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FoodCalorie: A Mobile Game to Learn Daily Calorie Intake Standard

Anik Das, Chittagong University of Engineering and Technology, Bangladesh
Sumaiya Amin, Chittagong University of Engineering and Technology, Bangladesh
Muhammad Ashad Kabir, Charles Sturt University, Australia
https://orcid.org/0000-0002-6798-6535
Sabir Hossain, Chittagong University of Engineering and Technology, Bangladesh
Mohammad Mainul Mainul Islam, Verizon Media, USA

ABSTRACT

Mobile games can contribute to learning at greater success. In this paper, the authors have developed and evaluated a novel educational game, named FoodCalorie, to learn food calorie intake standard. The game is aimed to learn calorie values of various traditional foods of Bangladesh and the calorie intake standard that varies with age and gender. They are the first in this field to perform an empirical study on women in Bangladesh to see how game-based learning can contribute to learn food calories. They further analyze and report the impact of participants' age, professions, and smartphone proficiency levels on their learning experience and progression. The study also conforms the finding of existing studies that game-based learning can enhance the learning experience.

KEYWORDS

Calorie Intake Standard, Food Game, Game-Based Learning, Healthy Meal, Mobile Learning, Women in Bangladesh

INTRODUCTION

Food is one of the basic needs of humans. For a healthy life, balanced food is necessary. Proper calorie intake can positively contribute to energy and well-being. Most people have no idea about the nutritional values of food, particularly the calories contained in each food. They either rely on ravishing food items without knowing what harm is caused, unconsciously leading themselves to fatal diseases, or they are simply deprived of proper nutrition (Shannon, 1994; Caamaño et al., 2019; Hakim & Kamruzzaman, 2016).

Improper nutrition can lead to health problems (e.g., obesity, malnutrition) caused by being overweight or underweight. A recent survey indicates that being obese or over-weight may cause a devastating effect on health (World Health Organization (WHO), 2013). Carrying excess fat leads to significant health hazards such as heart disease, stroke, and type 2 diabetes. It can also cause

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musculoskeletal issues such as osteoarthritis and some cancers, which might lead to undeniable impairment or even death. Malnutrition is a major cause of death in children and women. In addition to causing individual tragedies like maternal and child mortality, malnutrition results in excessive costs within the healthcare system through excess morbidity, increases premature delivery, and elevates risks of heart disease and diabetes (Health and nutrition status in Bangladesh: UNICEF, 2017). School-age children who suffered from early childhood malnutrition have generally been found to have lower IQ levels, deficient cognitive functions, below average educational achievements, and greater behavioral problems (Grantham-McGregor, 1995).

The global number of moderately or severely underweight girls and boys were 75 million and 117 million respectively in 2016. If post-2000 trends continue, the levels of child and adolescent obesity will surpass those for moderately and severely underweight youth from the same age group by 2022 (World Health Organization and others, 2017).

A study, conducted by the Imperial College London and the World Health Organization (WHO), stated that Bangladesh is facing the "dual burden" of both malnutrition and obesity (Islam & Reza, 2018). According to a study, between 1975 and 2016, the weight problems (malnutrition and obesity) among boys in Bangladesh have increased from 0.03% to 3%. Among girls, the rate has increased from almost zero to 2.3% (Khaled, 2017).

The prevalence of obesity increased from 2.7% to 8.9% among women in Bangladesh (Balarajan &Villamor, 2009). Childhood obesity is a particular public health concern for Bangladesh because children who are overweight or obese have a higher risk of becoming overweight or obese adults (Singh et al., 2008; Whitaker et al., 1997) and overweight adults are at increased risk for mortality and morbidity with obesity-associated chronic diseases, which are already a burden to the struggling health system in Bangladesh (Bhuiyan et al., 2013; Mirelman et al., 2012).

