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PediApp Finder: Creating a Pediatric Application Database

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PediApp Finder: Creating a Pediatric Application Database for Occupational Therapists

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This project, written under the direction of the candidates' faculty advisor and approved by the chair of the Master's program, has been presented to and accepted by the Faculty of the Occupational Therapy department in partial fulfillment of the requirements for the degree of Master of Science in Occupational Therapy. The content, project, and research methodologies presented in this work represent the work of the candidates alone.

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Abstract

It is estimated that of the 85% of Americans that own cell phones, over half of these cell phone owners use apps on their phone (Fox & Duggan, 2012; Purcell, 2011). According to the U.S. Food and Drug Administration (2013), by 2015, 500 million mobile device users will be using mobile health, or "m-Health" apps. Healthcare professionals are increasingly adopting mobile technology as an innovative, cost-efficient, and timesaving tool that may promote patient wellness and disease prevention (Kumar, 2013; mHealth Bible, 2013). Although mobile technology is a natural fit to the field of occupational therapy, research demonstrates that few resources exist for finding apps for use in occupational therapy intervention with children (Hoesterey & Chappelle, 2012; Waite, 2012). The purpose of this project was to develop a free and open-source app that serves as a centralized database of apps beneficial to pediatric occupational therapy intervention. Dominican University of California Occupational Therapy graduate students partnered with Mr. Ruben Rivera of Northern New Mexico College (NNMC) in developing and implementing this project. As a result, an app titled PediApp Finder was created for mobile Android platforms and published on Google Play for free public download. The main goals of this project were to provide a resource tool for pediatric occupational therapists that would facilitate and streamline the process of searching for apps for use in pediatric intervention, as well as to provide a platform in which therapists can share the most up-to-date app technology in order to stay current and relevant in pediatric therapy. A pilot version of PediApp Finder was shared with four pediatric occupational therapists along with a Likert scale survey for evaluation of the app's content, function, and design. Results of this survey guided the final refinement phase of the PediApp Finder development process. PediApp Finder is now currently available for free public download on Google Play.

Introduction

Mobile phones and portable tablet devices are quickly becoming a mainstay in the healthcare environment. With the explosion of information and communication technology for mobile devices, practitioners and professionals in all healthcare fields are facing the fact that technology will continue to become an increasingly important healthcare tool for both professionals and clients.

The term "mobile-health (m-Health)" has emerged from the more general term "electronic health (e-Health)" to refer specifically to the use of mobile technology applications for health services (Lui, Zhu, Holroyd, & Seng, 2011). The U.S. Department of Health and Human Services defines "m-Health" as "the use of mobile and wireless devices to improve health outcomes, healthcare services and health research" (USDHHS, 2013). M-Health tools are used on mobile devices including smartphones, tablets and netbooks in the form of application software, or "apps" (Purcell, 2011). Although no definitive definition exists, "apps" are described as "software applications that are designed for a mobile device operating system and which extend that device's capabilities." They perform specialized tasks related to areas such as information access, communication, games, media, social networks, organization, and health resources (Purcell, 2011).

Since the introduction of Apple's iPhone in January 2007, apps on mobile devices have become an increasingly popular tool among the general public to access information (Purcell, 2011). In the United States, over 85% of adults use a cell phone, 53% of whom own a smartphone that supports apps (Fox & Duggan, 2012). According to a survey conducted by the Pew Research Center's Internet & American Life Project in 2011, over half of adult cell phone owners use apps on their phones (Purcell, 2011). Additionally, Fox and Duggan's 2011 Pew

Internet survey revealed that between 2010 and 2012, the use of mobile devices for health related purposes nearly doubled from 17% to 31% of cell phone users. Due to the convenient and low cost nature of mobile device phones and tablets, industry analysts estimate that by 2014, the Internet will be accessed more frequently on mobile devices than desktop computers (Buzhardt, Walker, Greenwood, & Heitzrnan-Powell, 2012).

Technology trends in U.S. healthcare settings reflect the technology trends of the general public. Healthcare professionals increasingly view m-Health as a cost-effective tool to maximize patient outreach while minimizing healthcare costs (mHealth Bible, 2013). According to the findings of the National Institute of Health m-Health Evidence Workshop in 2011, m-Health technology has the potential to monitor individual and population health, encourage healthy behaviors, support self-management of chronic diseases, provide data for healthcare providers, reduce the number of healthcare visits, and provide innovative and personalized health interventions (Kumar et al., 2013). Increasingly, healthcare professionals are seeking innovative, low cost, and time saving mobile device alternatives to traditional modes of service.

Within the field of occupational therapy, the use of mobile app technology is a natural fit due to the profession's long history of assistive technology expertise. For nearly a century, occupational therapists have used technology as a means of optimizing occupational performance (Smith, 2000). According to the American Occupational Therapy Association's (AOTA) Technology Knowledge and Skills Paper, "technology and environmental interventions can support people's participation in occupations which, by definition, hold purpose and meaning for them" (AOTA, 2010). Of all the practice areas, pediatric occupational therapy stands out as exceptionally well suited to utilize the benefits of mobile devices; children are now

growing up immersed in technology from the moment they are born and have been classified as a new generation of "digital natives" (Prensky, 2001).

Despite the natural fit of app technology within the pediatric occupational therapy domain, literature on the use of mobile apps in occupational therapy is strikingly absent when compared to other healthcare fields. As part of the initial research and needs assessment for this project, a survey was sent out to pediatric occupational therapists throughout the country. The aim of the survey was to gain insight into how frequently apps are used in the pediatric occupational therapy setting, what apps are being used, and in what areas (e.g. assessment, treatment planning, intervention, documentation, and scheduling). Survey results revealed that of the 95 respondents, 67.37% of therapists were using a mobile device in practice, and that 80.6% of those using a mobile device, use it for intervention. Despite the emerging use of apps in therapy, literature on apps and resources to find useful apps for occupational therapists are sparse. According to a 2012 *OT Practice* article, there are no universal guidelines to finding apps, and therapists find searching for apps to be overwhelming and tiring (Waite, 2012).

In order to stay current as a health profession and continue to provide motivating and relevant interventions to clients, the occupational therapy profession must embrace the use of mobile technology in practice. Based on the high percentage of respondents that are using apps in the pediatric setting compared to the absence of literature on the subject suggests a need for more resources for occupational therapists to access mobile apps as a tool for therapy. To address this situation, this project created an open-source database app, titled PediApp Finder, to be used as a reference tool for pediatric occupational therapists to search for and find apps for interventions. By providing a database to search for apps, the aim is to simplify the search for relevant apps and thus promote greater use of current technology in pediatric interventions.

Literature Review

Introduction

In this review of the literature, we will examine the use of m-Health app technology from three angles. The first section will review the current uses of apps in various healthcare settings, examining the trends of health-related app use among healthcare professionals, as well as among clients. The second section will focus on the use of apps in occupational therapy, specifically focusing on pediatric occupational therapy by presenting the benefits afforded to both the therapist and the child by the inclusion of mobile technologies in intervention. The third section will examine how mobile technology is particularly suited to children today, examining the accessibility, motivating elements, and learning elements afforded by mobile apps.

M-Health Apps for Health Professionals

This section will examine the use of m-Health apps in the healthcare industry. Mobile device apps in healthcare settings are increasing in popularity amongst health care staff because of the conveniences and multifunctional ability of m-Health apps. According to industry estimates, by 2015, 500 million mobile device users will be using m-Health apps and by 2018 over 50% of the already 3.4 billion mobile device users will have downloaded an m-Health app (U.S. Food and Drug Administration, 2013). Not only are apps popular, but software apps serving healthcare professionals are a vital component of evidence-based medicine (EBM) that can be used at the point of care (Mosa, Yoo, & Sheets, 2012). Healthcare professionals use mobile device m-Health apps for a multitude of reasons including diagnostic capabilities, advanced literature searches, drug references, and healthcare communication and promotion.

M-Health apps have the capability to aid in the advancement of optimal care by providing innovative diagnostic tools. Diagnostic tools are an important component in providing EBM.

Diagnostic apps are tools that give healthcare physicians access to information regarding infectious diseases, pathogens, diagnosis, treatment, medications, differential diagnosis and much more (Mosa, Yoo, & Sheets, 2012). Not only are diagnostic apps beneficial for access to pertinent information to conditions, but they also help physicians in the clinical decision-making process. According to Sarasohn-Kahn (2010) the reliance on disease diagnostic apps are vital to help clinicians identify appropriate laboratory tests based on symptoms by avoiding unnecessary tests that are very costly (as cited in Mosa, Yoo, & Sheets, 2012).

Literature search apps are another form of m-Health apps that serve as diagnostic tools. Literature search apps help healthcare professionals answer clinical questions and reference medical information through various databases such as PubMed/MEDLINE, Essie, and MDot (Mosa, Yoo, & Sheets, 2012). Additionally, drug reference m-Health apps aid in the treatment of consumers. Findings from Burdette, Herchline, and Oehler (2008) revealed drug reference apps are a crucial factor in delivering EBM because these apps aid in the decision-making process of drug dosage, drug-drug interactions, and drug indications.

