

Bikers Game – Simulation Game to Introduce Calories for Children in Aged 7 – 8 Years Old

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Abstract

There is a trend in Indonesian people to shift their food pattern from traditional into high fat and low fiber fast food. Low level of knowledge about nutrition and balanced food, unhealthy dietary pattern, and sedentary activity were assumed as the main contributing factors for the increment of overweight and obesity in Indonesia. Childhood and adolescence are critical periods for health and development as the physiological need for nutrients increases and the consumption of a diet of high nutritional quality is particularly important. Eating habits, lifestyle and behavior patterns are established during this period that may persist throughout adulthood. Patterns of eating have a significant influence on health and well-being. This review will deal with the calories needs of children between the ages of 7 – 8 years with simulation game as a learning media.

For the purpose of this evaluation a new, more complete, paper-based questionnaire was constructed. The particular questionnaire, which elicited both qualitative and quantitative data. The questions corresponded to the following eight dimensions: perceived usefulness, ease of use, ease of learning, satisfaction screen, terminology and system information, system capabilities, and overall reaction to the software. The results indicated that the students' opinion about the game was positive, and suggest that with some extensions the game could be used as an effective learning tool. Finally, some corresponding conclusions and future improvements to the game are being discussed on the basis of the findings.

Keywords: calories, children, simulation game.

1. INTRODUCTION

Healthy eating can be defined as a balanced intake of food to meet the physiological needs of the body. The way of eating is determined by the age, the sex, the physical and/or mental work that is fulfilled by each individual and it can differ in order to ensure normal growth, employability and creating prerequisites for good health and life. A balanced intake of proteins, carbohydrates,

fats, vitamins and minerals with or without cooked food and distribution of meals during the day is a premise for maximizing the health and the quality of life [1]. Most are aware that this type of eating, if not in moderation, can damage the heart, kidneys, and waistlines; however, it is becoming increasingly clear that the modern diet also damages the immune system. The modern lifestyle is also typified by reduced exposure to microorganisms, increased exposure to pollutions, heightened levels of stress, and a host of other exceptionally well-reviewed variables that likely contribute to immune dysfunction [2].

There is a trend in Indonesian people to shift their food pattern from traditional into high fat and low fiber fast food [3]. Low level of knowledge about nutrition and balanced food, unhealthy dietary pattern, and sedentary activity were assumed as the main contributing factors for the increment of overweight and obesity in Indonesia [3]. Properties of food, such as large portion of high-energy-dense food has strong effect on excessive consumption, especially if it happened in long period [4]. The changes of food intake in middle-income country can be affected by availability of multinational fast food outlets [5]. Eating environment such as ready availability of palatable large portion of high-energy dense food can override the excess of energy intake over prolonged periods [4] and [6]. Previous study showed the correlation between energy density, low fiber, and high dietary fat pattern and increased fatness in childhood [5] and in adult [7, 4].

This review will deal with the calories needs of children between the ages of 7 – 8 years with simulation game as a learning media. Childhood and adolescence are critical periods for health and development as the physiological need for nutrients increases and the consumption of a diet of high nutritional quality is particularly important. Eating habits, lifestyle and behavior patterns are established during this period that may persist throughout adulthood. Patterns of eating have a significant influence on health and well-being. A healthy diet during childhood and adolescence reduces the risk of immediate nutrition

related health problems of primary concern to school children, namely obesity, dental caries and lack of physical activity.

The use of multimedia in education has significantly changed people's learning processes. Results from a number of research studies indicate that appropriately designed multimedia instruction enhances students' learning performance in science, mathematics, and literacy [8]. Previous studies indicate that computer-assisted instruction (CAI) programs have important factors that can motivate, challenge, increase curiosity and control, and promote fantasy in children [9]. Despite the fact that computer and video games have the same multimedia capability as CAI programs, their potential learning impact is often discounted by parents and educators.

