Fill Me App: An Interactive Mobile Game Application for Children with Autism

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***Abstract*—FillMeApp is an interactive mobile game application which is a supplementary learning material intended for children with Autism that helps them motivate in their learning process. This game application is focus mainly on Science basically on identifying the human's body parts. Accumulating the best time for focus monitoring, eye-catching graphics, simple level of exercises, video tutorial and background music that coincide with the current educational teachings are among the primary features that this application has to offer. The researchers analyzed the results of the test survey and proved that the application is user friendly, interactive, the logic of the game is understandable and would learn to use this application very useful in their learning. Based also from the researchers testing and result on the students motivational rating from the teacher, before, the students with Autisms' motivation level were LOW but after the game application was deployed and tested their motivation status begin to grow and become HIGH.**

***Index Terms*—Mobile Game Application, Autism Spectrum Disorder, Interactive, Science**

I. BACKGROUND RATIONALE

Autism Spectrum Disorder (ASD) was a developmental disorder that affects one in every five hundred children. These children demonstrate deficits in social interaction, verbal and nonverbal communication, and repetitive behaviors' (Schoenstadt, 2013). The said disorder share three main areas of difficulty, their condition affects them in very different ways. The three main areas of difficulty which all people with Autism Spectrum Disorder shares were known as the *"Triad of Impairments*" and the said impairments were the following: difficulty with social communication, social interaction and social imagination."

According to Lovaas, 2010, a world-renowned autism expert, once said, "If a child cannot learn in the way we teach, we must teach in a way the child can learn." Technology – specifically in Tablet form – has revolutionized the way kids with autism learn and communicate, and mobile apps have given parents, educators, and therapists multiple approaches to teaching a child who develops at a different pace than his peers. These new social interventions can be used in the classroom or other "everyday" settings. Nowadays, people with disabilities specifically persons with difficulties in social and emotional aspects spend and enhance their implications through playing mobile game applications that were in line in the augmentation of their impairments.

There were existing applications nowadays that help or aid children with Autism Spectrum Disorder (ASD) specifically for developing their social skills and emotional aspects. Audio books on IPADS and IPhone that help children with autism learn to read and many other instructional games that can help boost their weaknesses (Hutten, 2012). Audio books on IPADS and IPhone were one among the few existing application which can boost their scope of weaknesses.

Serious games for education were designed to help teacher or student during the teaching and/or learning process. Arshia et al., (2011) presented a personalized computer game based on digital story-telling concept that helps the children of age ranging from 9 to 14 years old with autism to understand the use of money. It would teach the autistic children the social behavior appropriate while shopping. The game was developed on BYOB (Build Your Own Block, an advanced offshoot of the game engine Scratch). Emilia Barakova et al., (2007) presented a design process, the outcome, and preliminary tests of an interactive toy that expresses emergent behavior and can be used for behavioral training of autistic children, as well as for an engaging toy for every child. The researcher exploits the interest of the autistic children in regular patterns and order to stimulate their motivational, explorative and social skills.

Maite Frutos et al., (2011) proposed a system which provides a solution to the learning and enhancement of habitual language in kids and teenagers with an autism spectrum using a simple and easy game focused on their personal needs and characteristics. This game was composed by two separated applications: the management application and physical game. The results were represented as a bar chart with the % score of the correct pronunciation of each word. These results can be exported and stored so as to keep a temporal register of final user's progression.

The Social Navigator which was a revolutionary social skills app was developed to assist children with social and behavioral challenges in adapting their behavior and developing life-long social skills. The Social Navigator allowed user to quickly enter the dynamics of their current social situation and instantly generates corresponding strategies and recommendations, so that the child can get their needs met in a socially acceptable manner (Millan, 2012). The Social Navigator was an application which is good in enhancing the social aspects for children with the said ailment.

The Sōsh which was a mobile application designed to help teens and young adults improve social skills. Sōsh

was based on a decade of work with children, adolescents, and young adults who struggle with social difficulties. The Sōsh framework divided the social functioning into five areas essential to social skills development and success: Relate (Connect with Others), Relax (Reduce Stress), Regulate (Manage Behaviors), Reason (Think it through) and Recognize (Understand Feelings). Individuals who used the app learn to: practice conversation strategies, relax, pursue social opportunities, recognize feelings, make successful transitions, journal progress, eliminate negative thoughts, monitor behavior, and regulate speech volume, to name some of the many features (Dr. Bowers, 2008-2012).

