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# Engaging Children with ADHD using Mobile Based Games

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Abstract—Students with ADHD find it difficult to pay attention to one thing, stay focused, are hyperactive and face difficulty in controlling behavior. They might also not perform well in school, get along with friends or finish their assignments on time. The advent of smart mobile devices brought about new methods of learning like mobile learning. The objective of this research is to determine whether mobile based games can be used to engage children with ADHD. The design of the mobile game was based on existing literature about how to retain the attention and engage children with ADHD. The game developed was evaluated based on the duration of time the children played the game for and their actions while playing the game. It was concluded that that mobile – based games can help in retaining the attention of children with ADHD. This opens room for a complete new approach that can be used for teaching students with ADHD and other students with attention problems.

Keywords—component; formatting; style; styling; insert (key words)

## I. INTRODUCTION

The advances in Information Technology (IT) over the years have changed the way data is being processed. Computers are used in almost every task. Every household have one form of computer or the other. No government or private office can run efficiently without the use computers. These advances also led to the development of mobile phones, PDAs, and now the popular smartphones and tablets etc., all referred to as mobile devices. Mobile Devices are becoming more common, user friendly and still very powerful. Modern Mobile devices are usable for children from early ages to elderly people as long as they can read and move. Children and young adults are now mostly occupied by either of these mobile devices, playing games or using any of the stocked applications available. The motivation of this research is to determine if mobile based games can assist in retaining the attention of children with Attention Deficit Hyperactivity Disorder (ADHD). This is important considering the simplicity, and ease of access of mobile devices. This is also vital because it can provide an alternative means of deriving therapy for children with ADHD as ADHD is a childhood behavioral disorder that have no cure. The treatment for the core symptoms of ADHD have a lot of side effects and is not always reliable.

## II. LITERATURE REVIEW

### A. Categories of Mobile technologies

Mobile technologies is a term that is generally used to refer to such technologies that are mobile and portable. Mobile technologies are escalating transformations of the technology-mediated teaching and learning pedagogy [3]. The rapid advances in mobile technologies provides great potential that can facilitate people to be able to work in a dynamic mobile environment [4]. According to [1] mobile technologies can be defined as technologies that are *mobile* and *personal* like a mobile phone. They classified mobile technologies into personal static, shared and portable technologies. The diagram below shows their classification of mobile technologies. The classification consist a Cartesian plane with each of the categories on each axis. The mobile devices are placed in a quadrant depending on the properties of such device [1].

The second quadrant consist of mobile devices that are considered are personal and portable. It means such technologies that provides personal interactions with the user and which can be carried along everywhere. Mobile phones, PDA's, Laptops etc. are all seen to fall under this categories because they are personal as they are owned by one person and they can be carried along all the time.

The second quadrant include such technologies that cannot be moved from one place to another, non – portable devices but still provides personal interactions with the users. Classroom response system is a technology that provides one to one interactions between teachers and students and enables students answer multiple choice questions. They are static because they cannot be moved out of the classroom but are still small enough to be considered as personal are they are commonly assigned to a single student.

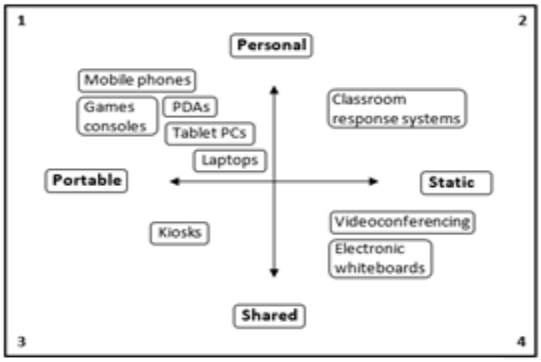

Fig. 1. Classification of Mobile Technologies [1]

The third quadrant consist of technologies that are portable and also shared. Being able to be moved physically from one place to another is not the only definition of portability when it comes to mobile technologies. Street kiosks, interactive museum displays, etc. provides a form of ubiquitous interactions with people but these devices are not actually physically portable. It is the users that are portable but not the devices. These technologies are large in size which makes

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them less personal and so they are considered as shared because they are normally shared among many people. The fourth quadrant can represent technologies that are shared and static. These devices are barely portable but they include it to show a complete space of possibilities of their classification [1].