The use of mobile devices for healthcare communication can be imperative for time-saving and life-saving circumstances. Voalte One, an m-Health app, combines phone calls, text messages, and alarm alerts in one device enabling easy access to all healthcare professionals, leaving less room for error (Mosa, Yoo, & Sheets, 2012). Health promotion via telemedicine and wireless monitoring of disease management and health outcomes allow healthcare professionals to monitor clients at all times to ensure optimal care (Blake, 2008). A new app developed by VitaLinkTM provides healthcare professionals information on the health status of their client via physiological behaviors. The client wears a non-invasive biosensor that collects multiple vital signs. The information is then sent through the wireless data network via a mobile device app to

a cloud-based analytic server. The cloud-based analytic server stores and categorizes client data for the healthcare professional; this feature enables real-time information on the client's status (Vgbio.com, 2012).

By providing versatile apps for diagnostic capabilities, advanced literature, drug references, and healthcare communication and promotion, healthcare professionals have the ability to technologically advance the medical industry. The convenience of having multifunctional apps available at the touch of a finger allows healthcare professionals to provide EBM, communicate efficiently amongst one another, and deliver optimal care to clients.

M-Health Apps for Clients

Mobile device apps in the healthcare industry not only benefit healthcare professionals, but the client as well. In the United States, client-oriented care is an increasing focus of healthcare, requiring patients to be advocates for their own healthcare needs and services. According to Mosa, Yoo, and Sheets (2012) if clients are more involved in the process of care via mobile devices, their overall health will greatly improve. Marshall, Mendvedev, and Antonv (2008) state that one of the most serious challenges in society today is how to support and manage lifestyle change and therapeutic programs for individuals with a chronic disease. Healthcare policy supports in-home self-management versus hospital settings because it is more effective clinically, economically, and socially (Marshall, Mendvedev, & Antonv, 2008). This section will discuss apps for medical programs, medication adherence, mobile home monitoring using m-Health apps via mobile devices, and the accessibility of mobile technology to clients.

Medical programs via mobile devices help clients self-manage their conditions. A pulmonary rehabilitation mobile device app was designed to target a specific exercise program for patients with chronic obstructive pulmonary disorder (COPD). This app serves as an

independently managed and participation tool to enable individuals to follow specific exercise regimes that are tailored to their specific needs (Marshall, Mendvedev, & Antonv, 2008). Other chronic illnesses such as diabetes can be monitored via m-Health apps, as well as provide feedback for symptom management. A study conducted by Charpentier et al. (2011) looked at the Diabeo System, a diabetic-based program. The program takes into account insulin dose based on carbohydrate intake, pre-meal blood levels, glucose, and reported physical activity. The Diabeo system automatically adjusts carbohydrate ratio and basal insulin to give immediate feedback to clients at the touch of their mobile device. The system also provides telemedicine communication, sending and storing all patient data to a medical staffing computer for future reference and follow-up. Overall, the Diabeo system helps improve metabolic control in patients with diabetes and reduces cost of care (Charpentier et al., 2011).

Medication adherence and compliance has become a barrier in the shift to home self-management versus hospital settings. Mobile device apps are helping to bridge this gap by providing phone reminders for taking medication and following home-based therapeutic programs. In a study conducted by Poropatich et al. (2010), a video cell phone reminder system was implemented to improve glycemic control in U.S. Army diabetic patients. Over a 12-week period, a control group and a group using the video cell reminder system were studied to see if blood glycemic levels could be adequately monitored by the system. The study revealed blood glucose levels were significantly lower in individuals who were not reminded to check their blood glucose levels versus those who were reminded (Poropatich et al., 2010).

Mobile and home monitoring systems via mobile apps are a newfound component of technology that could change the face of healthcare. As previously stated, VitaLinkTM helps physicians track the health status of chronically ill patients. The physician is able to monitor

physiological behavior through biosensors and cloud-based analytics from a smartphone. For patients, this monitoring device can help maintain independence, enable them to live at home, and allow them to enjoy activities of daily living (Vgbio.com, 2012). There are also a wide variety of wellness and fitness apps available that provide daily structure, testimonials, and inspiration for healthy living. Self-management is convenient and effective in improving client care. Client-oriented m-Health apps deliver healthcare services to clients that can aid in positive compliance, communication, management of chronic conditions, and health and wellness education.

Mobile device technology has crossed economic status lines in a way no other new technology has. The availability and convenience of mobile technology allows lower socioeconomic families to save money (Vaala, 2013). One device can serve as a primary phone, camera, Internet, and access to apps of all varieties and purposes. The use of mobile technology can overcome the challenges that larger technology like computers cannot (Jones, Scanlon & Clough, 2013). Consideration of accessibility and convenience may have significant implications to health professionals when considering intervention and education strategies for clients.

App Use in Occupational Therapy

Occupational therapy has a long history of expertise in the use of technology for therapeutic intervention (Aftel, Freeman, Lynn, & Mercer, 2011; Trefler, 1987). According to Trefler (1987), today's technology is far different from the technologies available in the beginning of the profession, but occupational therapy is still linked to the use of adaptive technologies in skilled intervention. Despite this fact, there has been little research published regarding general use of mobile apps in occupational therapy. Rather, publications have focused on specific apps and their uses in therapies.

Mobile apps are being used in a wide variety of healthcare settings and for a wide variety of purposes. Apps are used with populations ranging from older adults to young children. They are used as intervention tools, education aides, and in a plethora of different functions. In pediatric occupational therapy in particular, apps are becoming widely used in treatment. Although they are not being used solely for intervention in schools and special education intervention, their benefits are very well documented in this area (Aftel et al, 2011; Buzhardt, Walker, Greenwood, & Heitzrnan-Powell, 2012; Campigotto, McEwen, & Demmans Epp, 2013; Fernandez-Lopez, Rodriquez-Fortiz, Rodriquez-Almendros, & Martinez-Segura, 2013; Linder et al, 2013; Rickard, Smales, & Rickard, 2013).

The manner in which occupational therapists find apps for practice has not been widely researched, and information regarding these searching methods comes primarily from anecdotal evidence. In an interview of several occupational therapists, Waite (2012) found that therapists feel frustrated and overwhelmed when searching for apps to use in intervention. According to his 2012 *OT Practice* article, Waite stated that there are no universal guidelines to finding apps. AOTA has begun to create a list of apps based on practice area (AOTA, 2013). However, this list is not comprehensive, and many practitioners are not members of AOTA and therefore cannot access this resource. Google Play provides a store with a subsection for m-Health apps. After a search through this subsection, no apps were found that related directly to occupational therapy (Google Play, 2013). The Apple iStore has a specific sub-store for special education with apps that can help compensate for a variety of disabilities (iTunes, 2013). In 2013, Apple also created a healthcare professional sub-store and has begun to sort medical apps to categorize them according to usefulness and areas of practice (Jackson, 2013). However, occupational therapists

often seem to learn about apps by word of mouth from other therapists (Hoesterey & Chappelle, 2012).

As part of the initial research and needs assessment for this project, the authors distributed a web-based survey that was emailed to a diverse group of practicing pediatric occupational therapists. Of the 95 respondents, 67.37% of them are using a mobile device in their practice setting. This small sample of the pediatric occupational therapy field provides a glimpse into the already prevalent use of mobile devices and apps. The survey showed that the majority (80.6%) of apps are being used directly for intervention, while other apps serve multiple functions ranging from billing to research, as indicated by the respondents.

App Use in Pediatric Occupational Therapy

While mobile technology may be cumbersome and unfamiliar to older populations, it is particularly well suited to the younger populations seen in pediatric occupational therapy. Mobile technology offers many benefits to pediatric occupational therapists such as replacing multiple single-use therapy or assessment tools, being inexpensive and cost-efficient, and providing familiar tools for families to implement. These benefits serve both the therapist and client alike.

Combining devices and tools onto the same platform can reduce overall cost, space demand, and organizational demand on a therapist (Aftel et al., 2011; Linder et al., 2013). The digitization of ink and paper tools, the capacity to run multiple programs on the same device, and the ease of switching between functions and apps on one device all allow a single mobile device such as an iPad to replace multiple single-function tools. On one device the therapist can have access to metronomes, a video recorder, writing apps, assessments, and communication aides, to list a few (Aftel et. al., 2011). This is particularly of use to therapists who offer services outside a stationary clinic and would otherwise have to bring all the individual items to treatment sessions.

The computing and inter-device communication capabilities of mobile technology can also decreased delays in documentation and decrease errors in scoring and recording assessments. Therefore, mobile technology can be time-efficient, cost-efficient, and enable efficient communication amongst therapy team members (Buzhardt, et. al., 2012; Linder et al., 2013; Rickard et al., 2013).