2. LITERATURE REVIEW

2.1 Simulation Game

In recent years many managers, educators, and other practitioners have turned to the study of simulations and games in education [10, 11]. Also in academia simulations and games in education are a hot topic [12, 13, 14, 15]. Contemporary studies on games and education use a variety of definitions: education games, serious games [16, 17], digital game based learning [11], or applied games [18]. Simulations historically refer to both management/business simulations, and computer simulations [10]. In general, simulations are models that express complex real-world systems. A simulation is used to analyze specific systems, develop mental models in learners, or research artificial environments [19]. A difference between games and simulations is intent: 'the intent of games and simulation games is to engage players in a fun and entertaining experience, while the intent of simulators is to train and develop the skills of its operators [19]. The following definition of simulation games can be found in publications on management:

"A simulation game is an experiment conducted on a simulation model with a number of participants playing roles provided for in the game scenario. Participants are expected to make decisions, assess their consequences and formulate guidelines for making decisions in future periods" [19].

"A simulation game is a kind of a simulation model consisting of people (at least one person) playing roles that allow them to influence the remaining part of the model and get themselves familiar, at least partly, with its condition, whereas they choose freely some of the influences in each role" [10].

2.2 Gaming and Health

Research relating gaming to health has involved using various gaming mechanics to improve user interaction and engagement in monitoring and improving their health. One method found to educate people on nutrition is to allow them to challenge each other based on nutrition facts in a casual social game setting [20]. The advantage of casual social games is the ability to spur on critical thinking outside of gameplay and although the game simplistic in nature, it shows the notion of competition is a key driver that can be utilized to encourage continuous usage. Building on the notion of casual social gaming, daily healthy water intake is shown to increase by using a visual representation of the need to drink water in the form of a withering tree [21]. How healthy your tree is dependent on the amount of water consumed and results show improvement with the visual aid both with and without other players. This suggests the power of a visual representation to something normally that cannot be seen such as the need for water. Although we may know we need to drink water and we may feel thirsty, a visual cue and an external need (to save the tree from withering) is a stronger motivational tool that can push us to perform actions. This concept is fully developed and tested through a virtual-pet based game targeted at a younger audience [22]. In those application, data entry is performed through images and users will receive feedback on a 2 to 2-point scale with comments narrated by the pet. It was found that during the trial, "children playing the game ate a healthy breakfast 52 percent of the time; kids who didn't play it ate a healthy breakfast approximately only 20 percent of the time". Furthermore, both positive and negative feedback from the pet invokes a responsive action suggesting that the motivational ability of the game comes from the emotional connection with the pet and the ability to see the effects of their actions on the pet. The gaming mechanic from this study was similar to the initial proposal for Food Fight which also revolves around the concepts of virtual pets. However, the applications created for academic studies were not designed for prolonged use and thus did not consider user retention. For Food Fight, we proposed to incorporate further gaming elements such as competition in the form of challenges for the virtual pet to complete against friends.

The Food Fight prototype is essentially a social food journaling application with health feedback provided to the user. A user account is created when the user first signs up and information such as their height and weight are recorded and used to calculate their progress. Each user has a specific measurable goal they wish to attain and the app helps to track their weekly changes. The functionality of the application can be divided into four sections: profile, journal, advice and network. In the profile section, the user is able to view their own profile and make changes to what can be publicly seen by other

users of Food Fight. In addition, they are able to see their goal, the type of plan they are on and their most commonly entered foods. The journal section enables users to take photos and tag foods. These become meal entries which are stored on the Food Fight server. Each meal entry can consist of a photo and several tagged foods chosen from the food database we have created. Also recorded is the time of the entry and the user is thus able to view their previous entries in a chronological order, which provides a visual way of seeing exactly what they ate in the past week [23].