At the same time, Bangladesh has the highest rate of malnutrition in the world. As per the Food and Agriculture Organization of the United Nations (FAO), among preschool-age children, a ratio of 54% is stunted (which is greater than 9.5 million), whereas 56% are underweight and more than 17% are wasted further (Food and Agriculture Organization of the United Nations (FAO), 2010). Almost half of Bangladeshi women suffer from chronic energy deficiency for a long run and research suggests that little improvement has been made in women's dietary conditions over the past twenty years. Proper knowledge of the food values is essential for living a healthy life.

In Bangladesh, women hold the responsibility of cooking (Asaduzzaman et al., 2010; Barua, 2019; Charles & Kerr, 1988; DeVault, 1991; Ekstr̈om, 1990; E. L. F̈urst, 1997). They must be given proper knowledge of calories and nutrition in each food item. Only then, they can ensure a nutritious and balanced meal for each family member considering their age, gender, and activity. However, the traditional teaching approach is not fruitful since it is notoriously monotonous. A new approach needs to be introduced to overcome this challenging problem.

A wide range of smartphone applications are available for increasing awareness of the nutrition value of raw food items such as raw meat, raw vegetables, eggs, and milk. A number of these apps have focused on changing the lifestyle of people suffering from diabetes by game-based learning approach (e.g., Kamel Boulos et al. (2015)). Few of them have emphasized everyday exercise and daily nutrition intake for food in a specific country, for example, Korea (e.g., Lee et al. (2010)). One was developed only aiming at increasing fruit and vegetable intake among children (Baranowski et al., 2003). None of these has focused on the Bangladeshi (cooked) food nutrition values with a goal to enhance knowledge of Bangladeshi women, especially about calorie intake standard for different ages.

In this paper, we have developed a game in which player will learn food calorie values. Specifically, we have designed our game, named "FoodCalorie", for mobile phones and conducted an empirical study with 20 participants (Bangladeshi women) over two months period. Through pre- and post-intervention surveys, we studied how participants were acquired knowledge by playing the game. We have designed the game focusing on learning daily calorie intake standard for both male and female in different age, and calorie value of food items. Game has multiple levels, and in each level, a player

is asked to choose food items for breakfast, lunch and dinner for a person with a specific age and gender. Food items and amount must be chosen according to age and gender. After the completion of each level, a reward is given. Thus, a player can learn calorie values of different food items, healthy meals for breakfast, lunch and dinner, and daily calorie intake standard for both male and female of different ages by playing our "FoodCalorie" game.

In particular, in this paper we have made the following three major contributions:

- We have developed a mobile game to learn calorie intake standard. Our game is aimed to learn calorie values of various traditional foods of Bangladesh and the calorie intake standard that varies with age and gender.
- We have conducted an empirical study through our developed game to investigate how game-based learning approach can contribute to learning enhancement and conceptual understanding.
- We have also analyzed the impact of players' age, professions and smartphone proficiency levels on their learning experience and progression.

The remaining part of the paper is organized as follows. A comparative analysis of relevant research is discussed in 'Related Work' section. 'Food Calorie Game' section presents game architecture, interface and play rules. The section 'Empirical Evaluation' presents the results of our empirical study; and finally, the last section concludes the paper and outlines the future work.

RELATED WORK

Game-based learning (GBL) refers to the use of miscellaneous types of games such as digital or non-digital games, simulations, and electronic games (e-games). It has one or more specific learning objectives along with teaching & educational purposes (Wiggins, 2016; W. Tan et al., 2008; W. H. Tan et al., 2012; Cardinot & Fairfield, 2019; Wilsonet al., 2013).

Game-based learning has the ability to stimulate engagement, learning attitudes, and communication skills (Lui & Au, 2018; Sprengel, 1994; Garris et al., 2002). Additionally, it enriches the capability of understanding some critical concepts (Ganesh, 2014). There are several studies (Ke, 2008; Huizenga et al., 2009; Kolovou & Panhuizen, 2010; Miller& Robertson, 2011; Arnab et al., 2013; Annetta et al., 2009; Bourgonjon et al., 2010;Papastergiou, 2009; Lui & Au, 2018) which have proven success of game-based learning in primary, secondary and post- secondary education.

