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# A New Mobile Application for Educating Autistic Children: A Pilot Study

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**Abstract**

**Introduction: Children suffering from Autism Spectrum Disorder (ASD), exhibit multiple neurological, communication, social and emotional regulation deficits. These impairments constitute serious challenging obstacles to parents and health care providers specially in the education and learning settings. The paraprofessional role has been indispensable for supporting and assisting those afflicted children, however, in controversy a number of disadvantages resulted from their adherence to the child, their financial burden and the skeptic vision towards their qualifications and training.**
**Aim of the work: A new educational intervention has been introduced via a mobile app "The Shadow Teacher", which has been developed aiming at replacing the paraprofessional and engaging the parents in assisting their afflicted children through properly designed tasks.**
**Material and methods: This is a pilot study, based on three previously diagnosed autistic children, selected from their rehabilitation center. They were 2 males and one female, with ages 4, 7 and 10 years respectively, and diseases severity ranged from level 1 mild to 3 severe. The parents were interviewed to assess their feeling towards their child's disease and their perception of the paraprofessional role. The app was designed based on their expectations towards their children's need as well as consultation with a professional expert. After explaining the apps functionality, the parents were educated on how to use the app and assist their children in creating tasks coping with their children's interaction. Children improvements and progress was evaluated through a comprehensive questionnaire distributed to the parents regarding their neurological, communication, social and emotional regulation.**
**Results: Results were evaluated in relation to eight hypotheses, depicting that positive correlation occurred between the shadow teacher app and neurological deficit in relation with communication development and social interaction. Furthermore, difficulties using the app, was faced with the 4 y aged child. Conclusion: Shadow Teacher application proved to be a powerful promising tool that would improve the ASD children and their parents quality of life through improving their deficits.**

**Keywords:** Autistic Spectrum Disorder (ASD), Shadow Teacher Application, Communication; Social interaction; Flexibility of thought and Emotional regulation, mobile usability, Human Computer Interaction, Paraprofessional, friendly user interface, Mobile User Experience (UX)

## INTRODUCTION

The field of developmental of mental illness witnessed extensive research in the last decade. Autism, a subclassification of Autism Spectrum Disorder (ASD), received special attention. It has been defined as developmental mental disorder with associated intellectual disabilities. In the literature reviewed, several terminologies and terms have been used to identify specific differences in behavior all diagnostic of Autism such as, Asperger syndrome, Autism Spectrum Conditions (ASC), ASD, classic autism, Pathological Demand Avoidance (PDA), Kanner autism and Pervasive Developmental Disorder (PDD). (Autism progress, 2016). An accurate diagnosis of Autism requires a deep understanding of their peculiar deficits exhibited through four main aspects: *Communication; Social interaction; Flexibility of thought and Emotional regulation.*

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Affected patients show impaired social interaction, inflexibility of thoughts and deficiency in emotional regulation and social communication. These communication deficits involve, language disability, impaired and /or irrational social attention skills, negative emotional reactions, solitary playing patterns, limited facial perception and reaction, inactive emotional expression, unusual gaze and repetitive behavior as a stereotypic motor sensory action.(Daud, et al., 2018). These disabilities are considered as impeding elements to the learning and education processes of the autistic children, which requires a robust professional support aiming at overcoming these difficulties.

Paraprofessionals have been considered a frequent player whose substantial role was strongly stressed for providing the child with needed emotional and communication support in the school setting. However, concerns were frequently discussed regarding several factors; *First* their ill-defined qualifications lacking clear description of standards and specifications, which might jeopardize the desired outcomes. More serious considerations were also directed as far as exerting opposite negative impact secondary to their incompetence in performing this sensitive role of supporting those vulnerable mentally afflicted children. *Second*, their continuous adherence to the child in the educational environment, interferes with the interactive role of the professional educators and acts as a barrier to communicating with their peers. *Third*, they consist a financial burden to the overwhelmed families (Anderson, et al., 2004; Brock & Carter, 2016; Giangreco, 2010; Humphrey & Lewis, 2008; Koegel, et al., 2014).

