autistic Spectrum Disorder

According to the DSM-V, the autism spectrum includes several disorders such as childhood autism, early infantile autism, Kanner autism, high-functioning autism, atypical autism, pervasive developmental disorder not otherwise specified, Asperger's disorder, and disintegrative disorder (APA, 2013). This is a group of neurodevelopmental disorders, whose main features are deficits in the areas of social interaction and communication, as well as stereotyped repetitive behaviors. The appearance of the specific symptoms occurs during early childhood, limiting the daily functionality of individuals. The manifestation of these disorders varies according to the degree of severity of autism, the age of the individuals and their level of development. These diverse manifestations have led to the use of the term "spectrum" (ARA, 2013).

ASD is now very common, with 1 in 54 children aged 8 years old being diagnosed with it. These statistics are alarming, especially when compared to previous years, when the incidence in children was 1 in 150 (CDC, 2020).

### **1.2 The key features of ASD**

The major deficits in individuals with autism are categorized into three main areas, such as social competence and interaction, communication, and repetitive stereotyped behavior. Most of the time, difficulties are also noted in areas like concentration as well as in emotional, sensory, and cognitive functions, in general. Regarding social activity, people with autism face great difficulties in managing their social relationships, interacting with others, understanding their emotions, perceiving body language, and maintaining eye contact. The absence of knowledge about the people surrounding them and about their way of thinking and perceiving things is also typical of autism, which intensifies difficulties in social interactions (Rajendran, 2013). Moreover, there are deficits in the area of communication, due to the fact that non-verbal and verbal communication skills are not sufficiently developed. The speech of some of these people is not functional at all. More specifically, the deficits observed in non-verbal communication are the lack of eye contact and the absence of socially acceptable and appropriate gestures and facial expressions. These skills are of major importance for an individual's socialization, due to the fact that communication helps complete one's personality. In more detail, every time a person communicates with those around them, they learn about the values and standards of society and acquire experiences that contribute to the development of their personality. If this is not the case, the person becomes passive, can be rejected by others, and is unable to create positive social relationships (Allen et al., 2010).

Deficits in the areas of perceiving the feelings and thoughts of others, social and emotional reciprocity, and interactions are evident in younger children, who may demonstrate reduced or no social interactions, fail to exchange feelings, fail to adopt imitative behaviors and be unable to initiate or terminate a social imitation (Escobendo et al., 2012). Of course, in this case too, all the difficulties diversify according to the individual's language ability, age, and support they have received. Finally, another early feature of autism is the absence of joint attention, which is very important for communication within society and for the existence of interactions (Escobendo et al., 2012).

## **2. Assistive technology and autism**

### **2.1 A definition of assistive technology**

According to the World Health Organization (WHO, 2013) disability is a complex condition, which depends not only on physical disabilities or incapacities, but also on the way in which society deals with it. Therefore, removing social and environmental barriers can greatly improve the lives of people with disabilities and reduce their feeling of incompetence. This can also be done through assistive technologies. Assistive technologies support the performance of activities that would have been impossible or very difficult for these people to perform without using them (Bouraoui et al., 2007). For the World Health Organization, assistive technology includes some helpful and supportive products, services, and systems, developed for individuals with the ultimate goal of being able to improve their functionality and ensure their well-being (WHO, 2016). Assistive technology devices are any modified or adapted object and system of products, electronic or non-electronic, of low or high technology, that are used in order to increase, maintain and improve the functional capabilities of people with disabilities (IDEA, 1997).

Assistive technologies also include some non-technical aids, and digital and mechanical devices. There are three main categories of assistive technology, which are classified into low-tech, mid-tech and high-tech assistive technology. More specifically, the first category of assistive technology features zero or minimal assistive technology media, which are very low-cost and do not require any learning effort, nor do they include electromechanical tools. Next come the mid-tech assistive technology media, which include various devices that have batteries, but are not as complex as their high-end counterparts. Finally, there are high-tech media, which include more complex digital and electronic tools, they are high-cost, and require time to learn. This category includes all computers, software, applications, keyboards, and video cameras (Ennis-Cole & Smith, 2011).