Because mobile devices are available commercially in many different stores, obtaining mobile device apps is easy for occupational therapists that wish to incorporate apps into practice (Fernandez-Lopez et al., 2013). Thousands of educational apps designed for children are available for free or at a minimal cost (iTunes, 2013; Google Play, 2013). The broad commercial success and variety of mobile technology suggests that apps are becoming widespread and will be a mainstay in our society (Chiong & Schuler, 2010; Buzhardt, et. al., 2012).

Familiarity of parents and children with mobile technology facilitates greater ease of introducing pediatric clients to therapeutic apps. This familiarity with mobile technology may enable therapists to spend more time on intervention as opposed to instruction on device use (Chiong & Schuler, 2010). Because many parents are familiar with mobile technology and apps, it is easier for therapists to include them in the decision-making and therapy implementation processes (Buzhardt, et. al., 2012; Fernandez-Lopez et al., 2013). A major benefit of empowering parents of children in therapy is that they can continue the therapy process outside of the treatment session. The ability for mobile technology to be set up by occupational therapists ahead of time compiled with the familiarity with the device technology by the clients and the parents allows for greater self-education and self-pacing on the part of the clients and parents, which may reduce the demand on both therapists and families. This enables therapists to affect greater results with less work (Hoesterey & Chappelle, 2012).

There are clear benefits afforded to children when apps are incorporated into therapy. The mobile devices themselves come with qualities that make them amenable to a therapy setting. Some of these built-in functions include pinch control zoom, text-to-speech, font and contrast settings, which can all help children with visual deficits. Mobile devices also offer speech to text and modifiable interface controls that make using the devices much easier for children with limited motor control. These functions make the devices very customizable to accommodate different disabilities and levels of capability. This means they can be tailored to the individual needs of the user (Fernandez-Lopez et al., 2013; Hoesterey & Chappelle, 2012; Linder et al., 2013). In addition to providing accommodations for the user, these functions allow therapists to grade activities to provide a better fit quickly and with minimal time and effort (Buzhardt, et. al., 2012; Fernandez-Lopez et al., 2013).

Beyond the adaptability of the mobile devices themselves, many of the apps used in pediatric occupational therapy provide benefits to both therapists and clients. Some of these apps are made specifically for therapeutic purposes, such as Proloquo2Go. Likewise, apps such as iLoveFireworks, which are intended for entertainment, naturally have properties that lend themselves to intervention (Hoesterey & Chappelle, 2012). Proloquo2Go is an augmentative alternative communication app that facilitates communication for children with communication or language challenges. This tool enables easier communication, which can lessen frustration and thereby decrease maladaptive behaviors (Aftel et al, 2011; Fernandez-Lopez et al., 2013; Hoesterey & Chappelle, 2012). This program can lessen the need for a caretaker or translator, which can enable the user to live a more independent life. Kids' Yoga Journey and MeMoves are apps that encourage bilateral coordination and gross motor control. Kids' Yoga Journey also serves as a self-regulation tool to guide a child to a calmer level of arousal (Hoesterey &

Chappelle, 2012). These apps also have the added benefit of encouraging actual movement, not just screen interaction.

Other apps used in occupational therapy were not initially created for therapeutic purposes but lend themselves to pediatric interventions. iLoveFireworks displays and plays the sound of fireworks on the screen of a mobile device when the screen is touched and can be used to practice pointing skills and explore personal agency. The vibrant colors and sounds are rewarding, which helps children of all ages, particularly those with low cognitive abilities, maintain attention while recognizing themselves as the agent of change (iTunes, 2013). It also allows the therapist to observe fine motor skills and lends itself to home program assignments (Hoesterey & Chappelle, 2012). Another app not specifically created for therapeutic use but that lends itself to intervention is Toca Tea Party. This interactive app encourages social skills such as turn-taking, cooperation, and group communications, which are vital skills frequently addressed in occupational therapy settings (Hoesterey & Chappelle, 2012). Similarly, Tie Dye Doodle is a simple game where a child can create personalized digital cloths by tying them and then dipping the cloths in different dyes. The game can be useful when teaching sequencing and it encourages creativity (Hoesterey & Chappelle, 2012).

Mobile Technology and Children

In the past decade, the use of mobile technology by children has increased exponentially. Children have begun to spend as much time looking at screens as they do hours in school (Chiong & Shuler, 2010). Currently, almost three quarters of families in the United States who have young children have a mobile device in their home (Gutnick, Kotler, Robb, & Takeuchi, 2010). A recent study by the Nielsen Company found that preschoolers spend an average of four hours a day using media (as cited in Chiong & Shuler, 2010). This section will discuss the

accessibility of mobile technology for children, why these devices are inherently motivating, how mobile technology encourages learning through games, and address possible concerns about mobile technology use among children.

The accessibility of technology and media has created new trends for how mobile devices are used with children. One of the largest areas of related research has explored how children spend their time using mobile technology. Recently, researchers have seen a trend called the "pass-back effect." This describes the trend of parents passing their mobile device to their child to keep them entertained and contributes to the increasing use and familiarity of young children with mobile technology (Chiong & Shuler, 2010). While these sessions are often short, children use the mobile technology in a variety of ways during this period of time. Children often use apps to take pictures, watch videos, play games or go on the Internet. Parents who report allowing their child to use their mobile device report doing so least a few times a week. The usability study in Chiong and Shuler states that 60% of these children use their time on mobile technology to play games.

Another added benefit of using apps on mobile devices is that they are inherently motivating to young people (Campigotto, 2013; Chiong & Schuler, 2010; Fernandez-Lopez et al., 2013; Linder et al., 2013; Neely, et. al., 2013). Neely et al. (2013) observed increased academic engagement and decreased challenging behaviors when using iPad-mediated instruction as compared with using traditional materials with young children with Autism Spectrum Disorder. Neely et al. suggested that using mobile technology may be inherently motivating because of a history of reinforcement with mobile technology from parents. Most children see apps as fun and "cool" new technology that heightens external motivation. Social interaction on mobile devices provides another form of external motivation for youth by providing them the opportunity to

collaborate with groups of peers (Jones, Scanlon & Clough, 2013). Mobile technology can enable a personalized learning environment for children and can be adapted to fit each person's unique challenges. Most children do not need help navigating mobile technology, which facilitates self-confidence and a feeling of independence (Chiong & Shuler, 2010). Because mobile technology has been shown to be an engaging and motivating medium, it can also be an effective tool for teaching children.

Research indicates that apps can make learning more effective for children. Mobile technology is directly beneficial to the child in that it can offer immediate feedback on performance with or without an occupational therapist present. This reinforces the learning process and can at time make it more effective (Hoesterey & Chappelle, 2012). The use of apps also allow for informal learning. Informal learning occurs in an unstructured environment, is voluntary, and is led by the learner. Informal learning allows children to set their own goals while using mobile apps (Jones, et. al., 2013). An example of this is allowing children to play game apps or by using mobile technology as a medium for exploration. Research has indicated that greater control a child perceives as having over a mobile technology or game correlates with higher intrinsic motivation. This type of learning can occur at any place and any time due to its unstructured nature. The portability and inter-device communication capabilities of mobile technology also encourages peer-to-peer learning in group settings as one child can easily roam about a room to help or seek help from peers as they collectively navigate an app or prepared instructional materials (Campigotto et al, 2013; Chiong & Schuler, 2010; Fernandez-Lopez et al., 2013). This mobility enables the learning tools to be taken with the child into many different settings and used at almost any point in time (Chiong & Schuler, 2010; Fernandez-Lopez et al.,

2013). This learning structure contributes to the children's perception of apps as unstructured fun and encourages high levels of engagement (Jones, Scanlon & Clough, 2013).

Because use of mobile technology is becoming a social norm, enabling its use for individuals who might otherwise have difficulty or lack access to mobile devices can lead to lessened feelings of isolation, and thus enabling greater social participation. This is particularly true as social media becomes more and more prevalent (Buzhardt, et. al., 2012; Chiong and Schuler, 2010). Today, it is commonplace to see youth using mobile devices in public. This means that a child using a mobile device as assistive technology can blend in and not attract special attention. Not having to use specialized equipment can empower users to use the technology more discretely and with less fear of stigmatization (Campigotto et al, 2013).

Mobile technology does present some disadvantages for children. Dangerous behaviors on phones have the potential to go unregulated by adults. For instance, unless a child's time on the device is being regulated, children can access dangerous and inappropriate information. They can also go on sites that might put them at risk of being taken advantage of by others. With increased time spent on mobile devices by children, there is a growing awareness of children's need for physical activity. Studies have linked increased television, video games, and mobile device use to increasing risk for childhood obesity (Vandewate, Shim, & Caplovitz, 2004; Lajunen, Kaprio, Keski-Rahkonen, Pulkkinen, Rose, & Rissanen, 2007). The American Academy of Pediatrics (AAP) now recommends that television and mobile technology should be avoided for infants and children under the age of two (American Academy of Pediatrics, 2013). Mobile technology in general comes with an added challenge of having poor data privacy. It can be easy for others to hack into mobile devices and gain access to personal information (Koehler,Vujovic, & McMenamin, 2013). Additionally, many teachers still do not see mobile

technology as a beneficial learning platform. To date, there is currently no accepted 'mobile theory of learning' (Chiong & Shuler, 2010).