According to an article of Toca Boca which was a game development studio focused on child-friendly applications for tablets and smartphones, their researchers have found out that smartphones and tablets help autistic children develop new skills. Toca Boca, for example, created apps aimed at children aged three to six. Although the games are not specifically designed for children with autism, but they have proved popular among parents who have children with the said condition (Woollaston, April 2, 2014).

But nowadays, android phone has the least advantage since there weren't many applications that existed on the said scope of phones. Existing applications were based on individual weaknesses of children with Autism. Also the existing application like the Sōsh and the Social Navigator and as well as the Toca Boca has individual features that only focused on one (1) area of their impairment which was a bit hassle on the users side, because in order for them to use the said applications, they need to download it all just to play the game, unlike the researchers mobile game application which the researchers have developed consist a game in regards to Science where children with Autism can have fun and at the same time can learn by identifying basic body parts. In return, the mentors can't have a hard time downloading all the application necessary for the improvement of their students.

According to the researchers' interview with Dale Ebcas, a SPED Student - Teacher "The pupils nowadays with Autism can play well on mobile phones and tablets. Specifically they also learn while playing games. "

"Good teachers helped me to achieve success. I was able to overcome autism because I had good teachers. Many people with autism are visual thinkers. All my thoughts are like videotapes running in my imagination. Pictures are my first language, and words are my second language. Nouns were the easiest words to learn because I could make a picture in my mind of the word. To learn words like "up" or "down," the teacher should demonstrate them to the child", stated by Temple Grandin (2002).

In order to address the problems exist, the researchers have developed a mobile game application that would help children with Autism Spectrum Disorder that would also enrich their weaknesses via educational approach. Moreover, the researchers have developed a game in which the children with Autism will have fun and can learn at the same time with eye catching graphical user interface (GUI).

A. Statement of the Problem

Non-existent of mobile game applications for children with Autism related to Science and the absence of information related to time visually that lacks motivation from the students.

B. Objectives of the Study

1) General Objective

The study aims to develop an interactive mobile game application intended for children with Autism Spectrum Disorder.

2) Specific Objectives

1. Design an educational mobile game application for children with Autism in the field of Science specifically on identifying human's body parts.
2. Develop a centralized database which caters all the information needed for the exercises.
3. Test and evaluate the system's functionality and usability.

II. METHODOLOGY

A. Designing an Educational Android Mobile Game application

1) Analysis

As the researchers' interview with Sir Julian Ignatius Apalisok, the SPED Center manager of Mindanao University of Science and Technology, students with Autism Spectrum Disorder are attracted to bright and lively colors and he haven't seen such existing application in regards to Science.

Through thorough study and analysis of the existing studies presented by many authors about children with autism, the researchers created a mobile game application wherein students with autism can learn and have fun guided by their guardian. The features of this game application have a scoring system for focus monitoring, eye-catching graphics, simple level of exercises, video tutorial and background music that coincide with the current educational teachings.

2) Architecture of the Application

Figure 1 illustrates application architecture in which at the start of the game inputs were needed in order to proceed to the main process of the game. The game has both audio and graphics. User input is the login scene in where the user shall enter both the username and password before entering to the game logic. The game logic is where the sense of the game starts and on the game both audio and graphics are embedded on which the output is the game itself or the Fill Me App.

Figure 2 shows how the two users can utilize the application. The teacher can log-in, view, monitor and evaluate the student's performance based on how the student responds to the game. The teacher shall login in order to monitor and evaluate the students' performances. The teacher will see this evaluation through the web application. The teacher has an active account on the web application and is capable of monitoring and evaluating his student's performance. The teacher can monitor and evaluate one's performance by showing results of the game through a graph per level of exercises. All the data from the student's trials of the game per level up to the latest will be stored on the database via online through web application. The student can repeat the games how many times that he wanted to play it. There will be no limit towards the usage of the game itself.

