Fight Obesity App: A Proof-of-Concept Prototype of Mobile Game-based Treatment

Wang Yanzhen[1*], Tan Wee Hoe[2], Maizatul Hayati Mohamad Yatim[3]

[1]National Child Development Research Centre, Universiti Pendidikan Sultan Idris,
35900 Tanjong Malim, Perak, Malaysia
wyz2479@gmail.com
[2]UPSI Education Research Laboratory, Universiti Pendidikan Sultan Idris,
35900 Tanjong Malim, Perak, Malaysia
whtan@fskik.upsi.edu.my
[3]Faculty of Art, Computing and Creative Industry, Universiti Pendidikan Sultan Idris,
35900 Tanjong Malim, Perak, Malaysia
maizatul@fskik.upsi.edu.my
[*]Corresponding Author

ABSTRACT

This paper presents how a mobile game was designed and developed in an education research laboratory as a proof-of-concept for treating obesity in preschool children. It depicts how a pediatrician cooperated with game based learning researchers to produce a mobile app for a game based obesity treatment. The intention of the pediatrician was to guide preschool children between the ages of three to six years old, to understand the concept of childhood overweight and obesity, while keeping in mind the long term consequences of obesity, and how to choose healthy food in Malaysian daily living contexts. The interdisciplinary cooperation between these individuals resulted the creation of the Fight Obesity 2.0 mobile app. The mobile app has been featured through tablet computer as a platform to gamify healthcare education contents for toddlers and young children. The major difficulty faced in the game production was determining the modality of multimedia content presentation and selecting appropriate pedagogical approaches for preschool children. This paper illustrates how the difficulty was overcome and reflects lessons learned from the interdisciplinary cooperation. The experience shown in the study would benefit professionals in medicine, preschool education and game experts who are interested in initiating cross-disciplinary cooperation for making treatment of obesity fun, engaging and meaningful for children.

Keywords: childhood obesity, game-based learning; game-based treatment; mobile learning; preschool children

INTRODUCTION

Overweight and obesity among children has increased alarmingly and become a serious public health problem (Lobstein & Frelut, 2003). In Malaysia, one out of five school going children is overweight or obese (Alya Hamzah, 2014). The issue of overweight and obesity is not only a heavy healthcare burden to a nation and a society, but also causes physical and psychological disturbance in the affected children. Therefore, it is very important to prevent and treat childhood overweight and obesity.

The data and statistics revealed by World Health Organization (WHO, 2015) indicated that childhood overweight and obesity have increased dramatically since 1980. Forty-two million children under the age of five were overweight or obese in 2013 (WHO, 2015). This issue of child obesity is no longer considered a problem faced by high income nations. Instead, the issue is on the rise in low and middle income nations. The increment rate of childhood obesity in the low and middle income nations has exceeded 30% more than in high income nations (WHO, 2015).

In Malaysia, the Third National Health and Morbidity Survey reported the overall prevalence of overweight (including obese) children was 19.9% (Suzana et al., 2012). In particular, Khor et al. (2009) found out that 3.4% of Malaysian children below 5 years old were overweight.

Comorbidities associated with overweight and obese children are similar to adults, such as elevated blood pressure, dyslipidemia, increased risk of fractures, early markers of cardiovascular disease, psychological effects, experiencing breathing difficulties and a higher prevalence of factors associated with insulin resistance. Although overweight and obesity are associated with many severe medical consequences even at a young age, the most common short term consequences of pediatric obesity are psychosocial in nature, such as psychological problems, discrimination or teasing (Wille et al., 2010). The results of a multicenter study done by Wille et al. (2010) indicated a considerably reduced Health Related Quality of Life (HRQOL) in overweight and obese pediatric clinical samples. In a recent study, Solveig et al. (2014) examined and discovered that the incidence of childhood obesity between the ages of 5 and 14 years was more likely to occur at younger ages, primarily among children who had entered kindergarten overweight in

the United States of America. Thus, the prevention and treatment of obese children would be more cost effective at the preschool stage.