### *B. Mobile Learning*

Mobile Learning came into being in the 1990's [5]. Mobile Learning refers to a form learning that focuses on portable mobile devices like PDAs, tablets, smartphones etc. for learning purposes [2]. Mobile learning can be seen as electronic learning delivered through portable mobile devices. Electronic learning refers to the learning process that utilizes electronic medium specifically Information and communication technologies to facilitate learning [6]. Mobile learning is essential and of vital importance because of its mobility and ease of access. Learning can take place virtually anytime anyplace. The use of mobile technologies is changing the way we learn, learning can now effectively take place on the go anytime anywhere. According to [7], the effective use of mobile technology for learning will facilitate equality in learning opportunities for students by removing time zone and distance barrier. The mobile devices are quite small and portable enough to allow learners use these devices anytime and anywhere to interact with different learners across the globe and discuss or share ideas depending on their various specializations and can even work collaboratively to finish some assigned task.

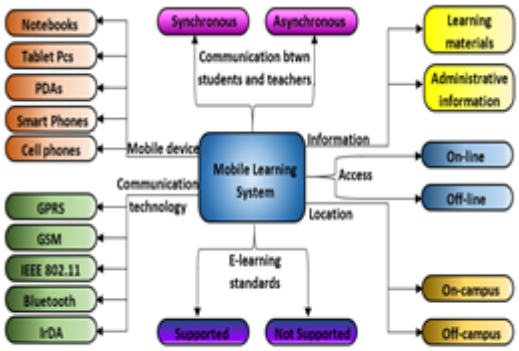


Fig. 2. A general classification of m-learning systems [2]

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According to [8] there are four fundamental elements in any mobile learning platform. They are the learners, instructors, teaching contents and teaching method. They further point out that the features of mobile learning as compared to traditional learning which are mobility, real-time, interactive, virtualization, digitization and individuation [8]. In a different research, [9] argued that the characteristics of mobile learning are accessibility, immediacy, interactivity, permanency and flexibility. This indicates that, generally every mobile learning platform should be at least ubiquitous, flexible and reliable in real-time. A detailed classification of mobile learning technologies was by [2]. They argued that the existing classifications support the information itself and the method used to access the information. And so, the existing classifications don't include some vital systems that don't correspond to their progress. They further pointed out that these existing classifications don't account for complexity of modern mobile learning systems and the support for e-learning standards and specifications. Figure 2.1 below shows their classification of Mobile Learning systems which is basically into Mobile devices, communication technology, information, location and communication mode between teachers and students With the advent of Mobile learning which is a new learning style, it becomes imperative to have some guiding strategies and theories that will guide this pristine mode of learning for effectiveness and efficiency and also to achieve all possibilities that the learning style can provide. This will ensure some uniformity and a form of standard. According to [10] taking mobile learning from other forms of learning perspectives like teaching theory, communication theory, design theory etc can facilitate the understanding of this new learning style. Mobile learning is closely related to several learning theories. [10] used ordinary and familiar concept of learning as a based that will facilitate the understanding of mobile learning in education. Their research showed that according to characteristics of learners, learning styles of learners, a variety of mobile learning device, learning resources etc., mobile learning can be broadly classified into four main categories as listed below:

- Regularity of Forgetting based Refresher Learning
- Pleasant Education based Game Learning
- Discussion based Cooperative Learning
- Some Common Mistakes

### *C. Mobile Game – Based Learning (mGBL)*

Mobile Game – Based Learning (mGBL) is a term used to refer to games that are specifically designed for mobile devices like smart phones and PDA's in which their primary target is learning. The main aim of mobile game – based learning is to use the game play in order to enhance the motivation for learning. [11]. According to [12] game – based learning have been proven to be a kind of learning method that enables students learning new things through game play thereby elevating motivation for learning.