### **2.2 Assistive technology in autism**

In recent years, assistive technologies have been increasingly used to develop the skills of people with autism. For this reason, they are a constantly evolving field, which can improve their lives. People with autism spectrum disorders make particular reference to the use of portable digital assistive technologies, as they are considered valuable tools meeting their communication and educational needs (Bauminger et al., 2007). Assistive technology can improve the daily life skills of many people by providing them with the ability to visualize information, making it easier for them to understand (Alcorn et al., 2011).

The use of assistive technologies promises to meet all the needs of individuals on the autism spectrum and help them ensure independent learning. It facilitates their access to their surroundings and significantly reduces the need for direct support from their trainers or carers. Therefore, assistive technology is beneficial for individuals on every level, as it has various applications, it is very easy to use, and allows for improvement in all areas where deficits may occur (Ennis-Cole & Smith, 2011). More specifically, the advantages of using new technologies in the education and support of people diagnosed with ASD are the following:

- Existence of clear and limited boundaries.
  - Limited stimuli for all senses.
  - Error control and utmost predictability.
  - Possibilities for improvement and personalization.
  - Possibilities for verbal and non-verbal communication.
  - Achievement of unimodality.
  - Improvement of interaction
- (Hayes et al., 2010).

Regarding the applications for mobile devices in particular, they are used to enhance the communication of children with autism. They can be very effective when used for providing prompts, as they promote correct and independent responding and at the same time reduce the need for external prompting by staff during activities. In addition, they encourage organization and time management through different programs, especially for children facing challenges in the cognitive domain (Van Laarhoven et al., 2009).

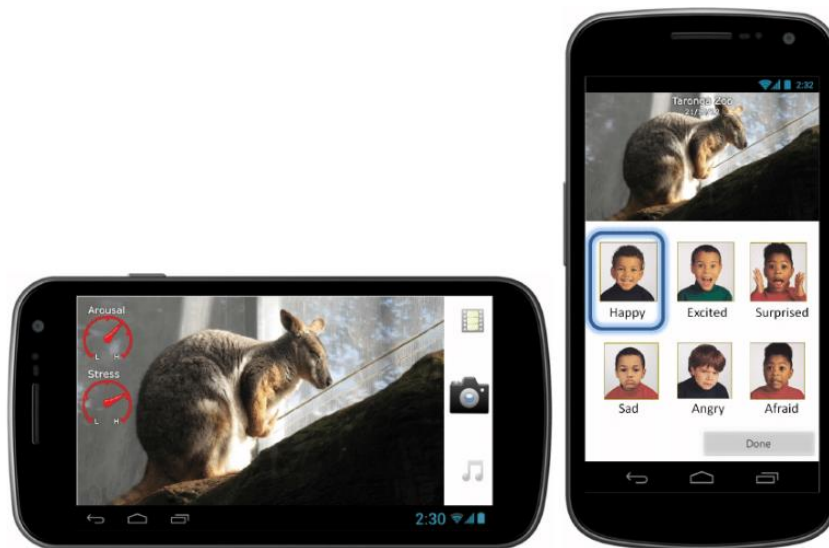
### **2.3 Benefits of using portable electronic devices for people with autism**

Mobile devices along with the applications they include, the functionality they promise and their ability to adapt to individual needs can significantly improve the daily lives of people with autism (McNaughton & Light, 2013). Their advantages, including accessibility, portability, plethora of applications available for social interaction and real-time communication, fluency, ease of use, reduced cost, ability to support personalization, and meeting the needs of individuals, have changed the way

services are provided, making them much more attractive in terms of design and functionality (Meder & Wegner, 2015).

### 3. Digital applications for people with autism

There are various digital applications that have been created to significantly help meet the needs of people with autism. One of them is "Capture My Emotion", which helps children with autism take various videos and photos and record sounds, while detecting their emotional state through the use of a wireless sensor. The aim is to improve their emotional education using their own material and to further assist the work of caregivers. It is a valuable tool that enables these children to identify and express their feelings. It uses the Q sensor from Affectiva, which can measure various parameters, such as conductivity and skin temperature, and as a result, indications are given about the emotional state of the users. These measurements will then be combined with the visual and audio material captured by the children along with various other information such as time, date, and location. This particular combination creates a personalized and individualized tool, which will help children discuss their feelings. This application can be used on Android tablets and smartphones (Leijdekkers et al., 2013).