Problem Statement

There is a striking absence of literature and resources regarding apps for occupational therapy use. For pediatric occupational therapists interested in finding apps for use in intervention, there is a lack of a central database that has a consolidated list of apps for therapeutic use. Based on results from our needs assessment survey of 95 pediatric occupational therapists, 67.37% used mobile devices in their clinical setting. Based upon additional results from the needs assessment survey, we also know that there are a wide variety of apps used in the pediatric occupational therapy settings; however, a major barrier to finding and utilizing these apps may be the difficulty and time-consuming process of finding them.

The purpose of this project was to develop a centralized database of apps beneficial to the pediatric occupational therapy setting. The aim of this project was to facilitate the ease of access to apps, thereby promoting their use in practice. Upon completion and publication of the pediatric app database, titled PediApp Finder, a field test was conducted with four pediatric occupational therapists. The field test was used to gain feedback from the occupational therapists using our PediApp database app to gain feedback on the app's content, function, and design and verify its efficacy for use in practice. Next, the therapists originally surveyed for the needs assessment were invited to download the app for free on Google Play, along with an invitation to rate the app on Google Play. Additionally, Google Play offers a feature to track the number of downloads to generate data on the number of people that download the PediApp Finder app. The goal was for this app database to fulfill the needs of pediatric occupational therapist and facilitate point of care interventions with ease of access and enjoyment.

Theoretical Framework: Expectancy Theory

The goal of this project is to facilitate the ease of access to therapeutically beneficial apps and thus promote their use in occupational therapy. We are seeking to motivate therapists to alter their behavior to include or increase their utilization of apps in their practice. As a theory of motivation, the Expectancy theory provides an understanding of motivation and allows us to see where we can be most effective in attaining our goal of motivating or promoting app use in pediatric occupational therapy. Based on this theory, we believe that creating an app database will be an effective way to promote app use in pediatric occupational therapy.

Expectancy theory holds that the motivation to engage in an activity is determined by the influence of three beliefs, including expectancy, instrumentality, and valence (Scholl, 2002). This theory explains the relationship between motivation and expectancy, instrumentality, and valence.

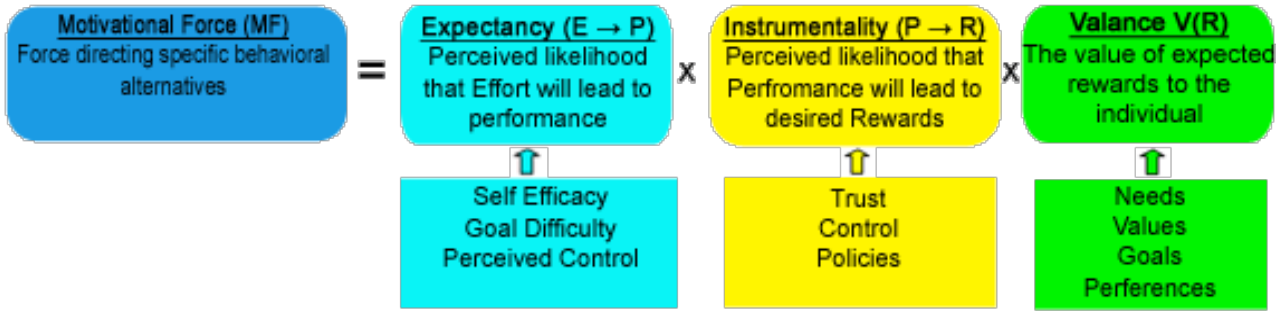

Figure 1. Expectancy theory diagram (Scholl, 2002)

As illustrated in the above figure, *expectancy* is the perceived likelihood that the effort of engaging in a task will result in the performance or accomplishment of a goal (Vroom, 1995). According to the theory, this perception is built on a sense of self-efficacy, perceived goal difficulty, and perceived level of control over the performance (Scholl, 2002). Self-efficacy is defined as the sense of capability to perform the task successfully (Scholl, 2002). This belief may

be based on a number of factors including previous experience, observing others, or a belief that the person has sufficient skill to perform the task. The greater a person's sense of self-efficacy, the greater their level of expectancy is. When self-efficacy is perceived to be low, expectancy will be low as well. Perceived goal difficulty refers to the assessment of the achievability of adequately performing the task or goal (Scholl, 2002). Goals that are perceived to be easily achieved lead to high expectancy, while goals that seem unattainable will lead to no expectancy. Perceived control is the sense that the individual can control the performance of the task (Scholl, 2002). Where no control is perceived, expectancy is low. Where control is perceived to be high, expectancy is higher. These three aspects of expectancy interact to produce the expectancy belief. As such, any of the three can be manipulated to increase or decrease motivation. When explained as an equation, the value of a person's task expectancy can range from zero, or no expectancy, to one, complete confidence (Behling & Starke, 1973).

Instrumentality refers to the perception that performing the task will result in a desired reward (Vroom, 1995). Instrumentality is impacted by an individual's level of trust in those in authority (Scholl, 2002). When an individual trusts that those in authority will reward performance of a task, instrumentality will increase. When a person has authority or influence, his sense of control will impact instrumentality (Scholl, 2002). A person who feels he or she can control whether or not rewards are received for performance will have a high sense of instrumentality (Scholl, 2002). Instrumentality can range from negative one, where the performed behavior would prevent the outcome, to one, full confidence in causality of performance toward the reward (Vroom, 1995).

The third factor influencing motivation is *valence* (Vroom, 1995). Valence is the value placed on the reward that will be received if the task is performed (Vroom, 1995). The more

value that is assigned to the reward for performance, the greater the valence will be. Like expectancy and instrumentality, valence is a function of subcomponents. When a reward fulfills an individual need, the reward is appraised as valuable, in proportion to the need it fulfills (Scholl, 2002). If the need is minor, the value will be minor. If it is great, the value will be high. The second subcomponent of valence is the individual's set of values. The strength of the individual's personal values associated with the reward positively correlates with the assessed value of the reward (Scholl, 2002).

The three components of motivation interact *multiplicatively* (Vroom, 1995). This means if there is no (zero) expectancy of adequate task performance, there will be no motivation to engage in the task regardless of instrumentality in the reward process, or outcome valence. The same is true of the other components as well. Less drastically, a low valence of a reward will diminish the motivation for performance, despite high expectancy and high instrumentality. To have high motivation, all three components must be high and solve to a positive value. With respect to a numerical valuation of motivation, the determinant of whether or not to attempt to perform is always a comparison between two or more choices (Behling & Starke, 1973). When considering options, a person weighs the total motivation for differing behaviors and elects to do the more motivating one. This may be a choice between different methods of obtaining the same objective, or a choice between attempting or not attempting to perform a behavior (Behling & Starke, 1973).

The proposed app for this project, PediApp Finder, is intended to make the choice to search for apps more favorable than not searching for them, providing our app database acts on the expectancy of finding beneficial apps for intervention. By creating a database of apps that can be beneficial for therapeutic use, we will change the assessed goal difficulty of finding these

apps. Having many rewarding and valuable apps in one easily accessible database will reduce the amount of effort required to achieve the goal of finding useful apps. It will also reduce the searching skills needed to determine which apps may be appropriate for intervention. By reducing the skill demand, the sense of self-efficacy for the search will increase, thereby increasing motivation to attempt it. Decreasing the perceived goal difficulty and increasing the sense of self-efficacy will increase the expectancy for searching for apps. By increasing an individual's level of expectancy of finding an app, we will increase that person's motivation to engage in the task of finding apps. It is also hoped that, beyond increasing expectancy, increased access to valuable apps via the database will increase the valence placed on therapeutic apps due to the many benefits enumerated above.

Methodology

Design and Target Population

The purpose of this project was to create a mobile app that can be used by pediatric occupational therapists as a resource to find apps for use in intervention. PediApp Finder is an open-source, dynamic, database-driven app that aims to assist therapists search for and filter through pediatric apps. The design is a dropdown menu that is searchable by a selected intervention focus. PediApp Finder is open-source, thus allowing therapists using the app to upload to the database new apps that they are using in order to keep the database current and comprehensive.

Although there are many sources for finding apps to use in practice, they are scattered and time consuming to find. The American Occupational Therapy Association (AOTA) has been compiling a list of apps for various practice settings, published on their website (AOTA, 2013). Under the "Children and Youth" section, apps are listed based on intervention focus. These include "General Health Apps," "General Apps for Practitioners," " Accessibility," "Behavior and Time Management," "Handwriting and Fine Motor," "Communication," "Independence and Transitions," "Music and Sounds," "Puzzles and Games," "Productivity," "Professional Development," and "Sensory Apps" (AOTA, 2013). While a useful list, many occupational therapists are not members of AOTA and thus do not have access to this list. This list is also not comprehensive of all apps currently in use by pediatric occupational therapists. Additionally, the 2012 OT Practice article revealed that searching for apps can be overwhelming, tiring, and a drain on time for therapists (Waite, 2012).