The rapid advances and development in mobile technologies has made learning to become independent of specific time or location. They provide wide range of possibilities to revolutionize the teaching and learning now. Combining mobile learning and mobile game – based learning can bring about this revolution in education [13]. Games are known as successful medium which propel individuals to play, collaborate, impart and learn. Game and learning could be effectively created and executed in learning environment by combining both game design and instructional design approaches and by considering different issues, for example, learning theories, theory of play, game design, instructional design, etc. [11].

### *D. Engaging Children with ADHD*

Children with ADHD seeks attention by speaking out of turn, moving around and distraction others. They find it difficult to follow instructions and they have problem with completing long tasks. To be able to effectively impact knowledge to anybody, there is a need to get his attention and this makes the study of how to engage children with ADHD vital to this research. Existing research showed that the use of multimedia and hypermedia contents while teaching children with Attention Deficit Hyperactivity disorder can help in retaining their attention. Multimedia contents include sounds, images and graphs while hypermedia is an extension of multimedia and can consist of graphics, audio, video, plain text and

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hyperlinks. Hypermedia have the advantage of providing learners the ability and flexibility to decide which content to view first and so they have some control on the instructional medium [14].

Reward is also an important factor to consider while teaching children with Attention Hyperactivity Disorder. Children with ADHD are more sensitive to rewards [15]. Providing some form of reward for every successful accomplishment can greatly help in engaging them during learning process. [16] emphasis on the use of reward in engaging and controlling the behavior of children with ADHD. They proposed many ways that reward can be used in controlling the behavior of children with ADHD and how it can be used in engaging them. They pointed out that rewards should be awarded frequently and should be withheld for uncompleted tasks or failing to follow instructions [16].

### *E. Electronic Learning for Children with ADHD*

There is no cure for Attention Deficit Hyperactivity Disorder, even though treatment for the core symptoms is available. This treatment have a lot of side effect like migraine, vomiting, etc. and it is quite worrying for parents to see their children taking strong antibiotics. There is need for an alternative and more efficient way to manage ADHD [17]. Quite a number of research have been conducted on electronic learning for children with Attention Deficit Hyperactivity Disorder. [17] proposed an innovative alternative approach to ADHD therapy. It consist of a digital game that they hope to improve children with ADHD attention effectively while playing the game. The game consist of two sets which each consisting of four games. They used the principle of activity design with concept of game theory in behavior therapy and cognitive behavior therapy to develop the game. This game is however designed for personal computers [17].

## III. METHOD

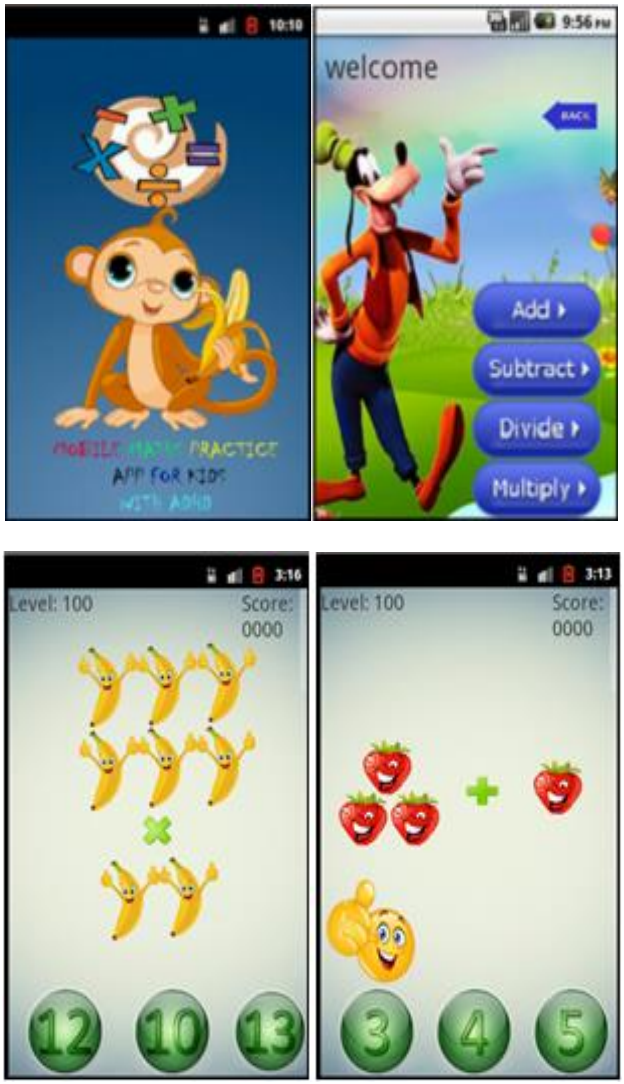
This research was based on qualitative approach (observation). Observation was suitable because it provides a better way to understand the participant who are children. The development technologies used for the development of the mobile game are Java, XML, SQLite and Eclipse ADT. The mobile game was developed based on the literature review conducted.