Exergames combine exercising with game play by requiring the users to perform some kind of physical activity (and exercise) in order to score points in the game. Exergames uses a custom designed Exercising Pad (called ExerPad) in order to track the user’s physical movement, and then automatically updates the corresponding game character’s position on the screen. The ExerPad contains different shaped images, which are captured from the smartphone inbuilt camera, and are automatically detected by our shape detection algorithm. We also use the smartphone inbuilt accelerometer and gyroscope to detect other physical movements from the user such as jumping, turning etc. The experimental results show that the proposed mobile exergames helps its users to burn calories and have fun at the same time [24].

2.3 Calories Needed for Children

Children aged 7-10 years old need lots of energy and nutrients because they’re still growing. The amount of energy that food and drink contains is measured in both kilojoules (kJ) and kilocalories (kcal) and is commonly referred to as calories. A healthy balanced diet for children aged 7-10 should include:

- at least five portions of a variety of fruit and vegetables every day
- meals based on starchy foods, such as potatoes, bread, pasta and rice (choose wholegrain varieties when possible)
- some milk and dairy products (choose low-fat options where you can)
- some foods that are good sources of protein, such as meat, fish, eggs, beans and lentils

School-age (7-8 years) children need about 1.200 to 1.400 calories per day for boys and girls, if they not do sport in a day or in category Not Active. In category Somewhat Active if they do sport 15-30 minutes in a day, so that boys and girls need 1.400 – 1.600 calories. In category Very Active if they do sport more than 30 minutes in a day, so that boys need 1.600 – 2.00 calories and girls need 1.400 – 1.600 calories, detail of calories needed each day for boys and girl can be seen in Table 1 for boys and Man,

and calories needed each day for girls and women can be seen in Table 2.

Table 1. Calories Needed Each Day for Boys and Man [25]

Age	Not Active	Somewhat Active	Very Active
2-3 years	1,000-1,200 calories	1,000-1,400 calories	1,000-1,400 calories
4-8 years	1,200-1,400 calories	1,400-1,600 calories	1,600-2,000 calories
9-13 years	1,600-2,000 calories	1,800-2,200 calories	2,000-2,600 calories
14-18 years	2,000-2,400 calories	2,400-2,800 calories	2,800-3,200 calories
19-30 years	2,400-2,600 calories	2,600-2,800 calories	3,000 calories
31-50 years	2,200-2,400 calories	2,400-2,600 calories	2,800-3,000 calories
51 years and older	2,000-2,200 calories	2,200-2,400 calories	2,400-2,800 calories

Table 2. Calories Needed Each Day for Girls and Women [25]

Age	Not Active	Somewhat Active	Very Active
2-3 years	1,000 calories	1,000-1,200 calories	1,000-1,400 calories
4-8 years	1,200-1,400 calories	1,400-1,600 calories	1,400-1,800 calories
9-13 years	1,400-1,600 calories	1,600-2,000 calories	1,800-2,200 calories
14-18 years	1,800 calories	2,000 calories	2,400 calories
19-30 years	1,800-2,000 calories	2,000-2,200 calories	2,400 calories
31-50 years	1,800 calories	2,000 calories	2,200 calories
51 years and older	1,600 calories	1,800 calories	2,000-2,200 calories

3.METHODOLOGY

Nutrition is an important part of the health of all children. It’s especially important for children getting cancer treatment to get the nutrients they need. Eating the right kinds of foods before, during, and after treatment can help a child feel better and stay stronger. There are many favorite foods for Indonesian children that consumed in their daily life.