A free and open-source app that may be used to search for apps to use in intervention or to recommend to parents may be an effective and valuable resource tool for pediatric

occupational therapists. Many occupational therapists have incorporated apps into practice for skill development in various areas (AOTA, 2013; Waite, 2012). In addition to using apps in intervention, apps may be a useful tool for home programs, as they are easy to implement and are motivating to most children. Because at least 56% of American adults now own a smartphone, apps can be recommended to parents to reinforce skills or for use in a home program (Pew Internet, 2013). A database design guided this project in develop an app that is simple, user-friendly, and time-efficient tool for therapists to meet the growing demand for incorporating mobile technology into practice.

This project specifically targeted pediatric occupational therapists as the primary users for our app. Pediatric occupational therapists were selected based upon the increasing familiarity of children with mobile technology. Children are now described as "digital natives," referring to the phenomenon of growing up using mobile technology from an early age (Prensky, 2001). Thus, as technology is an integral part of most children's lives, occupational therapists are increasingly using technology as a motivating and innovative method to teach and reinforce new skills in therapy. Based on the fact that mobile technology may be uniquely suited to the youth population, this project determined that an app designed as a tool for pediatric occupational therapists would be most appropriate.

Project Development

An online survey was sent out to a listserv of pediatric occupational therapists throughout the United States. The survey served as the initial needs assessment concerning app use in pediatric occupational therapy. The data obtained from this needs assessment guided the design of the app to be created for this project (see Appendix A). Based on the 95 respondents, it was determined that the greatest need in mobile technology for pediatric occupational therapists was

the need for a comprehensive database or resource to find pediatric apps for use in intervention. Therefore, the design for PediApp Finder was based on facilitating the search for apps based on intervention category.

The first step in developing the app was to compile and categorize a list of all apps relevant to the field of pediatric occupational therapy. To begin gathering apps for the PediApp Finder database, an excel spreadsheet was created to sort, categorize, and provide links to all relevant apps to be added to the database (see Appendix B). The apps added to the database were categorized according to intervention categories which are as follows: *Auditory Processing, Cognitive Skills, Learning Support, Fine Motor, Gross Motor, Handwriting Support, Reading Support, Number/Counting Support, Motor Planning and Coordination, Bilateral Skills, Music, Nutrition, Oral-Motor, Sensory Processing, Social-Emotional Skills, Communication, Time Management and Organization, Visual Processing, Autism,* and *Therapist Tools*. The excel database includes 6 categories for data entry: 1) the app name, 2) app platform (iOS/Android), 3) price of app, 4) description of app, 5) intervention category, and 6) the hyperlink to the iTunes or Google Play store. The apps were gathered from technology and education websites, feedback from the survey, blogs, the AOTA website, and pediatric occupational therapists. To date, the database has 312 apps with all data entry categories completed. It is expected that this list will grow as users upload new apps to the PediApp Finder open-source database.

Upon completion of the preliminary app database, the design process began. Three basic components guided the PediApp Finder design and building process: the app interface design, the need for unlimited data storage, and the ability to track analytics to assess the number of users using the app. An easy to use interface and an unlimited amount of data storage are necessary for an open-source design. Since the hope is that therapists will continue to add new

apps as they become available, a limited amount of data storage would limit the overall functionality of the app. Additionally, in order to evaluate the usability of the app, it was important to have an analytics component to analyze how many people use the app. The Google Play developer console provides user statistics that this project will use to track the number of people that download PediApp Finder on Google Play. Having a method to analyze how many consumers are using the app will provide data to analyze the usefulness of this tool.

To address the design of the app interface, an interface storyboard was created, outlining the visual components and functionality of each app page. The storyboard included the design of the opening page, the search page, the search results list page, the full app description page, and the "add an app" page. The storyboard for each page included the page layout, font, and color as it would appear on the mobile device screen. Additionally, the storyboard outlined the functionality of each clickable component on each page.

When opening PediApp Finder, the opening screen (see Appendix D, Fig. 1) displays the PediApp Finder cube icon above the name while the app is initializing. The search page (see Appendix D, Fig. 2) automatically opens after the app initializes. This page allows users to specify the intervention category they are looking for by searching from a drop-down menu of categories. This drop-down menu allows users to sort through the categories of apps and search for apps that they can use for a specific intervention (i.e. fine motor skills, social-emotional skills, etc.). They may also search by "keyword" for a more specific search. This search page provides options for users to refine their search by platform (Apple or Android device), as well as sorts the search by different options including price, date added, rating and number of views. This feature allows users to further narrow the intervention category search. Once users select their search criteria, users are redirected to a new page (see Appendix D, Fig. 3) with a populated list of all

the apps in the database that meet their search criteria. Each app in this list view displays the app name, user rating, price by operating system, and intervention category. An individual app from the list may be selected by tapping the app's name. This opens the full description page (see Appendix D, Fig. 4), which details the app price, description, rating, and provides a link to the app in the iTunes or Google Play store for download. Lastly, users can add new apps not already on the database by opening the "Add an App" page (see Appendix D, Fig. 5), which provides a data entry form for entering the information of a new app.

The next step in the development of the project was to research the best method for programming the app. Because this team has limited app programming experience, the programming options were limited to three methods: using a pre-made online template, using a "no-code" app development website, or consulting and hiring an app programmer. Using a template to create a database app would limit the amount of buttons permitted on the screen and limit the amount of data that could be stored in the app. Several "no-code" app development websites were experimented with, but were determined to be beyond the scope of this project. Therefore, it was determined that consulting with an app programmer would allow PediApp Finder to be fully customized, open-source, and unlimited in data storage capacity.

Ultimately, this team recruited Mr. Ruben Rivera, a volunteer programing consultant from Northern New Mexico College to assist in the final step of programming the app. Upon first consultation, we provided Mr. Rivera with the interface storyboard and the specifications to be an open-source design. Based on Mr. Rivera's experience programming apps for Android devices, it was determined that the app would first be programmed to be compatible with Android rather than iOS devices. Mr. Rivera provided three working drafts of PediApp Finder, each draft edited to reflect feedback on the previous draft. As part of the open-source design, a

Google account was created for PediApp Finder. As a new app is added to the database, an e-mail is sent to the PediApp Finder administrative account for verification purposes before it is permanently added to the database.

The goal of creating a pediatric occupational therapy app is to provide a streamlined intervention tool for occupational therapists that want to use the most current technology in their intervention with children. In designing the app, we hope to provide a large database of relevant pediatric apps with easy-to-use features in a reliable tool to be utilized in interventions. With this tool, occupational therapists will have a readily available database to use in searching for intervention tools based on the needs of each individual child.

Project Implementation

Building PediApp Finder consisted of four rounds of pilot testing and refinement by the app-building team and the app programmer. Once a working version of the app was completed to the satisfaction of the team, a preliminary pilot version of the app was sent to three pediatric occupational therapists for feedback. The occupational therapists completed the PediApp Finder Evaluation Survey (see Appendix C) to provide feedback on PediApp Finder's functionality, design, and suggestions for further refinement. Based on their feedback, the app team continued to fine-tune the app's features and design interface. Upon completion of the final updates and modifications, PediApp Finder was published on Google Play for free public download. An invitation was also sent to all therapists originally surveyed for this project's needs assessment to view and download PediApp Finder in order to encourage a greater number of therapists to download this free tool.

Project Evaluation Plan

An app evaluation survey (see Appendix C) was created to analyze the app's content, ease of use, and satisfaction among pediatric occupational therapists. A Likert Scale format was used to rate each category from 1, "strongly disagree" to 5, "strongly agree". The survey included an area at the bottom for occupational therapists to provide feedback, suggestions, and any other comments. This evaluation was completed by four pediatric occupational therapists that sampled the pilot PediApp Finder version. The four occupational therapists included: Julia Wilbarger, PhD, OTR/L, Joanne Figone, OTR/L, Melisa Kaye, OTR/L, and Wendy Frame, OTR/L. This preliminary pilot evaluation was used to ensure the app's usability as well as for the development team to make any modifications before distributing the app.

After adjusting the pilot version of PediApp Finder based on preliminary feedback, an announcement was sent out to the participants of our initial needs assessment survey. These therapists were invited to download PediApp Finder for free on Google Play and were encouraged to rate and review the app on Google Play in order to identify if PediApp Finder met the needs of the initial target group. Google Play also offers an analytics feature which enables us to track the number of downloads of PediApp Finder. This will provide feedback in the form of numbers in order to track the popularity of the app. The more occupational therapists utilizing PediApp, the more we feel the app is meeting the needs of the pediatric occupational therapy population.