Despite the fact that autistic children constitute 3% of the population of children with special needs, unfortunately statistics of Autism in Egypt are inaccurate with insufficient information about their proportion in relation to other mental impairment (Hammed, 2015). This may be attributed to the confusing similar clinical symptoms and emotional and social behaviors with other mental affections and conditions. Parents and health care providers face this frustrating challenge with increasing needs towards more professional specialized treatment and rehabilitation centers, which are still below needs and expectations or even completely lacking in the suburban areas. Appropriate care and services are granted in the private sector, which can only be afforded by rich people who can cover these high expenses. This undoubtedly, affects the Autistic children's education and learning paths, their mental and social limitations are overlooked as a pathological condition but are rather classified as an education failure entailing their eventual withdrawal from the schooling mainstream.

Mobile technology affected people's behavior tremendously, impacting their daily life, their communication patterns, education and even interactive business activities. The revolutionary advancement in the field, triggered researchers interest to expand their application to involve patients with impaired mental health, specially responding to professional ASD educators who emphasized the importance of diversifying the learning and teaching modalities to overcome the ASD students' disabilities (Amudha, et al., 2015).

In this regard mobile technology can enhance, ASD students communication ability through interaction with people. (Goulart, et al., 2014; Marco, et al., 2013). However, they require specific features to achieve a positive goal; being visual learners, the application should have a user friendly interface (UI), with good visibility which will warrant a positive response to visual interaction (Khan, et al., 2013). The embedded design elements should deploy the appropriate amount of information with limited software complexity. (Mohd Hanifa et al., 2015; Al-Zeer, et al., 2014).

Sofian et al in 2018, summarized the main characteristics of mobile applications covering the needs of ASD children as *objective*, in terms of usability quality, with *specific scope* for the patients' needs. Whereas considering the cognitive domain additional factors are: *easy to use, effectiveness, understandable, satisfaction, appearance, and efficiency.*

The present work aims at designing, developing and applying a new shadow teacher application as a new intervention, as a pilot study for autistic children having previous experience with paraprofessionals.

## SUBJECTS AND MATERIALS

The scope of the present pilot study was based on designing and implementing a mobile application as a new educational intervention tool for three autistic children previously shadowed by a paraprofessional.

The application design framework and elements were developed in compliance with the information provided through interviewing medical professionals and parents regarding the problems and challenges facing their autistic children.

The software used by the application were; *Cloud Firestore, ML Kit BETA, Cloud Functions, Authentication, Hosting, Cloud Storage, Realtime Database, Flutter, made by Google, Fast Development, Expressive and Flexible UI and Native Performance.*

Three children diagnosed for autism and their parents were selected from the treating center they were frequenting for their regular treatment and rehabilitation management. The patients were 2 males and 1 females, with age 4,7, 10 years old respectively. They varied in their level of autism from level 1 to level 3 from mild to severe according to their doctors' diagnosis. The 4 year old male child was an ASD level 1, while the 7 year old male child was an ASD level 2 and the 10 years old female patient was an ASD level 3. These variations in age, gender and level of severity was planned to evaluate the users' experience towards the new application representing different gender, age and disease severity. The selection criteria were further based on determine inclusion and exclusion criteria.

### Inclusion criteria

Children with ages ranging from 4-10 years, patients previously diagnosed with severity level from mild (1) to severe (3), patients free from any other associated sensory deficits such as visual, auditory or speech impairment, ASD children with previous

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experience with paraprofessionals, parents who have mobile or tablet devices compatible with the application and are willing to undertake the experiment after signing an informed consent to participate.

**Exclusion criteria:**

ASD children with co-existing syndromes other than autism spectrum disorder such as intellectual disabilities, hyperactivity disorder, attention deficit, obsessive compulsive disorder or genetic syndrome, and parents who did not show enthusiasm and devotion towards assisting their children and responding to questionnaires and interviews.

## RESEARCH METHODS

### 1. Interview

The experiments started with interviewing the parents by open ended questions to assess parental feeling and satisfaction level or concern towards Autism and paraprofessionals. Parents were prompted to answer the following questions based on Jacobs, et. Al., 2019 questionnaire. It include, the demographic data, the child's siblings, date of first diagnosis, what derived the parents towards professional consultation regarding the child mental health, level of severity of his disease, the meaning of ASD, the significance of acknowledging the diagnosis of ASD, how does the disease affect the child/ parents, and their impact on the child/ parents lives, what are the changes affecting child/ parents lives, whether the child has a paraprofessional, their economic burden and their role. The final questions are related to the mobile app and the parents trust to replace paraprofessional and their perception about their children's interaction with the apps regarding communication, Social interaction, Flexibility of thought and Emotional regulation.