Game-Based Treatment for Overweight and Obesity

The process of treating overweight and obese preschool children in present medical practice, from diagnosis to treatment, is tedious and time consuming (see Figure 1). The shaded areas shown in Figure 1 cover procedures which can be replaced by treatment through game playing or game based treatment. To date, the processes which still cannot be replaced by game based treatment include medical check on the physical body and laboratory examinations. If the diagnosis and the treatment could be done when children play games, a lot of time, energy, money and other resources could be saved.
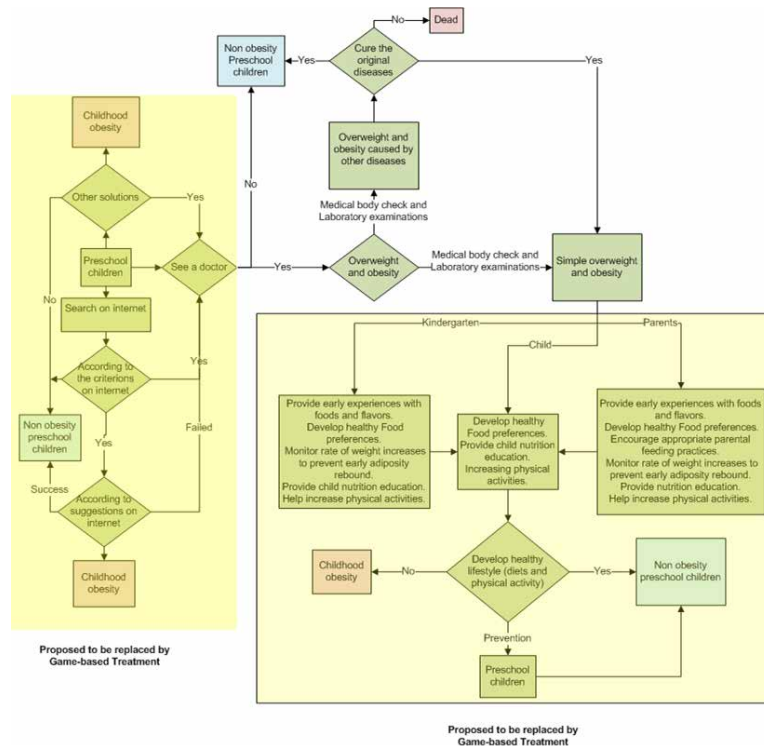

Figure 1: Processes (Shaded) which can be Replaced by Game based Treatment

Game based treatment is a form of patient centered treatment that uses games for health purposes. The notion of "game" in the concept of game based treatment is not about *what* types or genres of games can be used for treatment, instead it is about *how* various types or genres of games can help patients, doctors and the government to achieve the goals of prevention and therapy. In this sense, any type or genre of games which are related to achieving the goal of preventing or treating overweight and obese preschool children can be regarded as game based treatment in this study. Through game playing, patients get to know the causes, process, therapy and prevention of diseases associated with childhood obesity.

Game based treatment can be regarded as a form of electronic intervention. According to a systematic review on electronic interventions for prevention and treatment of overweight and obesity in young people, most studies demonstrated some forms of significant outcomes, i.e. reported changes in dietary or physical activity behaviors among the participants who received interactive electronic interventions (Nguyen et al., 2011). In medical science, game playing sessions were evaluated in randomized trials with the similar scientific rigor applied to pharmaceutical therapies (Kato et al., 2008).

One form of game based treatment is called exergaming. As introduced by Graves et al. (2008), exergaming involves using physically active digital games to provide a safe and fun means of energy consumption for children to lose weight. Exergaming dates back to 2004, when Vandewater et al. (2004) reported a study on how game playing was related to the fight against overweight and obesity. In fact, video games which feature wireless game console systems (e.g. the Nintendo Wii) and certain accessories (e.g. the dance pad in *Dance Dance Revolution*) showed a significant increase of energy expenditure among players (Graves et al., 2008). With the rapid development of electronic technology, children are commonly exposed to mobile and handheld devices, such as laptops and tablet computers, thus exergaming would continue to gain popularity among children (Kang, 2013).

Mobile Apps for Treating Obesity

According to Alexander (2013), mobile apps or mobile applications are software created to operate on mobile or portable devices, particularly

on smartphones and tablet computers. Through dedicated operation systems such as Android, iOS and Windows Phone, the apps facilitate mobile devices in performing practical tasks which are beyond the physical operation of the devices themselves.

In this study, mobile apps which are designed specifically for treating obesity are classified as mobile apps for treating obesity (MATO), regardless of the types of content, the genre of game play, and the choice of treatment approach. An ideal MATO for children should support the conceptualization and visualization of a healthy childhood lifestyle, while preventing overweight and obesity in daily living. In terms of cognition, the use of text based contents should be minimized if not avoided.

In general, there are a vast number of existing mobile apps and games that offer contents on how to lose weight. These apps might be used as MATO among children up to a certain extent. However, generally two issues would pop up. First, most mobile apps were created as games and published in Google Play Store and Apple App Store, in which the targeted players were not limited to preschool children. When this is the case, the contents were not dedicated specifically for children, thus the effectiveness of the apps in treating childhood obesity would be in doubt. Second, some of the mobile apps are wordy and require users or players to read lengthy instructions. The demand for comprehension would be a barrier of cognition among preschool children.