Games can develop healthy habits as demonstrated by several studies (c.f., Brazendale et al., 2015). Video games have shown useful for health and physical education (c.f., Papastergiou, 2009). Griffiths et al. surveyed several edutainment games for health and argued that video games can enrich the participants' knowledge about food and influence them to lead a healthy life (Griffiths et al., 2013).

Lee et al. proposed an application game called "SmartDiet" which was developed to analyze the patterns of everyday exercise and daily nutrition intake (Lee et al., 2010). It gives a customized diet profile and promotes understanding about nutrition via a diet game. They compared the usefulness of the application in terms of obtaining knowledge about weight control, dietary needs, and consumer contentment. Another study created five mini games to teach school children about food and nutrition (Yien et al., 2011)). The study showed that game play enhanced nutrition education better than a traditional learning approach.

The game called "Yummy Tricks" includes two mini games to teach children healthy food items (Ingl ́es-Camats et al., 2012). However, the paper has not evaluated the effectiveness of those games on changing food habits.

Another game called "Food Quiz" teaches children the carbohydrate values of bread, fruits, etc. using a carbohydrate unit-counting quiz, but it has a lesser effect on learning because of the unimproved prototype (Glasemann et al., 2010).

"MunchCrunch" is a game for children and adolescents that facilitates heuristic knowledge about food (Mansour et al., 2009). The game is to be played between teams who need to answer questions in each category represented by a virtual food pyramid. Through the answers of the questions, players enhance their food knowledge. However, there is no information about serving sizes in the question.

Mona O. Al-Sager et al. developed a game aimed at encouraging children to eat breakfast regularly and participate in more physical activities (Al-Sager et al., 2017). In this game, when a player (mainly a child) selects a food for breakfast, he/she is told whether the food item is healthy or not. After completing the breakfast, their total consumed calories are shown on the screen.

A game called "Squire's Quest!" was developed as part of a research study (Baranowski et al.,2003). The study showed that games could enhance the fruit, juice, and vegetable intake of children.

The games discussed above were aimed at teaching different groups of people about healthy foods and nutrition values for different kinds of food. None of the above-mentioned games has considered food items with specific unit of measurement. Most importantly, none of the above aims to educate daily calorie intake standard of a person with different ages and gender. Compared to the above research, in our game, we consider food items that are appropriate to the specific meal such as breakfast, lunch, and dinner. We have also considered daily calorie intake standard for individual person considering age and gender. We are the first to study this game-based learning in Bangladesh. A comparative summary between our study and other related studies is presented in Table 1.

FoodCalorie GAME

In this section, we will discuss our game architecture and interface in detail, including ratings and rules for achieving each level of the game.

Game Architecture

Figure 1 shows the game architecture. Our game uses Google Firebase[1] where food and calorie information is stored. Thus, an internet connection is required for playing our game. When the game is installed for the first time, a Login ID is generated by the Firebase, which is stored in the user's mobile phone for automatic login on future game play. When a user opens the game, the stored Login ID is used to authenticate the user in the Firebase and retrieve game data to display on the game application interface.

Game Interface

At the very beginning, the home screen will be shown (Figure 2). This screen shows the user the following options: Play – start to play the game; How to Play – a short demo video on playing this game; Profile – total number of levels with how many levels tried and passed; About – information related to the creation of the game; and Quit – to exit the game (see screenshot Figure 3).

A person's daily calorie intake requirements vary by gender and age. It also has a strong relationship with physical activity. For instance, a sedentary person usually requires fewer calories than a moderately active person (United States Department of Agriculture (USDA), 2002). In our game, we have used the average calorie value of sedentary and moderately active levels (assuming that the person does some physical activities). For calorie calculation, we have used data from a reputable health website (Medindia, 2001).