### 2. Procedure

The experiment was conducted based on eight hypotheses verifying and evaluating the current shadow teacher app as an intervention practice promoting positive outcomes, improving the autistic child's neurological deficits through fostering communication development, social interaction, flexibility, emotional regulation as shown in Figure (1). H1, H2, H3, H4 advocating a positive correlation between the shadow teacher app and communication development, social interaction, flexibility of thought and emotional regulation respectively. H5, H6, H7, H8 stating a positive correlation between the enhancement of neurological deficit and the communication development, social interaction, flexibility of thought and the emotional regulation respectively.

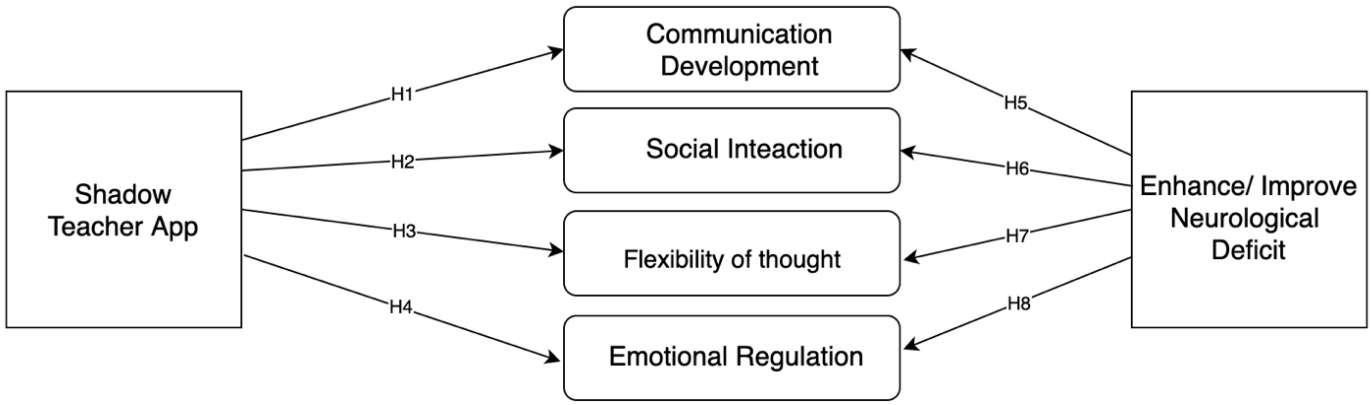


**Figure 1:** Shadow teacher application prototype

The experiment was carried out in planned four hours session over 10 days. The sessions were held in a medical center specialized in autistic cases, under the supervision of the medical professional care giver, who was previously consulted and recommended the application and the sessions. Detailed information regarding the application and the experiment was delivered to the parents, who all gave a written consent to voluntarily participate in the study.

After collecting the basic demographic information, parents were interviewed before experimenting the application to understand their feelings, concerns, trust towards paraprofessionals and mobile applications. The parents were trained and coached on how to use the application and undergo the experiment. Children attended the sessions with their parents. All parents were instructed to download the application on their mobile phones. Six tasks were prepared daily on the children's phone, before the start of each session, consisting of a mixture of the four problematic issues; *Communication, Social Interaction, Flexibility of Thought and Emotional Regulation.*

An implemented feature included in the app, is a reminder for the child to perform the task, repetitively until they act in a self-motivation approach, through preforming this specific task without notification or reminder. Reaching this point, the parents were instructed to move to the next task. Tasks in each session, were delivered to the children depending on their level of understanding and response to achieve the activity. On the other hand, parents were asked to encourage their children to get used to the application throughout the day independent of the scheduled sessions, in a trial to replace the paraprofessionals.

### 3. The Shadow Teacher Application

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The application allows the parent to create an account using their name, email, password and pin code. The pin code is used to switch from the child's view to the parent's view. Each parent can create tasks according to their child needs and response. The steps of task creation are presented in Figure (2).