Game based Treatment Mobile App Design and Development

Tan, Nurul Fazmidar and Wang (2014) proposed a gamification model for designing and developing educational games. The model is based on outcome based education, in which learners become the center of teaching and learning activities, in which defining the intended learning outcomes is the first step of gamification. Each of the intended learning outcomes consists of three components, i.e. observable behaviour, degree of attainment, and conditions of attainment.

In the context of game based treatment, this model could be modified to gamify treatment of childhood obesity. In this sense, the intended outcomes of MATO are aligned to three structural components of games (Prensky,

2007), as shown in Figure 2. In the gamification process, the goal of the game needs to reveal intended observable behaviours, such as choosing appropriate food and drinks at the right time of the day. Rules that depict attainment conditions should be made explicit to players, i.e. the game should inform players what they can and cannot do to attain the game goal. Players' actions and reactions in the game playing session should be given feedback, informing the players of the degree of their attainment of the game's goals. In a word, game based treatment design is essentially a series of alignment between medical treatment steps and the structural elements of games.
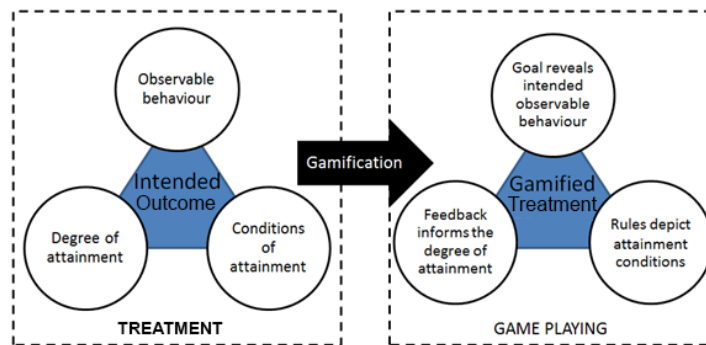
Figure 2: Fight Obesity is Created by Adapting the Gamification Model Proposed by Tan, Nurul Fazmidar and Wang (2014)

As for the mobile app development, medical practitioners ought to work alongside the game graphic artist, game audio specialist and game programmer. Every step of construction of the mobile app should be tested for its validity of contents and its quality of play. The contents must be validated by qualified medical practitioners, while the quality of play can be verified through play testing and usability testing.

Fight Obesity 2.0 App Design and Development

Fight Obesity 2.0 is a proof-of-concept educative mobile app dedicated to get children to conceptualize and visualize the importance of maintaining a healthy lifestyle, as well as the consequences of an improper diet which leads to obesity. The targeted players have been set as Malaysian preschool children. The game is playable on smartphones and tablet computers. Figure 3 shows the splash screen of the game.

Figure 3: The Splash Screen of Fight Obesity 2.0

In terms of development of game contents, a pediatrician structured the knowledge needed by children to prevent obesity into three types, i.e. knowledge of terminology in childhood obesity, knowledge of ways and means of treating childhood obesity, and knowledge of universals and abstractions in treating childhood obesity (see Table 1). The contents become the materials for gamification, i.e. the basis for preparing the intended treatment outcomes.

Table 1: Type of Knowledge Needed for Game-Based Treatment

Knowledge Type	Prompting Questions
Knowledge of terminology in childhood obesity	Q1. What is childhood overweight and obesity?
	Q2. What the cause of childhood overweight and obesity?
	Q3. What are the consequences of obesity?
Knowledge of ways and means of treating childhood obesity	Q4. What can be done to fight the childhood obesity epidemic?
	Q5. How can we develop a healthy diet?
	Q6. What is the recommended level of physical activity for children aged 2 to 5 years?
Knowledge of the universals and abstractions in treating childhood obesity	Q7. What are the principles for treating overweight and obesity in children?

When the pediatrician was preparing the game contents of Fight Obesity 2.0, the production team began to pitch game ideas to the pediatrician. A constructive alignment was done to ensure game playing activities in Fight Obesity would be parallel to the acquisition of knowledge and skills in three game levels: 1) Choosing Healthy Food Level, 2) Doing Exercise Level and 3) Answering Question Level.

At the beginning of the play session, players are allowed to choose the gender and body size of an in-game character to represent their actual body size. The customization of players' character or *avatar* is meant to create a sense of ownership and motivate the players to attain intended outcomes.

