

# A CURRENT REVIEW OF THE USE OF MOBILE TECHNOLOGY TO ENHANCE LEARNING AND COMMUNICATION AMONG CHILDREN WITH DEVELOPMENTAL DISABILITIES

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## Abstract

An autistic person is said to have impairments in social interaction, emotional development, communication disorder as well as bizarre behaviors that severely affect their relationship with their families and others around them. It is also reported that 50% of individuals diagnosed with autism do not speak but are highly visual-oriented with the presence of strong visual-spatial skills. Autistic persons are drawn to and respond well to visual representation which includes written words as well. In UK, USA and other European countries, there is a wide array of intervention techniques which take advantage of these visual inclinations and strengths to improve these impairments. Among the intervention techniques, Augmentative and Alternative Communication (AAC) systems have received much attention and are used very often by professionals and therapists to teach social and communication skills to children with autism. The AAC systems and techniques are commendable with a plethora of research evidence citing their usefulness and effectiveness and have since improved many lives of autistic persons. However, each of these techniques has its limitations such as mobility, expensive cost as well as practicality. Some researchers have addressed some of these limitations by marrying these techniques with emerging technologies such as mobile devices. With the flexibility of multimedia content, easy portability and relatively cheaper cost, plus easy content creation capabilities, there is immense potential to utilize mobile devices to teach autistic persons with specialized and individualized content. It serves as an AAC in the pocket and has since gained popularity because of its flexible multimedia content and storage, portability, mobility and affordability. The touch screen interface makes it appealing and simple to use as well. This paper, therefore, provides a current review of research literature and case studies related to the use of mobile technology as educational intervention to enhance learning and communication among children with developmental disabilities particularly those located in the autistic spectrum.

**Keywords:** Mobile devices, special education, educational intervention, autism, developmental disabilities.

## 1 INTRODUCTION

An autistic person is said to have impairments in social interaction, emotional development, communication disorder as well as bizarre behaviors that severely affect their relationship with their families and others around them. It is also reported that 50% of individuals diagnosed with autism do not speak but are highly visual-oriented with the presence of strong visual-spatial skills. Autistic persons are drawn to and respond well to visual representation which includes written words as well. In UK, USA and other European countries, there is a wide array of intervention techniques which take advantage of these visual inclinations and strengths to improve these impairments. Among the intervention techniques, Augmentative and Alternative Communication (AAC) systems have received much attention and are used very often by professionals and therapists to teach social and communication skills to children with autism. The AAC systems and techniques are commendable with a plethora of research evidence citing their usefulness and effectiveness and have since improved many lives of autistic persons. However, each of these techniques has its limitations such as mobility, expensive cost as well as practicality. Some researchers have addressed some of these limitations by marrying these techniques with emerging technologies such as mobile devices. With the flexibility of multimedia content, easy portability and relatively cheaper cost, plus easy content creation capabilities, there is immense potential to utilize mobile devices such as iPod, iPhone as well as PDAs and Smartphones to teach autistic persons with specialized and individualized content.

This paper, therefore, provides a current review of research literature and case studies related to the use of mobile technology as educational intervention to enhance learning and communication among

children with developmental disabilities particularly those located in the autistic spectrum. First, a brief background of Augmentative and Alternative Communication (AAC) will be given. Then, a review on the current use and case studies of Augmentative and Alternative Communication (AAC) systems as educational intervention will be highlighted as well as recent developments in mobile technology.

## **2 AUGMENTATIVE AND ALTERNATIVE COMMUNICATION (AAC)**

Augmentative and alternative communication (AAC) has been known to assist people with autism as well as others with communication difficulties and disabilities to express their thoughts and needs. It is generally defined as a type of assistive technology to compensate verbal communication using pictures, words, symbols or gestures. Ronski and Selvic define AAC as an "intervention approach that uses manual signs, communication boards with symbols, and computerized devices that speak or vocalizations, gestures, manual signs, communication boards and speech-output communication device. A child can communicate using a range of representational mediums from symbolic (e.g., speech or spoken words, manual signs, arbitrary visual-graphic symbols, printed words) to iconic (e.g., actual objects, photographs, line drawings, pictographic visual graphic symbols) to non-symbolic (e.g., signals such as crying or physical movement)" [1, p. 177].