Table 3. Calories Resource from Children’s Favorite

Kind of food	Kind of drink	Kind of Fruit	Kind of Vegetable
Instant noodle	Chocolate Milk	Blewah Melon	Spinach, cooked
Fried rice	Orange Juice	Banana (pisang mas)	Fried corn
Fried chicken wing with skin	Tea with Sugar	Apple, dried	Potato cutlet, deep fried
Beef meatballs	Naga Fruit Juice	Grape, red, raw	Carrots, baby, raw
Soto Ayam	Water	Pear	Broccoli

In Table 3 show resource calories that obtained from interview from student in Elementary School Dukuh Kupang V Surabaya, East Java, Indonesia, as participation. The number of participation in this research was 22 children in aged 7 – 8 years old. From this interview research show 20 of item in each kind of food, drink, fruit and vegetable. Those 20 calories resource was pick top five, which is the most favorite calories resource that consumed participation. Those calories resource consist of food, drink, fruit and vegetable. Kind of favorite food which is instant noodle, fried rice, fried chicken, meatballs and Soto Ayam. Kind of favorite drink which is chocolate milk, orange juice, tea with sugar, Naga Gruit Juice and water. Kind of favorite fruit which is blewah melon, banana (Pisang mas), apple, grape and pear. Kind of favorite vegetables which is spinach, corn, potato, carrots and broccoli.

Table 4. Total Calories

Calories Resource	Calorie *)	Fat *)	Carbohydrate *)	Protein *)
Instant noodle	219 calories	3,3 g	40,02 g	7,22
Fried rice	333 calories	12,3 g	41,7 g	12,47 g
Fried chicken wing with skin	137 calories	9,16 g	4,64 g	8,45
Beef meatballs	57 calories	3,69 g	2,12 g	3,47 g
Soto Ayam	312 calories	14,9 g	19,55 g	24,01 g
Chocolate Milk	190 calories	5,25 g	28,88 g	7,7 g
Orange Juice	112 calories	0,5 g	25,79 g	1,74 g
Tea with Sugar	55 calories	0 g	14,36 g	0 g
Naga Fruit Juice	50 calories	0,38 g	12,26 g	0,78 g
Water	0 calories	0 g	0 g	0 g
Blewah Melon	19 calories	0,1 g	4,49 g	0,46 g
Banana (pisang mas)	105 calories	0,39 g	26,95 g	1,29 g
Apple, dried	61 calories	0,17 g	16,33 g	0,35 g
Grape, red, raw	110 calories	0,26 g	28,96 g	1,15 g
Pear	96 calories	0,2 g	25,66 g	0,63 g
Spinach,	74	4,16	6,81 g	5,33 g

cooked	calories	g		
Fried corn	101 calories	0,03 g	24,28 g	1,88 g
Potato, deep fried	359 calories	18,7 g	45,38 g	4,21 g
Carrots, baby, raw	54 calories	2,48 g	7,99 g	0,74 g
Broccoli	87 calories	4,33 g	11,24 g	3,7 g

*) per 1 medium cup

Water is a major component of every part of the body. Although water contains no Calories and seemingly no necessary nutrients, it is necessary for digestion, nutrient absorption and waste-elimination. It also helps regulate circulation, body temperature and a host of biochemical reactions. Water lubricates joints and maintains healthy skin [26]. Calories resource in Table 4 was adapted from Tabel Komposisi Pangan Indonesia (TKPI) or we can say that Indonesian food composition table [27]. According to Table 1 and 2 whereas calorie's need in 7-8 years old are 1400 – 1600 calories, then the research made scenario game to simplify game on this research, the scenario is shown in below:

1. Player put his / her name, so that this game can write the player's name and child excited that she / he is play the game.
2. Game count down from 30 minutes as total duration playing game.
3. Game show source of calories as randomly, so the player could not get bored
4. Player choose source of calories as he / she wanted
5. Game always add and save choices source of calories from player
6. If the player no chooses any kind of source of calories as long as he / she play, then the player lost the game because player are less calories
7. If the player chooses source calories more than 1.600 calories, then player must take "water" to made calories to zero.
8. If the player not choose "water" in 5 second, then player is loss the game because player are excess calories.
9. If the player could keep calories between 1.400 – 1600 calories, then player win the game because player are enough calories.

Finite State Machines (FSM) are used to describe reactive systems [28]. A common example of such systems are communication protocols. FSMs are also used in OO modelling methods such as UML and OMT. This research need FSM to give better visualizing to explain scenario on this game.