**Image 1: Capture My Emotion Application**

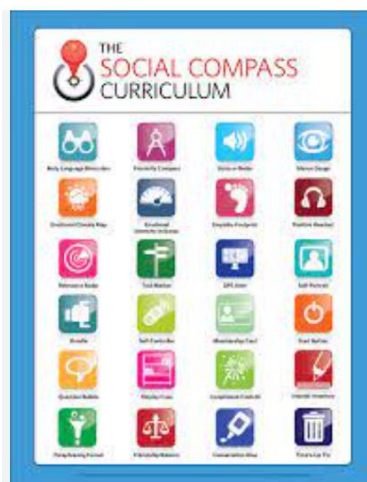
Another important application includes three-dimensional animations and trains autistic children to identify and perceive emotions and facial expressions. It is based on the movie Toy Story. Its simplicity and predictability, combined with the well-known cartoon character it features, make it very attractive

and familiar to children. The possibilities that this application provides are particularly encouraging, since it facilitates children in their effort to identify the feelings of others through their facial expressions (Fergus et al., 2011).



**Image 2: Toy Story Application**

Next comes the Social Compass Curriculum, which is an educational and behavioral program that helps improve the social skills of children with autism. In this application social stories are combined mostly with visual supporting material so as to achieve its objective (Boyd et al., 2013).



**Image 3: The Social Compass Curriculum**

In their own study Escobedo et al. (2012) presented the mobile-supported application MOSOCO that introduces children to various real-life social situations. This application includes various interactive features that encourage children to get in touch with other people through their own eyes, engage in conversations, be able to maintain good space boundaries, and gain the ability to share interest, be able to control their interactions, and understand the basic rules of communication. This software can operate on Android smartphones, which should be connected wirelessly to a server. This application uses the camera to simulate real social situations through visual support. After each interaction, the children using the application can fill out various self-assessment forms. It has been shown that behavioral issues of students with autism can be reduced and interactions with their peers can be increased.



**Image 4: MOSOCO application**

Another important application is Speech Blubs. It is an ad-free application that significantly helps educate children with autism at the beginning of their school years. Speech therapists adopt Speech Blubs as a tool to complement the daily therapy sessions for children with autism, Down syndrome and apraxia. With the aid of facial recognition technology and by encouraging the child to imitate what they see, Speech Blubs teaches them to produce new sounds and motivates them while having fun. Thus, they acquire new vocabulary and participate in various games, quizzes, and puzzles. For students with autism, it can be used to encourage vocal imitation (Heni & Hamam, 2016).





**Image 5: Speech Blubs Application**

Finally, another application for mobile phones is Dino Tim: Kids' Addition and Subtraction. This is a very good application for developing the mathematical ability of autistic children. It teaches them geometric shapes, vowels and consonants with the aid of a reading software for autism. This application can be very exciting, as children can solve puzzle games and learn fundamental math concepts. It allows users to switch between languages and helps primarily young children learn foreign languages. This innovative tool enhances the understanding of children with autism through the help of an adorable dinosaur, called Tim. It was created to assist children from the age of 2 to set the foundations for their mathematical skills. It is supported by iPhone and iPad devices (Zoerner et al., 2016).



**Image 6: Dino Tim: Kids' Addition and Subtraction**

#### **4. Conclusions**

Finally we underline the importance of the digital technologies in education domain and language comprehension that is very productive and successful, facilitates and improves the assessment, the intervention and the educational procedures via Mobiles which brings educational activities everywhere [27-35], various ICTs applications which are the core supporters of education [36-70], AI, STEM & ROBOTICS which raise educational procedures into new levers of performance [71-89], and games which transforms the education in a very friendly and enjoyable interaction [90-95]. Additionally, the enhancement and combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation [96-140] as well as with environmental factors and nutrition [23-26], accelerates and improves more over the educational practices and results, especially in the language comprehension domain and its practices like assessment and intervention.

The aforementioned details highlight the major importance of the use of assistive technology and its applications in particular, in improving the daily life of children with autism. As already pointed out, most of the difficulties they face are in the area of interactions with others and for this reason it was made clear that most of these applications focus on the smooth socialization of these children. In light of the above, these applications are valuable tools in the hands of all people supporting these children, helping them deal with the difficulties they face in the best possible way and opening the way to their independence.

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