3) Context Diagram

Figure 3 shows the interaction between the users through the application. The diagram comprises two actors which represent the different user rights; User and Teacher or the Guardian. Teacher or the guardian role applies to administrators who can only create the profiles of each student and can evaluate each score of the students and Student role may refer as the receiver. The teacher or guardian can create, read, update, delete and evaluate, while the Students which are children who has Autism Spectrum Disorder can only play and view the video.

4) System Flow

Figure 4 illustrates the system flow of both the game and of the web application. On the diagram above, it shows how the game and web works. The game and the web have different functions but coincide with the data of the game. FillMeApp: before starting the game, the user shall login with the help of the guardian or a teacher which is a must. After logging into the game, the user shall choose between playing the game or quitting the game. If the user will choose to play, there will be another option in which the user will choose, its either the Play Video or Play Game. If the user will choose to play the "Play Video" option then a video in regards to body will then be playing. If the user will not choose the "Play Video" then the other option which is the "Play Game" will now start. In the start of the game instructions will now appear, then after finishing level 1, level 2 and level 3 it will then navigate to the main page in which the user shall choose from in between the "Play Video" or "Play Game". For the web application: the teacher or the guardian shall login before navigating to its home page, which will now show the list of students that is registered towards the game. If the teacher or the guardian will click the button "Evaluation" beside the name of the student, user profile of the registered student will be shown then options for evaluation for "Level 1, Level 2 and Level 3". If the teacher or the admin will click the button for "Level 1, Level 2 or Level 3" there will be a graph which represents the time played of the specific student.

III. HIGHLIGHTS OF FINDINGS AND DISCUSSION/DATA PRESENTATION

Figure 5 shows the result of the survey conducted by the researchers. Every first 4 bars indicate the guardian's data then every second 4 bars indicates the teacher's data. Based on the highest points, the guardians and the teachers both agreed that they would use the application frequently and the functions were well integrated. The guardians strongly agreed that the application is easy to use and would imagine that their autistic child would learn to use this application very useful in their learning.