There are two major types or categories of AAC, unaided and aided. Unaided systems require only the use of the person's body such as gestures and sign language. Aided systems require the use of something external to the person's body for example objects, pictures, words or symbols. This paper will focus on aided systems.

## **3 CASE STUDIES AND RECENT REPORTS**

This section will highlight several case studies and recent reports on how aided AAC can be assimilated with mobile technology where "high" technology strategies can be implemented with more flexibility, mobility, portability and at a relatively lower cost.

### **3.1 Case Study 1: Picture Exchange Communication System (PECS) in smartphones**

Among the many types of AAC intervention, picture cards have been found to have the most empirical validation in it's effectiveness in increasing functional communication among non-verbal autistic persons. A significant body of research has also pointed out that the use of picture cards or graphic symbols in a training protocol called Picture Exchange Communication System (PECS) to be particularly successful in teaching functional communication to autistic children with limited or no functional verbal communication [2-5]. In PECS, autistic children learn to combine series of cardboard pictures to convey a message. These picture cards are made specific and personalized to each child for their use.

In a research project carried out by university researchers Dr. Gonyer Leroy and Dr. Gianluca De Leo, the PECS system was designed and developed to be used in smartphones. Citing the traditional low tech PECS to be cumbersome, time-consuming and inefficient, the researchers developed software that emulates the system of PECS that addresses the limitations of paper pictures. In their smartphone solution, the software system is able to first, allow the child to move the images around to form sentences simply by touching the mobile device screen as well as track the number of times each image is being used by the child to form messages. Second practical solution to enhance the PECS system is the ability to easily customize the images based on the needs, interests and preferences of each child as compared to the tediousness of creating personalized picture cards [6]. An example of the images on a mobile device screen in operational and display mode is shown in Fig. 1. An online report of this research project claims that "initial trials of the application involving children with moderate to severe autism have yielded encouraging feedback about its advantages over traditional laminated paper cards." [7].



**Figure 1a: Operational mode. Selection of image/images**



**Figure 1b: Display mode. Visualization of image or sentences**

Figure 1: PECS on smartphones (image taken from *Proceedings of the 7th international conference on Interaction design and children*, p.47)

### 3.2 Case Study 2: Mobile communication tools for children with special needs

Based on two major prior studies [8, 9], researchers Monibi and Hayes, using a mixed method approach, designed prototypes of Mocoto, mobile communication tools for children with special needs. They discovered, through interviews and observations, the need for extreme flexibility and customization in these visual communication tools. Recognizing children with special needs possessing only crude motor skills, they explored new technologies, such as the "capacitive screens on many small touch-screen devices" which could provide fresh path for interaction [10, p122].

Their first prototype Mocoto is operated on portable device, a Nokia N800 cell phone. The touch screen capabilities allow for easy interactions with a comprehensive library of cards which come preinstalled with the Mocoto. The system has the flexibility for users to add customized images such as digital photographs, scanned materials or created digital images. These images can be easily managed and categorized with the customizable meta-data for future searches [10].



Figure 2: Mocoto prototype on the Nokia N800 (image taken from *Proceedings of the 7th international conference on Interaction design and children*, p.124)

### 3.3 Case Study 3: iPod, therefore I can

Some researchers have addressed some of the limitations of high tech assistive devices or aided systems which are typically complex and costly by marrying these techniques with emerging technologies such as iPod and iPhone. Recent developments of applications have capitalized the potential of iPod and iPhone to support communication among autistic persons [11].

In a research carried out by Dr Genee Marks and Jay Milne in a special developmental school in Victoria, Australia, the use of iPod suggested improvement and progress in the participating students. The main aim of the study was to explore the educational potential of emerging technologies, particularly, the iPod. The majority of the participants of this study were located on the autistic spectrum. In this study, contents such as "photos for personal self-esteem and social cognition; movies featuring the student as social scripts to demonstrate and reinforce appropriate behaviours; the use of pictorial symbols for coin recognition, days of the week, and daily activities (such as timetabling); and pictorial symbols, photos and videos to improve cognitive skills, such as classifying and categorising" were placed in the devices to be used with/by students in the classroom under the supervision of teachers [12, p. 173].