Ethical considerations

The authors feel that two ethical considerations surrounding the PediApp Finder project must be addressed. The first is ensuring the intellectual and property rights of the owners of the apps included in the database. The PediApp Finder app is intended to function as a directory

database. It is important to protect the intellectual property of the owners of the various apps included in the database. There will be no sales through PediApp Finder; therefore, no profit can be gained from producing it. Users will be directed to the proper place to purchase or download the apps listed in PediApp Finder.

The second consideration is the overuse of apps in therapy. The PediApp Finder is intended to be a resource that harnesses the community of knowledge in the pediatric occupational therapy field. By making the app-finding process easier for therapists, we hope to increase the availability of therapeutically beneficial apps that can facilitate sound, effective therapy sessions. Used appropriately, apps can be effective and innovative tools for therapy. However, app use in therapy or as recommendations to parents should be used prudently. App use should be adjunctive to therapy when and where there is a therapeutic benefit.

The danger posed by integrating apps into therapy is in over-using them. No skilled occupational therapist should use apps as their only means of intervention. Apps can be useful adjunctive therapies but cannot and should not replace other therapies. Apps can be used as a bridge to develop a therapeutic relationship. They should never replace the relationship between a client and the therapist. When apps are used in home programs, a similar danger is present. The danger in this situation is that parents may come to depend on mobile technologies in place of a more actively engaged parental role. Again, apps can serve as beneficial tools, but can never replace parent-child interaction. Neither can they substitute for true play, which is a primary occupation for a developing child.

Discussion, Summary, and Recommendations

Mobile apps have become an increasingly popular and ubiquitous tool among the general public. With over 53% of the adult population in the United States now owning a smartphone, mobile apps are quickly becoming a principal method for communicating, socializing, entertainment, and accessing information (Fox & Duggan, 2012). These trends are reflected in healthcare trends, as mobile health apps are increasingly viewed as cost-effective and efficient tools to maximize health care outcomes. Within the field of occupational therapy, the use of mobile apps as assistive technology is a natural fit in supporting participation in occupations, particularly in the pediatric field, as children are now growing up with technology at their fingertips.

However, the occupational therapy profession as a whole has been slower to embrace this new technology when compared to other medical fields. Mobile technology use in treatment raises concerns that therapists may inappropriately rely on apps as their primary tool for intervention. Additionally, the American Academy of Pediatrics (AAP) now recommends that television and mobile technology should be avoided for infants and children under the age of two (American Academy of Pediatrics, 2013). However, with conscientious application, mobile technology has the potential to be an exciting, motivating, and powerful tool for intervention with children.

The purpose of this project was to develop an app to be used as a resource for pediatric occupational therapists. Based on this project's needs assessment survey of pediatric therapists as well as anecdotal publications about apps in occupational therapy, many therapists are now using apps in practice. However, searching for appropriate apps can be tedious and time-consuming, as there are no comprehensive lists or databases of apps that are appropriate for occupational

therapy intervention (Waites, 2008). By developing a free and open-source app that offers a searchable database of apps for therapy with children, we endeavor to reduce the time-consuming search for apps and provide an easy-to-use, efficient resource for pediatric therapists. With thoughtful and appropriate use of mobile technology, occupational therapy may stay current in the increasingly digital healthcare field, and continue to provide relevant and motivating therapy approaches to children and parents.

There were two primary factors limiting the scope of this project. Time constraints limited the extensiveness of the app database. The aim was to create and categorize a comprehensive database of current pediatric apps. However, due to the enormous number of apps available, as well as the ever-changing nature of new technology, compiling a complete and comprehensive list of pediatric apps was beyond the scope of this project. By designing PediApp Finder as open-source, the hope is that therapists will embrace this app as a knowledge-sharing platform and will continue to add more apps in order to make the database more comprehensive. Additionally, due to the programming expertise of our app programmer, Mr. Ruben Rivera, PediApp Finder was programmed for the Android platform only. However, based on the needs assessment survey and word of mouth, most pediatric occupational therapists utilize Apple/iOS mobile device platforms, which limits the number of therapists who can utilize PediApp Finder. Going forward, it would be beneficial to program PediApp Finder to be compatible with both Android and Apple platforms in order to fully realize the goal of offering a comprehensive, centralized tool for all pediatric occupational therapists.

References

Apple. (2013). *Where can I buy Apple products*. Retrieved October 15, 2013, from http://www.apple.com/buy/

Aftel, L., Freeman, M., Lynn, J., & Mercer, W. (2011). App support: Mobile software applications for individuals with cognitive and behavioral challenges. *OT Practice, 16*(11), 8-12.

American Academy of Pediatrics (2013*). Children and media*. Retrieved from http://www.aap.org

American Occupational Therapy Association. (2013). Apps for occupational therapy: Find apps for your practice area. Retrieved on October 14, 2014 from http://www.aota.org/practice/manage/apps.aspx#sthash.ajenU6p5.dpuf

American Occupational Therapy Association. (2010). Specialized knowledge and skills in technology and environmental interventions for occupational therapy practice. *American Journal of Occupational Therapy, 64*, S44-S56.

Behling, O., & Starke, F. (1973). The postulates of expectancy theory. *Academy of Management Journal,* 16(3), 373-388. http://dx.doi.org/10.2307/254999

Blake, H. (2008). Innovation in practice: Mobile phone technology in patient care. *British Journal of Community Nursing, 13*(4), 160-165.

Buzhardt, J., Walker, D., Greenwood, C. R., & Heitzrnan-Powell, L. (2012). Using technology to support progress monitoring and data-based intervention decision making in early childhood: Is there an app for that? *Focus on Exceptional Children, 44*(8), 1-18.

Campigotto, R., McEwen, R., & Demmans Epp, C. (2013). Especially social: Exploring the use of an iOS application in special needs classrooms. *Computers & Education, 60*(1), 74-86. doi:http://dx.doi.org.ezproxy.dominican.edu/10.1016/j.compedu.2012.08.002

Charpentier, G., Benhamou, P., Dardari, D., Clergeot, A., Franc, S., Schaepelynck-Belicar, P., & Farret, A. (2011). The diabeo software enabling individualized insulin dose adjustments combined with telemedicine support improves HbA1c in poorly controlled type 1 diabetic patients A 6-month, randomized, open-label, parallel-group, multicenter trial (TeleDiab 1 study). *Diabetes Care, 34*(3), 533-539.

Chiong, C., & Shuler, C. (2010). *Learning: Is there an app for that? Investigations of young children's usage and learning with mobile devices and apps.* New York*:* The Joan Ganz Cooney Center at Sesame Workshop.

Fernández-López, Á., Rodríguez-Fórtiz, M. J., Rodríguez-Almendros, M. L., & Martínez-Segura, M. J. (2013). Mobile learning technology based on iOS devices to support students with special education needs. *Computers & Education, 61*, 77-90. doi:10.1016/j.compedu.2012.09.014

Fox, S., & Duggan, M. (2012, November 8). Mobile health 2012. *Pew Research Center's Internet & American Life Project.* Retrieved from http://www.pewinternet.org/Reports/2012/Mobile-Health.aspx

Google Play (2013). *Google play: Apps*. Retrieved September 15, 2013 from https://play.google.com/store/apps

Gutnick, A. L., Robb, M., Takeuchi, L., & Kotler, J. (2010). *Always connected: The new digital media habits of young children*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Hoesterey, C., & Chappelle, C. (2012). Touch the future: Using iPads as a therapeutic tool. *OT Practice, 17*(13), 7-9.

iTunes (2013). *App store*. apple.com. Retrieved October 7, 2013, from https://itunes.apple.com

Jackson, S. (2011, September 16). *Apple now sifts through health apps for docs.* Retrieved October 9, 2013, from http://www.fiercemobilehealthcare.com/story/

Jones, A., Scanlon, E., & Clough, G. (2013). Mobile learning: two case studies of supporting inquiry learning in informal and semiformal settings. *Computers & Education*, *61*, 21–32.

Koehler, N., Vujovic, O., & McMenamin, C. (2013). Healthcare professionals' use of mobile phones and the internet in clinical practice. *Journal of Mobile Technology in Medicine, 2*(1S), 3-13.

Kumar, S., Nilsen, W. J., Abernethy, A., Atienza, A., Patrick, K., Pavel, M., & Swendeman, D. (2013). Mobile health technology evaluation: The mHealth evidence workshop. *American Journal of Preventive Medicine, 45*(2), 228-236. doi:http://dx.doi.org.ezproxy.dominican.edu/10.1016/j.amepre.2013.03.017

Lajunen, H., Keski-Rahkonen, A., Pulkkinen, L., Rose, R. J., Rissanen, A., & Kaprio, J. (2007). Are computer and cell phone use associated with body mass index and overweight? A population study among twin adolescents. *BMC Public Health, 7*(1), 24.