In Level 1, the game goal is to help tackle the problem of obesity in Malaysia by educating the children of the virtues of healthy eating habits, where the players need to choose the healthy foods and feed the in-game character (see Figure 4). The outcome players obtain in Level 1 will be carried forward to Level 2, to signify consequences of their dietary choice.

Figure 4: Screenshot of Level 1 in Fight Obesity 2.0

In Level 2, players are directed to learn the importance of doing exercise. By controlling the *avatar* in this level, players would be able to establish the connection between exercise and three important concepts, i.e. overweight, normal weight and underweight.

Figure 5: Screenshot of Level 2 in Fight Obesity 2.0

As for Level 3, the players are guided to learn the characteristics of a good lifestyle and habits (see Figure 6). Most of the questions use colorful graphics as opposed to text to minimize the need to comprehend textual information. To win the game, players need to answer all the questions correctly. If a player fails repeatedly in Level 3, he or she will be directed to visit a pediatrician for dietary advice (see Figure 7).
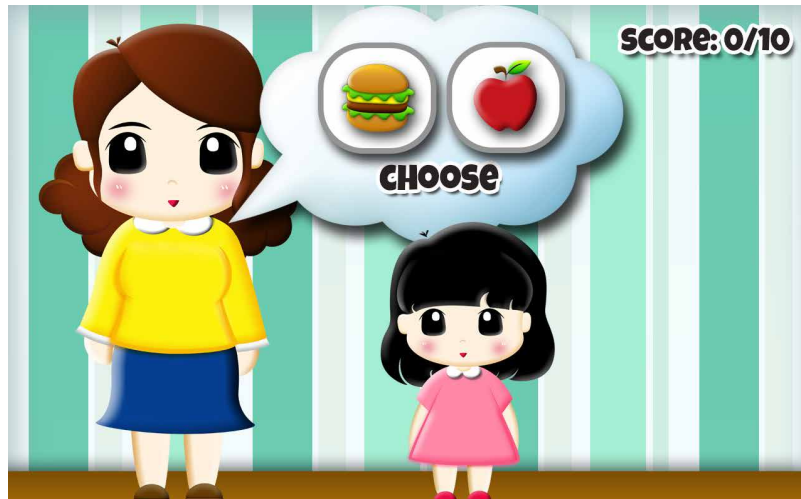

Figure 6: Screenshot of Level 3 in Fight Obesity 2.0

Figure 7: Lose Scenario, in which the Player Visits Doctor for Dietary Advice

DISCUSSION AND CONCLUSION

The idea of game based treatment is indeed not new, but it is rare to have a medical practitioner participate in the design and development of MATO. Thus, Fight Obesity 2.0 can be seen as a credible gamification attempt at obesity treatment. Nonetheless, the design of game based treatment should be initiated by defining the intended treatment outcomes, particularly the observable behaviour, the conditions and the degree of outcome attainment.

When Fight Obesity 2.0 was published in Google Play Store in mid May 2015, its contents were rated by Google Inc. and set by the International Age Rating Coalition (IARC). The result of the age based rating indicates that the minimum maturity level of content in Fight Obesity 2.0 is suitable for children aged three years old and above (see Figure 8). Also, Fight Obesity 2.0 won a gold medal in the International Invention, Innovation and Technology Exhibition (ITEX), after scoring more than 80 out of 100 marks in the following five judging criteria:

1.   Novelty and inventiveness

2.   Usefulness and application

3.   Presentation and demonstration

4.   Market and commercial potential

5.   Environmental friendliness

With the endorsement of IARC and the level of quality assured by ITEX, Fight Obesity 2.0 can be used by preschool teachers and parents to encourage children to conceptualize and visualize the importance of keeping a healthy lifestyle, in addition to the outcomes of an incorrect diet that cause childhood obesity. In practice, teachers or parents should begin by introducing the objectives of the game to the targeted child players. When the children fail to overcome challenges at any game level, teachers or parents should provide suitable explanations for the failure and then guide the players to win every game level. Upon completion of the game, teachers or parents should debrief the players as to their achievement, helping individual players to transfer knowledge gained through playing the game to daily living.

Medical practitioners who get involved in game based treatment design should be guided to understand how the contents they prepared could be gamified into game features. This is important to validate contents created for treating overweight and obesity.

Although the usefulness and the content maturity were validated by experts, empirical studies should be carried out to gauge the effectiveness of Fight Obesity 2.0 in treating childhood obesity. In other words, experiments, or at least quasi-experiments should be conducted with actual preschool children in Malaysia to examine the effectiveness of the game.

Figure 8: Age-Based Rating Certificate of Fight Obesity 2.0

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