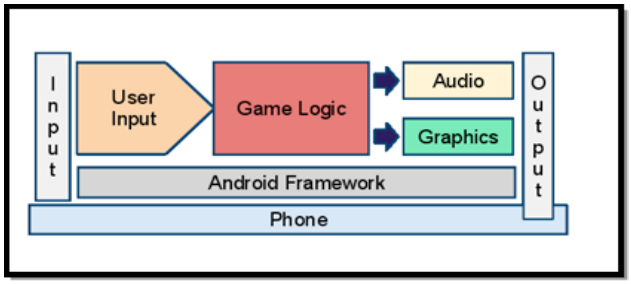

Figure 1. Architecture of the Application

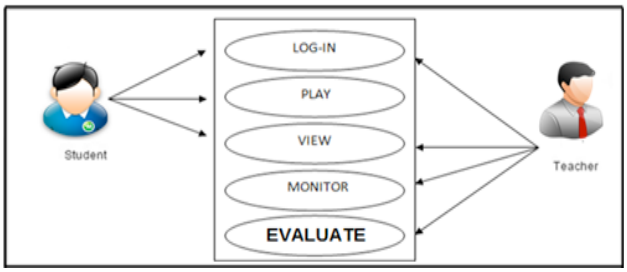

Figure 2. Use Case Diagram: Teacher and Student roles

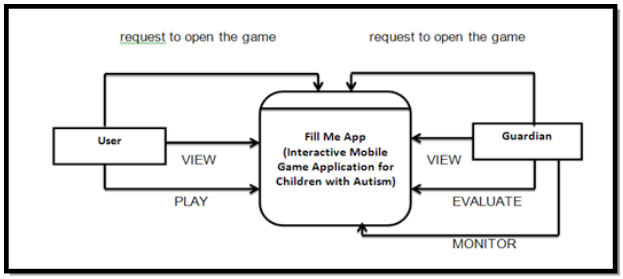

Figure 3. Context Diagram

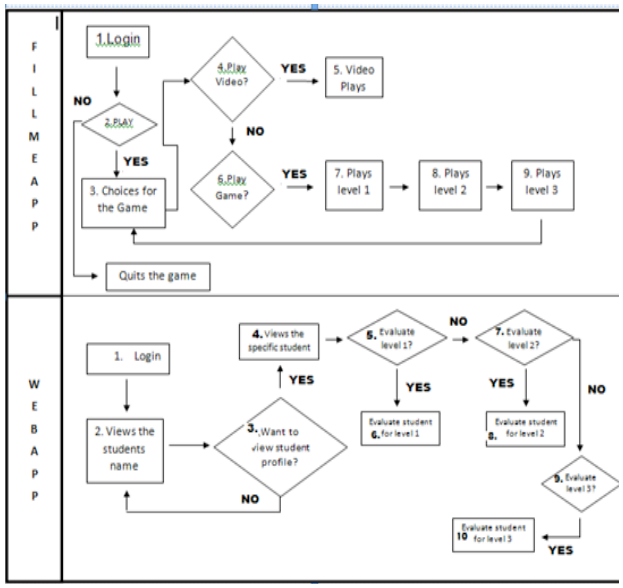

Figure 4. System Flow of the Game and of the Web Application

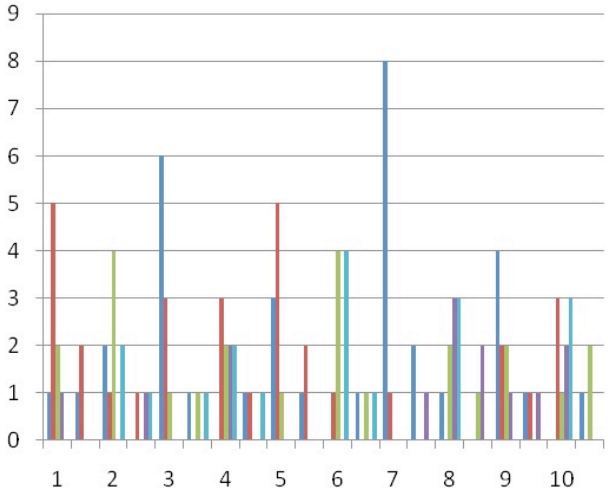

Figure 5. Summary of the System's Usability

Figure 6 shows the summarize functionality results done by the researchers through a survey. Every first 4 bars indicate the guardian's data then every second 4 bars indicates the teacher's data. Most of the guardians and the teachers said that the application was interactive, informative, and easy to move the parts around, the logic is understandable.

Figure 7 indicates how children with Autism focus on learning materials and through how children with Autism focus on FillMeApp. In MUST – SPED Center, they have 11 students with different ages. Student 1, 4, 6, 9, 11 can last their attention to books from 1-10 minutes while student 1 and student 9 doesn't have desire towards using technologies and the student 4, 6, 11 has the same span of attention towards the application and the book. On the other hand student 2 and 8 has the longest span of attention towards the game FillMeApp rather than the book and other instructional materials. Meanwhile, student 3 and 5 has the same attention span for the book and the game FillMeApp. Student 10 has more attention span to the book rather than the game and lastly student 7 has no desire in using technology and also has the shortest span of focus towards visual aids or books

Figure 8 indicates how long the student with Autism focuses on visual aids or books and also their attention towards the game FillMeApp. There are 8 students in West City Central School: Student 1-8 they have more attention towards FillMeApp rather than the visual aids or books. But the student who has the longest span of attention towards FillMeApp is both student 3 and 5 on which they can focus their attention up until 10 minutes. While student 1 and student 2 have the shortest span of attention towards the book they can only last for up to 1 minute. But more likely students with Autism in West City Central School attention towards books wouldn't last long for about 5 minutes but compared to our game their attention exceeds up to 8-10 minutes.

Table I illustrates the motivation status of each student in MUST. It shows how the student reacts after the supplementary tool has been tested. Some students are still the same before and after the game have been deployed. But more students are highly motivated after the game was deployed.

Table II illustrates the motivation status of each student before and after the application was deployed. Before, the students with Autisms' motivation level were LOW but after the game application was deployed and tested their motivation status begin to grow and become HIGH.