*First*, parents should click on "add tasks" then write the task name. *Second*, they have to select the icon color and the corresponding icon appearing with the specific task. *Third*, they determine the intended date for each task, and whether repetition feature and frequency is allowed or not. *Fourth*, after setting the date, the application allows the parent to choose the appearance of his preferred display as text, audio or video.

When the task time is due, an audio notification says "You have a task now" together with a pop up window that will appear on the child's phone marking the task status as done or missed. This status will concurrently show in the parents view as done or missed by their child.

Whenever, the parents needs to edit something, they can click to edit the task, and there addition will appear in a list view.

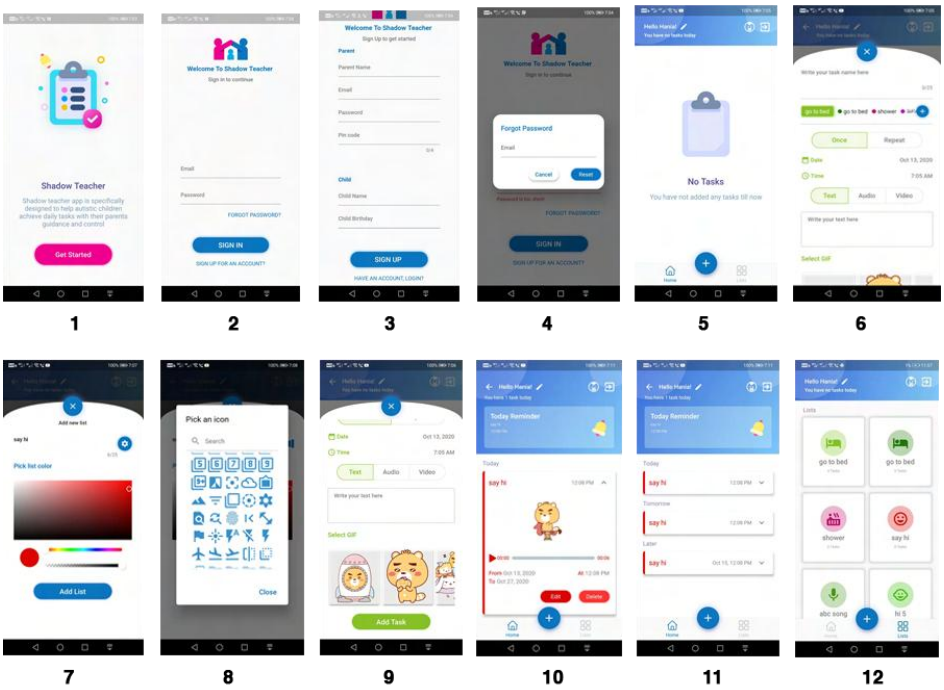


**Figure 2:** Shadow Teacher Application

## 4. Tasks

The trained parents created 6 tasks on the children's phones for each session. They were instructed to start the same 6 tasks similarly, then tasks were changed according to how each child excelled in the task, and no longer needed the application's reminding feature to repeat the task. Parents were asked to continuously create new tasks at home according to the child's level of interaction. The following tasks were distributed among children:

1. Communication (Matson, et.al.,2012):
   a. Welcome people when they enter the session
   b. Answer questions asked to them
   c. The applications asks them to go pick toys they like
   d. Write their names
   e. They were asked to do crafts
   f. Ask them to tell a story

2. Social interaction (Papacek, et.al., 2016):
   a. Introduce themselves to other kids (stand up, look the others in the eye, smile, say, "Hi. I'm……")
   b. Ask the other kids to introduce themselves
   c. The application tells them to ask the other children to play with them
   d. Play puzzle (16 pieces- big floor puzzle)
   e. Building blocks
   f. Sing ABC with each other

3. Flexibility of thought (Braem, & Egner, 2018):
   a. Ask children to tell a story from their imagination
   b. Ask them while playing with a toy to shift to another one
   c. Switching from one task to another
4. Emotional regulation(PositivePsychology.com, 2020):

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a. Link is added for a video so they can watch a social story
b. Ask children to go to an image of a thermometer to encourage a child to "measure" their emotions
c. Ask them to draw emotions that explains how do they feel

## QUANTITATIVE DATA COLLECTION

After the experiment was conducted a questionnaire was distributed to the parents to evaluate their level of satisfaction with the usability of the mobile app and to see if the parents can recognize their child's neurological progress through communication development, social interaction, flexibility, emotional regulation based on a 5-points Likert's scale.