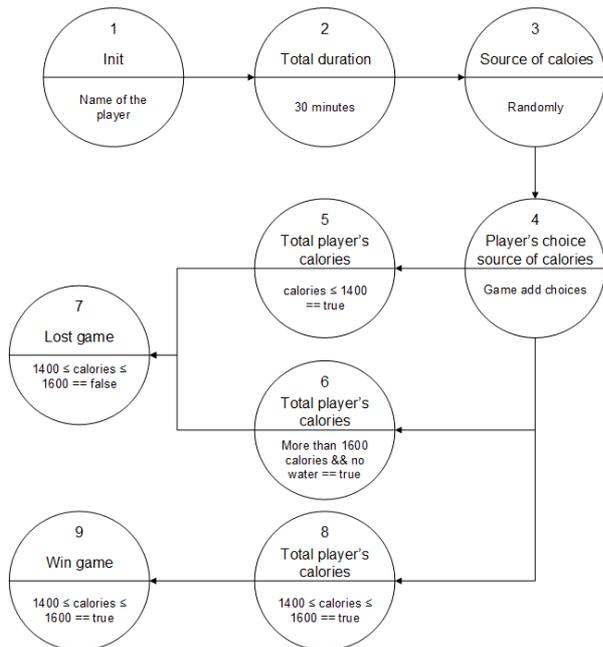


Figure 1. FSM Bikers game

Bikers Game receives as input the .apk file of the game that we want to profile. Disassembling and installation are done. Then, with the information from the Android Manifest we know which activity is the main one. The main activity is the one that is shown at the beginning of the execution of an application. Once it is launched, we start to collect execution traces. This cannot be done before because the process ID (PID) is required to get the game system calls, and this is assigned when the application boots. Then, once we have the first screen displayed, we get the current activity ID and current package name and we take a screenshot. This step is the beginning of every iteration on the main loop of Bikers Game. With this data, we check if (for any reason) we are outside of the game. For example, we could end on the web browser, seeing the game developers web page. In this case Bikers Game forces to get back to the game. Then we analyze if that screen is new or not, if we continue inside the game. When the screen is new, we have to load the source of calories and total duration of play game, get the clickable views and if necessary, detect objects. We save all this information to use it later, because whether the screen was previously shown, then we can load the saved information instead of gathering them again. After that, the next element to touch is calculated, in order to touch on every element in every order. When this is achieved, we mark that screen as completed. After that, the element obtained is touched or a swipe gesture is done over it. If all the screens we have discovered are completed, then we save the results (traces, screenshots, etc.) and Bikers Game stops. If not, we start the loop again. As it is very hard to complete all the screens due to the path explosion problem, Bikers Game can be stopped

at every moment. In this case Bikers Game also finishes properly, as if all the screens were completed. This process is shown in Figure 2.