The researchers cited an example during the experiment of how the iPod was used as an educational intervention tool effectively. Having struggled teaching a simple social skill such as proper procedure of washing hands to one particular child for years, the iPod was used as a teaching device in this experiment. Photographs of the child performing the process and procedures were captured and stored into the iPod with voice over to complement the same photos placed in a book and other places as visual cues. The child was found to be at ease using the iPod and it was not long he was washing his hands properly [12].

### 3.4 Case Study 4: AAC in the pocket

In other recent reports, applications such as iConverse (<http://www.converseapp.com/>); see Fig. 3 and Prologue2go (<http://www.proloquo2go.com/>); see Fig. 4, are showing favourable success in aiding persons with communication disabilities. These applications are specifically developed for persons with impairment in communication and language. It serves as an AAC in the pocket and had since gained popularity because of its flexible multimedia content and storage, portability, mobility and affordability. The touch screen interface makes it appealing and simple to use as well.

iConverse was specifically designed for young children especially those which communication difficulties and disabilities. In their website, creators of iConverse are optimistic that as an educational tool, it could assist in communication just as any high tech AAC but in a less bulky and inexpensive way. As you can see from Fig.3, there are 6 basic icons representing a person's most basic needs. These icons are activated when touched, giving both visual and auditory representation. Important features of iConverse is the My Buttons's features which includes: ability to make custom icons with pictures; add text to the pictures to enable text to audio; visual display of custom icons with scrolling ability; audible sentence stating the icon that was touched.



Figure 3: iConverse application on iPod or iPhone (images taken from <http://www.converseapp.com/>)

Another application that is gaining popularity is Prologue2go. Doctoral student Samuel Sennott stated that Prologue2go was created to provide a cheaper and easier way to convert text to speech. Though there is no empirical data to support its effectiveness, recent feedbacks from parents with autistic children are shouting its usefulness and practicality. One parent exclaimed that the application has changed her son's life. "He is actually communicating," she says. "It's nice to see what's going on in his head" [11]. The website also reported that "special educators, speech language pathologists, occupational therapists have found Proloquo2Go a proven communication solution for children and adults". Some of its key features are: full communication solution with a default VocaSpace vocabulary of over 7000 items; built-in natural sounding text-to-speech voices; supports picture and/or text-based communication; close to 8000 built-in symbols, automatic conjugation of verbs, automatic plurals and possessives for nouns; extensive customization options: item size, color, interactivity, restrictions, speech; one-button addition of new vocabulary items and categories; easy cut, copy and paste of items; quick access to recently spoken items for the last 15 minutes, last hour, all the way up to one week back; and typing view for typing full paragraphs.



Figure 4: Prologue2go – AAC in your pocket (images taken from <http://www.proloquo2go.com/>)

Though these reports and cases such as iConverse and Prologue2go cannot be generalized and taken as research evidence as you would with any control experiment, but it does give an early indication of the immense possibilities of where these emerging technologies could bring us.

#### 4 CONCLUSION AND FURTHER RESEARCH

The case studies and recent reports discussed in this paper have highlighted immense possibilities in advancing the full potential of AAC systems as well as assistive technology. It offers promising development as well as practical communication solution for autistic persons as well as for their families. The flexibility and the advanced capabilities of mobile technology are opening new opportunities for further research in the area of augmentative communication and as educational intervention for children with developmental disabilities.

However, development of new assistive technologies often presents with it copious number of challenges, what more when it involves a group of special children. There is obviously a dearth of research studies in this area. Issues such as assessment procedures, training of professionals and caregivers, parents' involvement, technological and pedagogical challenges, language and culture barriers for non native English speakers as well as state and educational policies are just a fraction of an array of challenges that needs to be addressed. Yet, having said that, there is no doubt that these emerging technologies has so far elevated and enhanced the quality of life for children with communication impairments and their families. Further empirical and well designed research would definitely carry this life-changing phenomenon to another step higher.



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