Linder, L. A., Ameringer, S., Erickson, J., Macpherson, C. F., Stegenga, K., & Linder, W. (2013). Using an iPad in research with children and adolescents. *Journal for Specialists in Pediatric Nursing, 18*(2), 158-164. doi:10.1111/jspn.12023

Liu, C., Zhu, Q., Holroyd, K. A., & Seng, E. K. (2011). Status and trends of mobile-health applications for iOS devices: A developer's perspective. *Journal of Systems and Software, 84*(11), 2022-2033.

Marshall, A., Medvedev, O., & Antonov, A. (2008). Use of a smartphone for improved self-management of pulmonary rehabilitation. *International Journal of Telemedicine and Applications*, 2.

Mosa, A. S. M., Yoo, I., & Sheets, L. (2012). A systematic review of healthcare applications for smartphones. *BMC Medical Informatics & Decision Making. 12*(1), 67-97. doi:10.1186/1472-6947-12-67

Neely, L., Rispoli, M., Camargo, S., Davis, H., & Boles, M. (2013). The effect of instructional use of an iPad® on challenging behavior and academic engagement for two students with autism. *Research in Autism Spectrum Disorders, 7*(4), 509-516. doi:http://dx.doi.org.ezproxy.dominican.edu/10.1016/j.rasd.2012.12.004

Poropatich, R., Pavliscsak, H. H., Rasche, J., Barrigan, C., Vigersky, R. A., Fonda, S. J., & Bell, A. (2010). Mobile healthcare in the US army, *Wireless Health 2010,* 184-187.

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon, 9*(5), 1-6.

Purcell, K. (2011). Half of adult cell phone owners have apps on their phones. *Pew Research Center's Internet & American Life Project.* Retrieved September 15, 2013 from http://pewinternet.org/Reports/2011/Apps-update.aspx

Rickard, N. A., Smales, C. J., & Rickard, K. L. (2013). A computer-based auditory sequential pattern test for school-aged children. *International Journal of Pediatric Otorhinolaryngology, 77*(5), 838-842. doi:10.1016/j.ijporl.2013.02.024

Sarasohn-Kahn, J. (2010). How smartphones are changing health care for consumers and providers. *California Healthcare Foundations, 1-19.*

Scholl, R. (n.d.). Motivation: Expectancy Theory. Retrieved October 3, 2013, from http://www.uri.edu/research/lrc/scholl/webnotes/Motivation_Expectancy.htm

Shuler, C. (2009). *Pockets of potential: Using mobile technologies to promote children's learning*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Smith, A. (2013). Smartphone ownership – 2013 update. *Pew Research Center, Washington, DC.* Retrieved October 15, 2013 from http://www.pewinternet.org/2013/06/05/smartphone-ownership-2013/

Smith, R. O. (2000). The role of occupational therapy in a developmental technology model. *The American Journal of Occupational Therapy, 54*(3), 339-340.

The Mobile Healthcare (mHealth) Bible: 2014 - 2020 (2013). Retrieved October 9, 2013 from http://www.researchmoz.us/the-mobile-healthcare-mhealth-bible-2014-2020-report.html

Trefler, E. (1987). Technology applications in occupational therapy. *American Journal of Occupational Therapy, 41*(11), 697-700.

Vaala, S. (2013). *Aprendiendo juntos (learning together): Synthesis of a cross-sectorial convening on hispanic-latino families and digital technologies*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Vandewater, E. A., Shim, M., & Caplovitz, A. G. (2004). Linking obesity and activity level with children's television and video game use. *Journal of Adolescence, 27*(1), 71-85.

Vroom, V. (1995). Work and motivation. San Francisco, CA: Jossey-Bass Publishers.

U.S. Department of Health and Human Services. (2013). *MHealth*. Retrieved October 1, 2013 from http://www.hrsa.gov/healthit/mhealth.html

U.S. Food and Drug Administration. (2013). *Mobile medical applications*. Retrieved from http://www.fda.gov/medicaldevices/productsandmedicalprocedures/connectedhealth/mobilemedicalapplications/default.htm

VgBio (2012). VitaLink Remote Patient Monitoring. *vgbio.com*. Retrieved October 1, 2013, from http://www.vgbio.com/#

Waite, A. (2012, July 2). "App"titude: Smart gadget applications showing their worth in practice. OT Practice, 9-12.

Yamkovenko, S. (2013, September 18). Apps for occupational therapy: *Find apps for your practice area.* Retrieved October 1, 2013 from https://www.aota.org/en/Practice/Manage/Apps.aspx

APPENDIX A

Survey Questions and Results

Below are the questions and results of the original online needs assessment survey, powered by Surveymonkey.com.

Are you currently using a smartphone/tablet in your practice setting?

Answer Choices	Responses
Yes	67.37% 64
No	32.63% 31
Total	95

Which operating system are you using?

Answer Choices	Responses
Apple (IOS)	69.32% 61
Android	5.68% 5
BlackBerry OS	0.00% 0
Nokia's Symbian	0.00% 0
None	25.00% 22
Total	88

Are you using any smartphone/tablet applications in your practice setting?

Answer Choices	Responses
Yes	64.89% 61
No	35.11% 33
Total	94

How are you using the applications on your smartphone/tablet?

Answer Choices	Responses
Assessment	14.93% 10
Treatment Planning	8.96% 6

Answer Choices	Responses
Intervention	80.60% 54
Documentation	26.87% 18
Scheduling	32.84% 22
Compliance	2.99% 2
Responses Other (please specify)	16.42% 11
Total Respondents: 67	

Which specific applications are you using in your practice setting? Please list.
Sample answers from respondents:

"Handwriting without Tears, Wet Dry Try, various other handwriting apps, various games to work on eye hand coordination, eye brain training, form constancy by sensational kids therapy" 9/11/2013 11:31 AM View respondent's answers
"Visual Timer, Netflix, YouTube, BeBop Blox, Mrs Potato Head, Sound Box, BoogieBopper, Monsters, Pitch Painter, First Words Feelings & Sampler, injini Lite, Endless ABC, Agnitus, Little Writer for Kids, Kids Doodle, Don't Let the Pigeon Run This App, Miblio, Peekaboo Friends, Photo Vault, Miss Spiders Tea Party" 9/10/2013 5:23 PM View respondent's answers

What practice area do you feel an application could be beneficial? (please select 2 choices)

Answer Choices	Responses
Assessment	48.86% 43
Treatment Planning	37.50% 33
Intervention	63.64% 56
Documentation	55.68% 49
Scheduling	29.55% 26
Program Compliance	10.23% 9

Answer Choices	Responses
Responses Other (please specify)	3.41% 3
Total Respondents: 88	

What practice setting do you primarily work in?

Answer Choices	Responses
Schools	40.00% 38
Early Intervention	17.89% 17
Private clinic	25.26% 24
Hospital/Rehabilitation	5.26% 5
Responses Other (please specify)	

What age range:

Results: 93 out of 94 respondents replied that they worked with clients between the age of 0-21

If you could create any application for your practice what would it be?
Sample Responses:

treatment planning and intervention 9/6/2013 6:10 AM View respondent's answers
App for specific interventions for specific sensory processing challenges. An app used for easy data collection in a variety of treatment areas. 9/6/2013 6:09 AM View respondent's answers
Treatment ideas 9/5/2013 10:39 PM View respondent's answers
visual motor, play skills 9/5/2013 8:59 PM View respondent's answers
Easy way to take pictures, sequence them to use as a visual schedule for treatment 9/5/2013 7:38 PM View respondent's answers

APPENDIX B

Excel Database Example

Below is a sample of the excel database our thesis team is using to categorize all pediatric apps. This database will be used to compile all data before coding items into the PediApp Finder.

NAME OF APP	iOS/ANDROID	APP DESCRIPTION	PRICE	INTERVENTION CATEGORY
Colors With Dally Dino	iOS	This app teaches matching, sorting, sequencing, finding, counting, and much more!	$3.99	Visual processing
iReward	iOS	Post pictures of rewards and the child can earn stars towards earning these rewards based on their behavior	$4.99	Social-emotional skills
Jetpack Math	iOS	This app works on math equations with addition, subtraction, and multiplication.	$0.99	Learning supports (dyscalculia)
Pinch Peeps	iOS	Pinch and drag two similar peeps together to score points and progress to more challenging levels	Free	Fine Motor
Trace Your Name	iOS	This app allows the child to trace their name and alphabet letters and numbers	$0.99	Handwriting
Twinkl Phonics Phase One	iOS	The app sounds and names of each letter of the alphabet, works on letter formation, and blending sounds in CVC words	$3.99	Handwriting

APPENDIX C

PediApp Finder Evaluation Survey

Select the number that best represents how you feel about the PediApp finder. Please provide addition feedback in the comments section under each question and/or at the end of the evaluation.