In this game, users are required to select food that provides appropriate calorie intake for a person with a particular gender and age. Our game has 96 levels (each level is for a particular age) starting from 3 years to 99 years. We did not consider 1- and 2-year-old children as they have special meal requirements. Figure 4 shows the level screen of our game. At each level, foods need to be chosen for a person at a particular age. The meals are planned as – breakfast, lunch, and dinner. There are six individual identical windows on each level. The first three windows are for male breakfast, lunch, and dinner and the next three are for female of a particular age.

Table 1. Summary of existing works

Reference	Country of Study	Aim/ Goal	Target Audience	Calorie Knowledge Coverage			
				Food Items	Age	Gender Considered	Meal
Ingl ́es-Camats et al., 2012)	Spain	Teach children healthy food items	Children (7-10years)	NS	NC	NC	NC
Yien et al., 2011)	Taiwan	Whether gamification enhances nutrition education	School Children (3 years)	NS	NC	NC	NC
(Glasemann et al., 2010)	Germany	Awareness of Carbohydrate in Food	Children and Adolescents (10-15 years)	Bread, Fruits, others	NC	NC	NC
(Mansour et al., 2009)	Georgia	Provide heuristic knowledge about food	Children and Adolescents	Dairy; Poultry, Fish & Eggs; Nuts; Fruits & Vegetables; Healthy Fats; Whole Grains; Potluck	NC	NC	NC
(Al-Sager et al., 2017)	Qatar	Take regular breakfast and promote physical activities	Elementary School Children	NS	NC	NC	Only Breakfast
(Baranowski et al., 2003)	USA	Enhance healthy food consumption	Children (8-12 years)	Fruit, Juice and Vegetables	NC	NC	NC
Our study	Bangladesh	Proper calorie intake based on age and gender	Women	Rice, Bread, Curry (Poultry, Fish and Vegetables), Fruits, Desserts, Dairy and others (including fast-food)	3 to 99	Yes	Breakfast, Lunch and Dinner

Note: 'NC' indicates 'Not considered' and 'NS' indicates 'Not specified'

Figure 1. Architecture of our FoodCalorie game

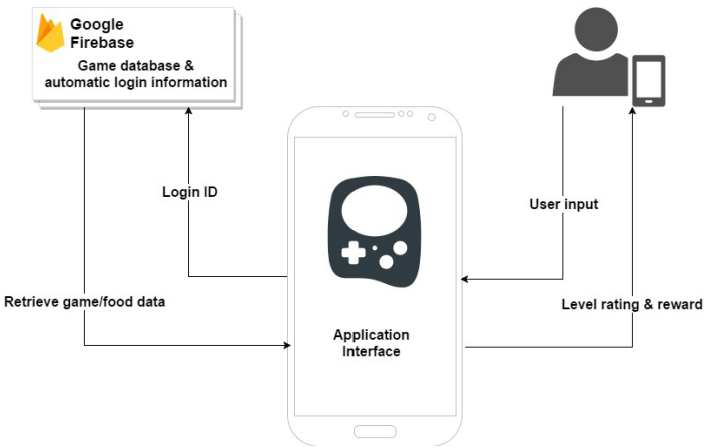


Figure 2. Home screen of our game

Figure 3. How to play screen

Figure 4. Level division of our game

We have included 72 food items in this game that are classified into seven types. Eight items are rice (e.g., plain rice, biriyani, khichuri, etc.); five items are bread (e.g., roti, slice bread, naan, etc.); thirty-two items are curry (e.g., meat curry, fish curry, vegetable fry, etc.); eleven items are fruit (e.g., pineapple, jackfruit, mango, etc.); six items are dessert (e.g., kheer, pudding, halwa, etc.); four items are dairy (e.g., eggs and milk); and six items are classified as other (including fast-food, e.g., burger, haleem, etc.). In our game window, the user needs to select three food items out of six given items chosen randomly from 72 food items.

Every country has its own tradition of food. In Bangladesh, rice and bread are considered the main food staples for breakfast, lunch, and dinner. Thus, we have designed our food selection pool in such a way that there are always two items from rice and bread types. The remaining four items will be chosen randomly from the other five assortments.