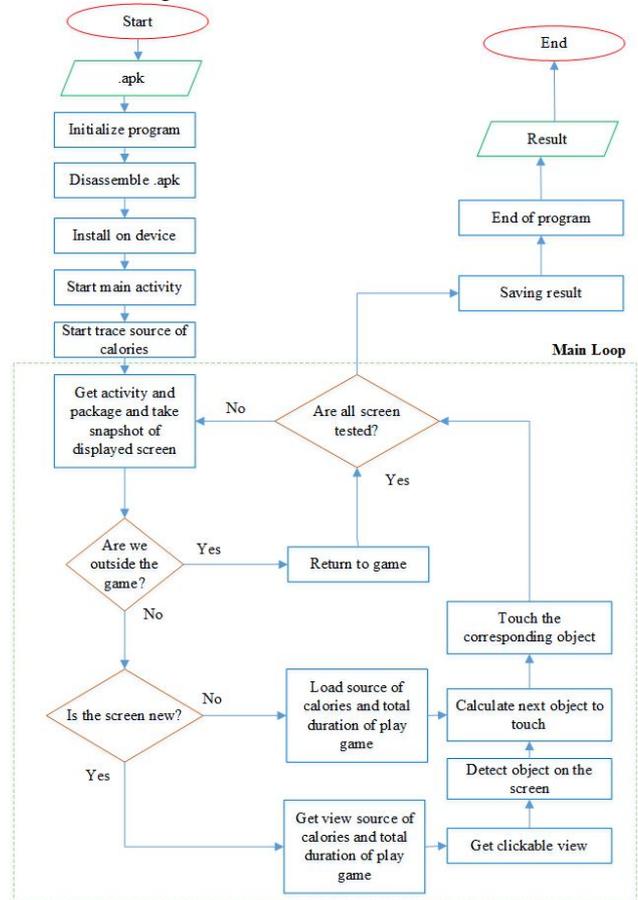


Figure 2. Flowchart Bikers game

4. RESULT

This section discusses the implementation of educational game. Figure 3 shows players choose source calories consist of food, water, fruit and drink. These source calories are displayed during play game. Player could press the space bar to move the characters begin play, and left click to choose source of calories. Source of calories turn in blue when player pick them up. When player source of calories more than 1600 calories, then the game displayed "water" in five second to make calories to zero.



Figure 3. Biker game

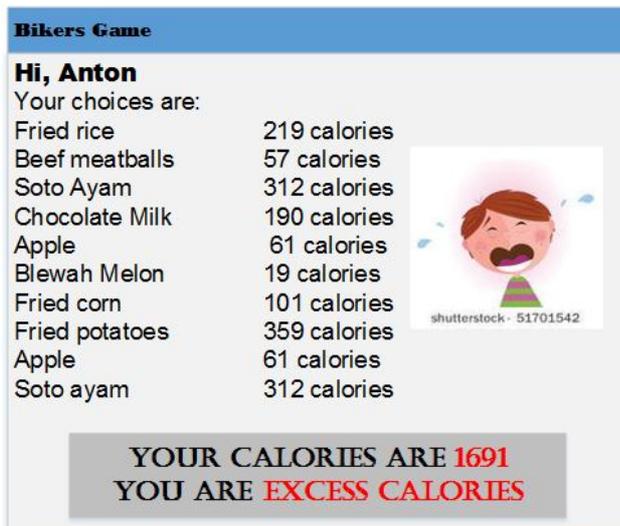


Figure 4. Player are loose game because excess calories

Figure 4 shows when player choose source calories consist of friend rice, beef meatballs, soto ayam, chocolate milk, apple, blewah melon, fried corn, fried potatoes, apple, soto ayam, and he doesn't take water. Total his calories are 1691 calories and he is excess calories.

5. DISCUSSION

Description of evaluation activities

An important objective of this study was the evaluation of the game as to its usability, capabilities and perceived usefulness, in order to improve it in subsequent editions. For that reason, several educational activities, which served as a means to gather qualitative data, were organized and implemented. Hence, the researchers had the opportunity to observe the players' reaction to the game, and to ask them for their feedback. Additionally, in order to gather quantitative data, a pilot study with thirty-two (32) 2th grade students of a private school was conducted. The group of participants consisted of eight (8) girls and fourteen (14) boys which have different kind of favorite source of calories, aged 7-8 years old.

For the purpose of this evaluation a new, more complete, paper-based questionnaire was constructed. The particular questionnaire, which elicited both qualitative and quantitative data, was based on the Questionnaire for User Interface Satisfaction (QUIS) [29], and on Lund's USE Questionnaire (USE) [30]. The 22 questions that were included in the questionnaire corresponded to the following eight dimensions: perceived usefulness, ease of use, ease of learning, satisfaction screen, terminology and system information, system capabilities, and overall reaction to the software. The questions' type was five-point Likert scale. This scale has 1 to 5 scale and 1 was assigned to 'strongly disagree' and 5 to 'strongly agree'. Additionally, the questionnaire included two open-ended

questions about the best and worst aspects of the game. The participants played the game in the class during 2 hours.