	Strongly Agree	*Agree*	*Undecided*	*Disagree*	*Strongly Disagree*
1. The PediApp Finder was easy to use.	1	2	3	4	5
Comments:					
2. The PediApp Finder was presented in a user-friendly format.	1	2	3	4	5
Comments:					
3. I was comfortable navigating the PediApp Finder.	1	2	3	4	5
Comments:					
4. The PediApp Finder saved me time when looking for interventions.	1	2	3	4	5
Comments:					
5. The PediApp Finder included appropriate intervention categories.	1	2	3	4	5
Comments:					
6. The PediApp Finder provided a sufficient amount of relevant apps.	1	2	3	4	5
Comments:					
7. I was satisfied with the overall quality of the PediApp Finder.	1	2	3	4	5
Comments:					

Additional feedback, suggestions, and/or further comments:

APPENDIX D

PediApp Finder Screenshots

Fig. 1. Opening screen

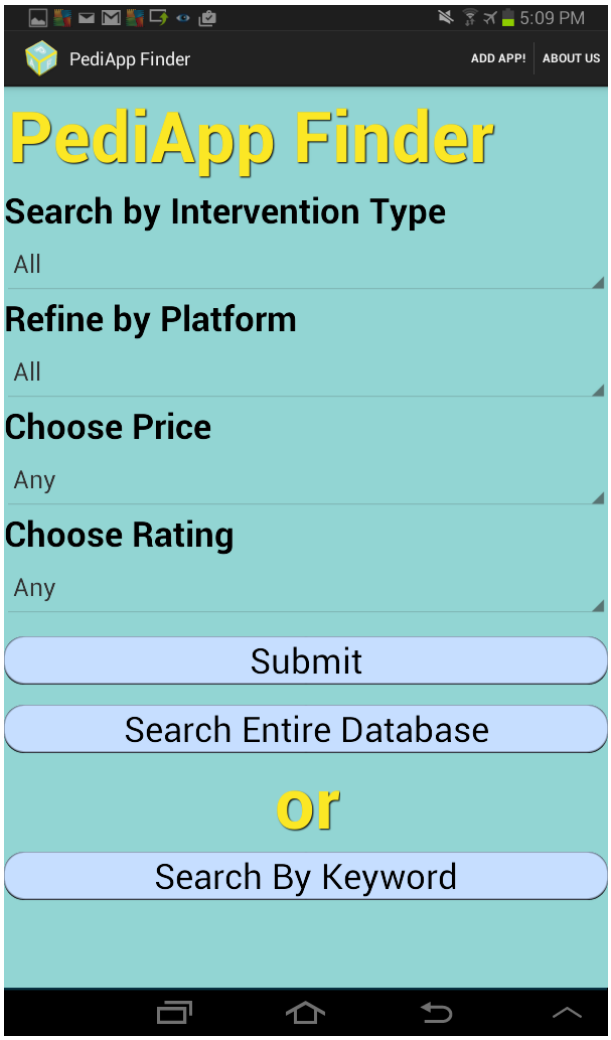

Fig 2. Search Screen

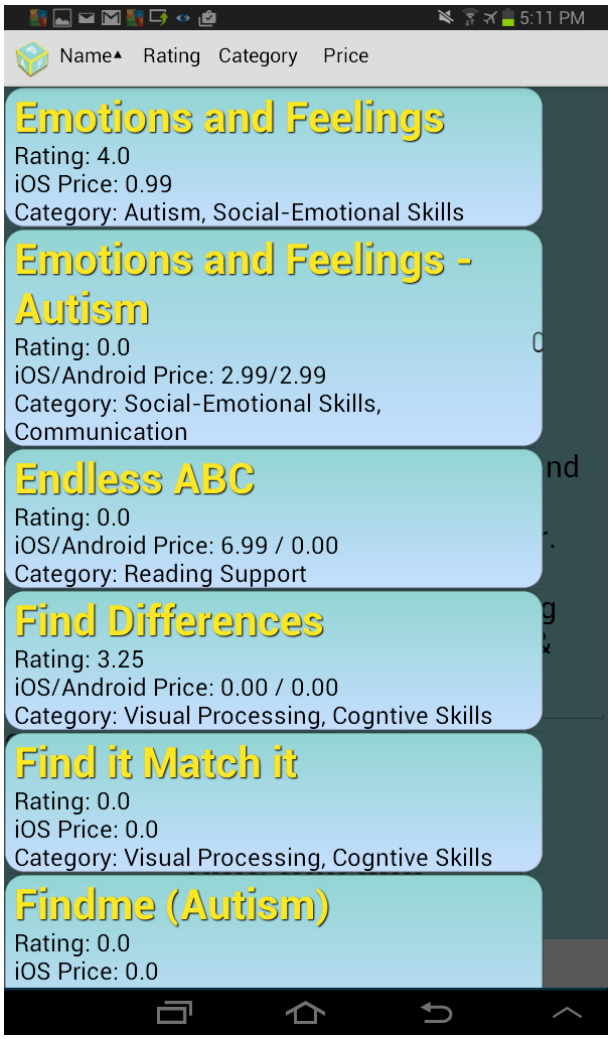

Fig. 3. Populated results list

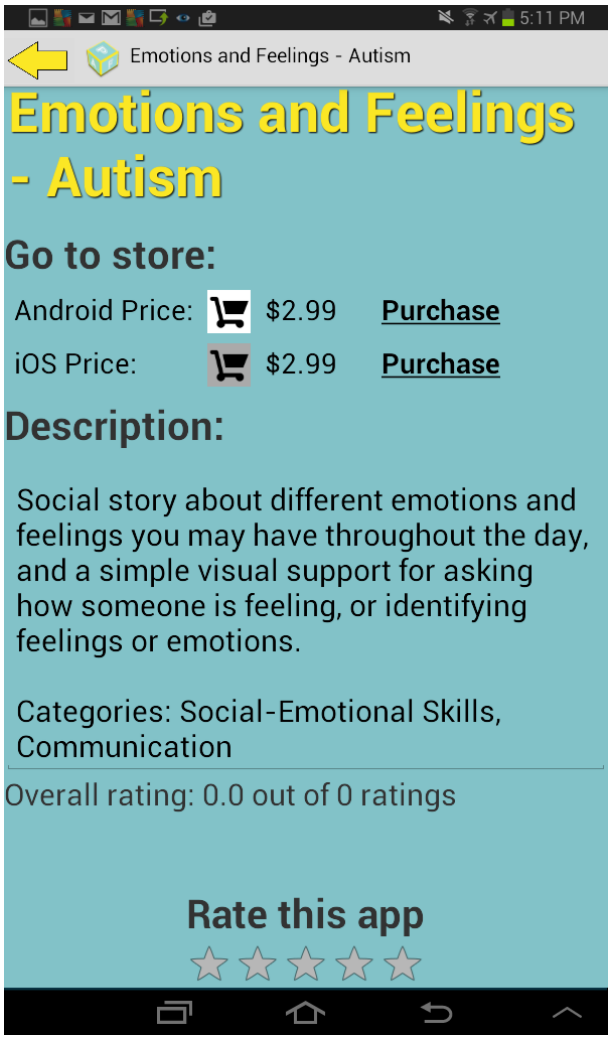

Fig. 4. Full description page

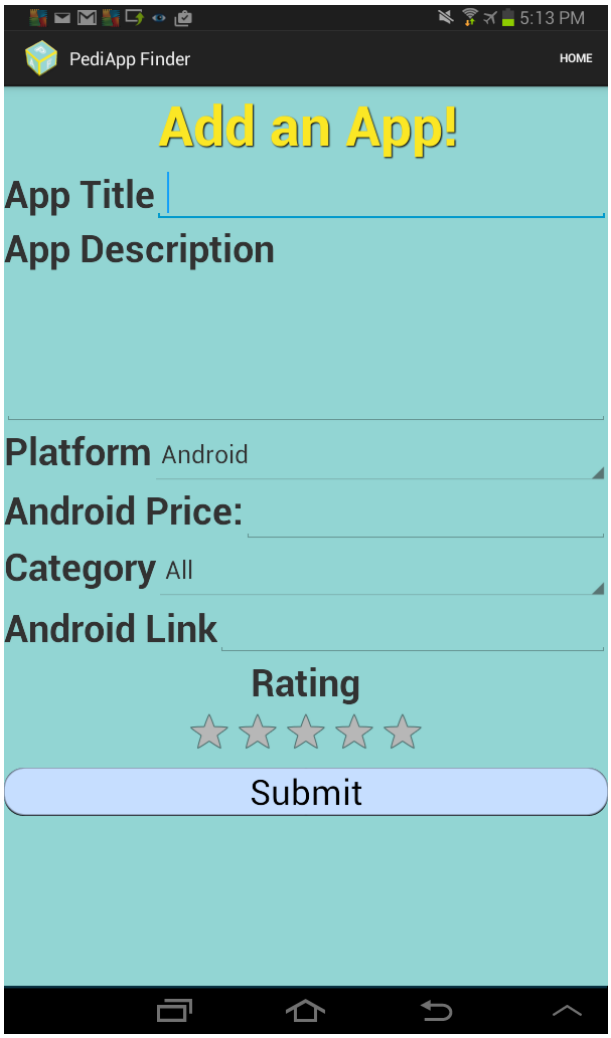

Fig. 5. Add an App page