### *A. The Subjects*

The gamed developed was tested in a school for children with behavioural disorders like ADHD and Autism. The school is operating under Quranic Research Centre (QRC) of University of Malaya in Malaysia. They have 70 students out of which five have ADHD. They classify two out of them as low functioning and three of them as high functioning. Three of the children with ADHD participated in the research. They are the children that were classified as high functioning. The children that are low functioning cannot participate in the research because of the stage of their ADHD. The three participants are 12, 13 and 17 years old.

### *B. Game Development*

The mobile game was developed based on literature review, focusing implementing features that can help in retaining the attention of the subjects. The game was developed for android operating system using native application development methods and toolkit.




### *C. Usability Testing*

Mobile application testing is specifically very important because of the wide range of devices available and the several interactions possible with these mobile devices. Usability testing was conducted. Questionnaires were used to get feedback from the participants. The aim of this testing is to ensure that all the features included work as intended on several android smartphones, the buttons and options are clear enough and readable and to ensure majority of people can use the mobile game with no or minimal instructions.

## IV. EXPERIMENTAL PROCEDURE

The Observations were grouped into four main aspects each of which have a number of attributes and the attributes are classified as either positive or negative. The four main aspects are body language, facial expressions, in game behavior and comments. The participants were allowed to play the mobile game developed unconditionally. Table 1 was used to record the activities and reactions of the participants while playing the game.

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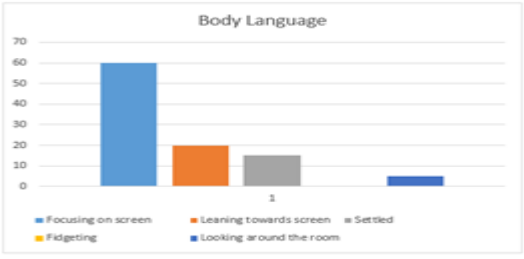
Table 1: Observation

| Type of Observation | +ve/-ve | Specific Actions Observed |
|---|---|---|
| Facial Expressions | Positive | ○ Concentrating/ attentive<br>○ Concerned<br>○ Surprised/shocked |
| | Negative | ○ Bored<br>○ Distracted |
| Body Language | Positive | ○ Focusing on screen<br>○ Leaning towards screen<br>○ Settled |
| | Negative | ○ Fidgeting<br>○ Looking around the room |
| Comments | Positive | ○ Discussion of game elements<br>○ Laughs<br>○ Assertion of joy |
| | Negative | ○ Assertion of boredom<br>○ Discussion of issues outside of game<br>○ Requests to stop the activity |
| In-Game Behavior | Positive | ○ Staying on task<br>○ Following instructions |
| | Negative | ○ Spending long time on a question<br>○ Answering questions randomly<br>○ Skipping tasks<br>○ Ignoring tasks |

## V. Results and Discussion

From the observation, all the participants played the mobile game developed for averagely 20 minutes voluntarily. Figure 3 shows the body language of the participant while playing the game. It can be seen that the average period of time the participants were focused on the screen is 60%. This indicates that the participants were engage will playing the game.