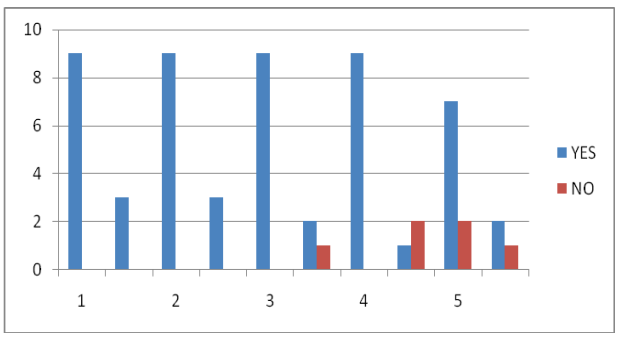

Figure 6. Functionality Result of the Application

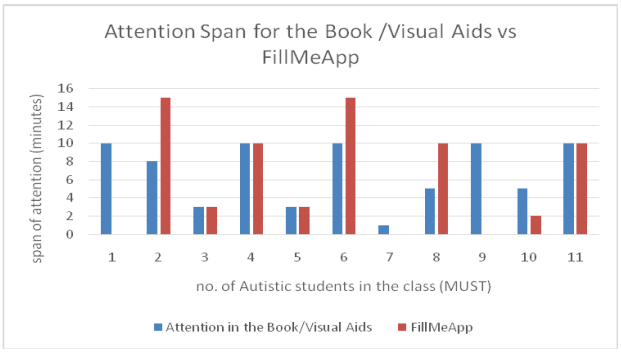

Figure 7. Attention Span of Children with Autism in Regards to Learning Material versus the Attention Span towards the FillMeApp in MUST – SPED CENTER

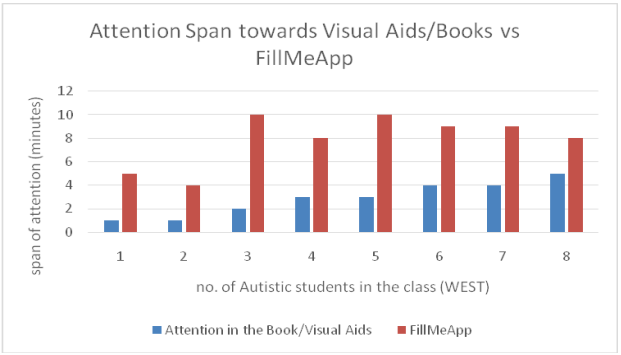

Figure 8. Attention Span of Children with Autism in Regards to Learning Material versus the Attention Span towards the FillMeApp in WEST – City Central School

TABLE I.
BEFORE AND AFTER MOTIVATION RATE IN MUST

MUST Autistic Students	Before	After
Kim	High	High
Aljon	Average/Nearly high	High
Trent	Average	Average
Jeff	Average	Average
LJ	Average	Average
EJ	Low	High
Andre	Average	High
Ted	Average/Nearly high	High
Joshua D.	High	High
Shaira	Average/Nearly high	High
Vince	Average	Average

TABLE II.
BEFORE AND AFTER MOTIVATION RATE IN WEST CITY CENTRAL SCHOOL

WCCS Autistic Students	Before	After
Joe	Low	High
Niel	Low	High
John	Low	High
Joshua S.	Low	High
River	Low	High
Christian	Low	High
Mike	Low	High
Arianne	Low	High
Vanessa	Low	High

IV. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

Based on the results, the Fill Me App which is a supplementary tool towards children with Autism has more span of attention rather than the books or visual aids; they focus more on the game, and were motivated rather than the traditional methods. But the researchers also concluded despite of the effectivity of Fill Me App towards children with Autism, the age also matters. Since mostly of the students in West City Central School is 15 below students is focusing more on the game rather than the traditional methods. While on MUST SPED Center most of their students are 18 plus and those students don't have the longest span of attention towards the game. The main goal of this is to help and assist the Autistic children that would enhance their understanding and capabilities by developing a learning game application specifically in the Science subject regarding with the Human's body parts. After thorough research, interview and surveys, it was then concluded that with the development of the game application, this has become more promising in terms of its efficiency and usability. The teacher or the parent can view or check the progress of the child's performance through the web application via internet. They would have the records of the child's passed activity trials.

B. Recommendations

The present system has failings and nonexistence in some of its processes. For its further development, the following details are highly recommended;

1. The researchers would like to recommend this game to children with Autism and to children who wanted to learn the human body parts especially those who are intellectually disabled.
2. Add more levels to improve one's learning capability and to make the game application more exciting and interesting.
3. It is also recommended that the users of the application must familiarize themselves with it in order to maximize all its functionality.

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