Collected data was statistically analyzed using SPSS (20)

## RESULTS

The children's ability to perform the tasks delivered through the shadow teacher mobile application as well as their ability to interact and communicate with other people were assessed to evaluate the results in relation to the proposed hypotheses.

Results obtained after qualitative and quantitative data analysis proved a positive correlation between the shadow teacher app and communication development (H1) and social interaction (H2). Moreover, the enhancement of neurological deficit showed positive correlation with the communication development (H5) and the social interaction (H6).

On the other hand, negative correlation opposite to the proposed hypotheses between the shadow teacher and flexibility of thought (H3) and emotional regulation (H4), as well as between the enhancement of neurological deficit and flexibility of thought (H7) and emotional regulation (H8).

The present results showed positive correlation regarding the age rather than the severity of the disease since the 4 y old male child though suffered severity level1, needed exhausting assistance by the parent who complained of her child's poor compliance and her inability to perform even the primary tasks. On the other hand, the male aged 7 years old with severity level 2, had done almost all the tasks, despite few poorly performed few tasks for the first 2 days. By the end of the experiment 3 tasks were performed successfully. The best were shown by the female aged 10 years old with severity level 3, she was able to perform all the tasks. Her parent was able after the third day to change 2 of the tasks, as she started to show progress by the end of the experiment 6 tasks were changed.

## DISCUSSION

The development of the shadow teacher app proposed in this study was preceded by an interview with the parents to evaluate their perception and concerns towards Autism. Their contribution, was important since the design framework and its elements were aligned with the parents encountered difficulties with their children.

The present app has a user friendly interface and ease of simple task through a simplified software, this is in accordance with Khan et. Al., in 2013 and Mohd Hanifa et al., 2015; Al-Zeer, et al., 2014 advocations inquiring that good visibility of mobile based application is mandatory for autistic children being visual learners would potentially enhance visual interaction. Moreover, the simple task performance that can be operated and designed by the parents helped replacing the paraprofessional roles, and their doubtful roles.

One of the main hypothesized advantages of the shadow teacher app is overcoming the skeptic negative impact of paraprofessionals and their questionable qualifications and their influence on students learning. These disadvantages were listed in different reviewed research ranging from poor training or specific job description (Howard & Ford, 2007), (Stephenson & Carter, 2014). Furthermore, they may impede positive education outcomes, social engagement and improvement of communication ability through overshadowing the child (Giangreco, et al., 2011; Howard & Ford, 2007; Webster & Blatchford, 2015).

The design of the present work focused on enhancing child's engagement through developing a sense of accomplishment and self-motivation guided and supported by the parents rather than the paraprofessionals. This conforms with one single work carried out by Torii et.al in 2013, who introduced a new schedule application, "Smiley", for autistic children. However, it overlooked the role of the paraprofessional and the need to replace it . Whereas previous apps were exclusive activities relying on games, educational applications, applications reading facial expressions, while others used augmented reality with limited focus on self-achievement.

Regarding the patients selection in this pilot study the variation in age, gender and level of disease severity was intentionally planned a variable sample representation for a wider evaluation for the future study.

## FUTURE WORK AND CONCLUSION

The initial success of this experiment will help in adding more features to the shadow teacher application for the ASD children using mobile and iPad devices. Suggested extra features are adding location, to share it with the parents. Parents version can be added on their own phones and can send instant tasks for the their child to perform immediately, independent of their adherent presence. Also, the experiment needs to be extended to involve more ASD children and for a longer period of time. Children with Autism will have to live with their condition as there is no cure in today's medical advancement. However, some practices and therapies can help improve their condition and assist in their quality of life. The Shadow Teacher application has been proven as a powerful tool to help children with autism, teach them new skills and replace paraprofessionals. In the

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experiment, it was found that the Shadow Teacher application helped the children learn some communication and social skills. Children with ASD find it hard to concentrate for a long period of time, but when they are visually engaged, they are motivated and encouraged to excel. Positive response was obtained from this pilot study and it is planned to continue expanding this work to help these children in other aspects.

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