Result

The participants answer to the Likert type questions of the questionnaire were analyzed by descriptive statistics, and their answers to the open-ended questions were grouped according to their common themes. The statistical analyses were performed using the SPSS 16. The game's usability was assessed using the students' performance in each dimension. This was calculated using the mean score of their answers to the corresponding questions [31]. Generally, as the results indicated, the students' opinion about the game's usability was moderate to good. In particular, regarding the game in ease of learning, the statistical results are the following: $M = 1.47$, $SD = 0.58$, $N = 32$. The participants, the concerning the game statistical results terminology and system information are also positive, as the statistical results are $M = 3.67$, $SD = 0.84$, $N = 32$, and $M = 3.63$, $SD = 0.77$, $N = 32$, respectively. Furthermore, their responses to the rest of the questionnaire's dimensions were all above average, while the mean score for the participants score of the questionnaire ($M = 3.63$, $SD = 0.77$, $N = 32$). However, the lowest score was observed in the dimension concerning the system capabilities ($M = 3.33$, $SD = 0.98$, $N = 32$). In addition, according to the participants' answers to the open-ended questions, the game: (a) helped them understand calories needed, as well as water's need for human body; (b) it is easy, entertaining and pleasant; (c) it helps apply a more innovative approach to introduce calories needed for participant; and (d) it is flexible and, thus, it can constitute a useful tool for the revision of the lesson taught. Thus, concerning the first research question (What is your opinion regarding the usability of the 'Bikers Game'?), it was deduced that the participants were quite positive.

However, some participants encountered minor problems regarding the use of the game. For example, five participants stated in their comments that they would prefer the water should have more duration to show in this game so the player could not loss this game easily. Other observations were that it is quite simple, and it does not provide enough explanations on some solutions.

For instance, regarding the game was very easy to understand how the game is played ($M=4.67$, $SD=0.778$, $N=32$). Also the game did not require any complex computer usage ($M=4.42$, $SD=0.793$, $N=32$). The participants game was a lot more positive, function button and motivational appeal were also quite positive ($M=2.50$, $SD=1.88$, $N=32$).

6. CONCLUSION

This paper presented the design and development of the prototype of a configurable 2D game, aimed at introducing calories needed for children in 7 – 8 years old. Furthermore, the bikers game was evaluated in order to assess its usability aspects and to find any possible flaws. According to the results of the two evaluation studies, the participants' opinions about the game were mostly positive, and they considered it to be a useful and engaging learning tool. Furthermore, concerning the game's usability, most of its features elicited average to positive responses from the participants. These findings are encouraging and suggest that biker game are well-accepted and appreciated by participants. The work presented in this paper had certain limitations; for instance, the game is addressed to older ages and has limited number of challenges and functions. Additionally, the evaluation studies focused in eight dimensions: perceived usefulness, ease of use, ease of learning, satisfaction screen, terminology and system information, system capabilities, overall reaction to the software and two open ended questions about the best and worst aspects of the game.

Our future work aims at improving and extending the game, by adding new features, more hints and help messages. Moreover, a multi-player feature should be added to the game, in order to assess its impact on participants' opinion about the game. Also, it would be worth investigating whether cooperative or competitive game playing can enhance participants' engagement and motivation. And much better when there are speed of cycling to reduce player's calories.

The contribution of this paper is that it described a concrete case study on the creation and evaluation of simulation game designed according to calories needed for children [25]. In more detail, the game included interaction and feedback elements, a background story, clear rules, objectives and outcomes, combined with educational aspects. Finally, this paper demonstrated that it is possible to create simulation game that can be adapted according to calories need. In conclusion, it is hoped that this study adds to the existing research on instructional games and that the presented game will eventually become an effective educational tool.

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