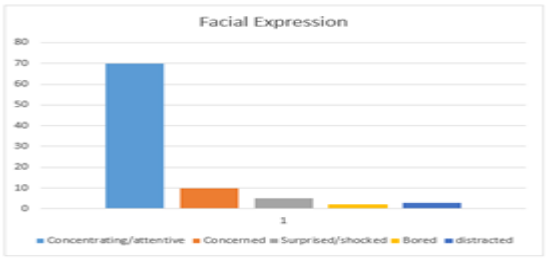

Positive: 95%
Negative: 5%

Fig. 3. Body Language results

Also figure 4 shows that the participants stayed on task with average 50% but 35% for following instruction which is in agreement with existing literature on children with ADHD that they find it difficult to follow instructions. Figures 5 and 6 all indicates a high level of engagement of the participants while the game. Based on the ethnographic studies and analysis of the interview, it can be concluded that that mobile games can help in enhancing the level of concentration and attention of children with ADHD and thereby can aid their learning progress.

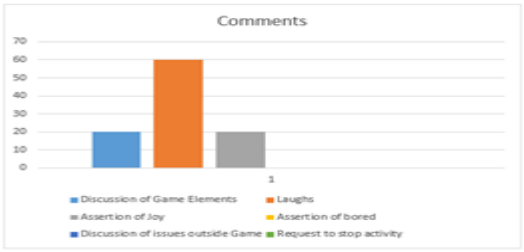

Positive: 85%
Neutral: 5%
Negative: 10%

Fig. 5. In game behaviour results




Positive: 85%
Negative: 15%

Fig. 4. Facial Expression results




Positive: 100%
Negative: -

Fig. 6. Comments results

### A. Result of Usability Testing

Table 2 shows the result of the testing. Questions mark with * are negatively warded questions. The questions are on a scale of 1 – 5 with 5 being strongly agreed. In general, the usability testing result shows that the mobile game is acceptable and the functions and objectives are clear enough and so the researcher can proceed with the experiment.

Table 2: Usability Testing Results

| Question No. | User Friendliness Construct: | Average Rating |
|---|---|---|
| 1 | The mobile game can effectively get and retain the attention of players based on your understanding of attention and concentration | 3.6 |
| 2 | There is no need for any guide to be | 4.2 |

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| | | |
|---|---|---|
| | able to play and explore all the options in the mobile game | |
| 3 | The texts, colours used and images are clear and nicely selected. | 4.3 |
| 4 | *Some of the functions in the mobile game are not fully clear. | 0.8 |
| 5 | *Some of the contents of the mobile game does not match with their intent. | 0.6 |
| 6 | It is very easy to start the game and create a new player | 5 |
| 7 | It is very easy to swap and navigate between the menus in the game. | 4.1 |
| 8 | *Players can get stuck while trying to perform and action in the mobile game | 0.6 |

## VI. CONCLUSION

In this paper, we investigate to determine if mobile games can be used to retain the attention of children with ADHD for educational purposes. An android mobile game was developed to include features used in retaining the attention of child with ADHD and was evaluated for usability. An experiment was carried out, in which children with ADHD are allowed to play the game voluntarily and their actions were recorded. Based on thorough analysis of the ethnographic studies and the video captured, and comparing the results with literatures about the average duration children with ADHD can concentrate on any particular tasks, it indicates a much higher percentage of interest in the game. This suggests that mobile games can help in enhancing the level of attention and concentration of students with Attention Deficit Hyperactivity Disorder and can there by aid their learning process. The mobile game developed was based literatures studied on learning strategies and learning theories for children with Attention Deficit Hyperactivity Disorder, and the results of the testing suggests that using high quality multimedia contents, regular and frequent reward for success, short sounds clips, simple graphics and short tasks in mobile games can assist in engaging students with Attention Deficit Hyperactivity Disorder.

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