Figure 5 shows the food selection window of our game. In this window, a user needs to choose 1 to 3 items from the six items shown, using a drag-and-drop function. It also has an option to specify the quantity of the added item(s) by increasing (pressing the '+' button) or decreasing (pressing the '-' button) the units. Figure 6 shows the game after the selection of food items. As appropriate, in

Figure 5. Before selection of food items (for female age 33 breakfast)

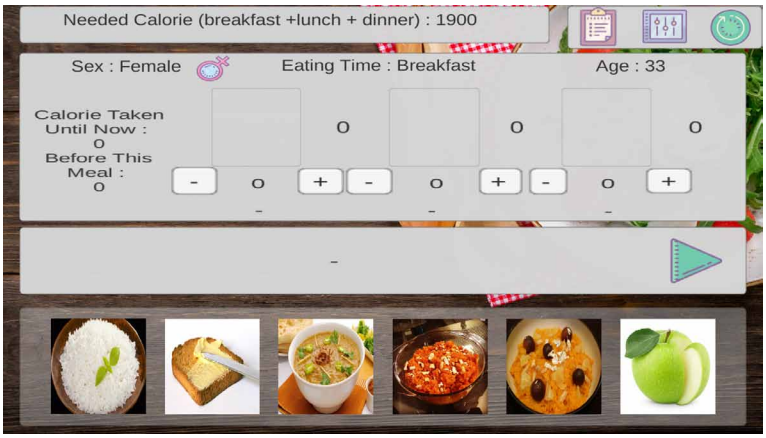
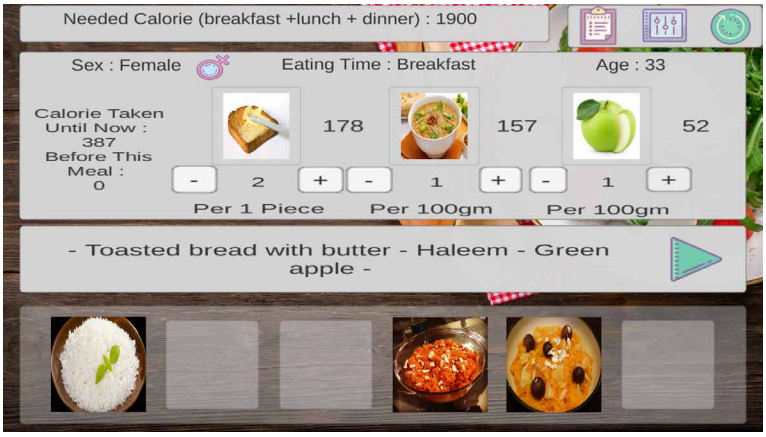


Figure 6. After selection of food items (for female age 33 breakfast)



our game, we have considered four types of units to measure food: 100 gm (for rice, dessert, etc.), piece (for bread, fruits, etc.), glass (for milk), and cup (for some curries). The total calorie count for each item for the specified quantity will be calculated and shown in the window. At the top of the window, we display the required daily calorie (i.e., breakfast, lunch, and dinner together) for a person with a specific gender and age. This needs to be considered while selecting items for breakfast, lunch, and dinner. The goal is to ensure that the total calorie count of the selected food does not exceed the daily limit.

Rating and Level Passing Rules

A level comprises six selection windows where a user selects breakfast, lunch, and dinner for a male and female. At the end of each level, a summary result is shown (Figure 7).

Based on the selected calories (corresponding to the selected meals) for male or female we award zero, one, two, or three stars to the game player as shown below:

- If the *selected calorie* $\leq$ *required calorie* $+5$ and *selected calorie* $\geq$ *required calorie* $- 5$, then the player will get 3 stars.
- If the *selected calorie* $\leq$ *required calorie* $+10$ and *selected calorie* $\geq$ *required calorie* $- 10$, then the player will get 2 stars.
- If the *selected calorie* $\leq$ *required calorie* $+20$ and *selected calorie* $\geq$ *required calorie* $- 20$, then the player will get 1stars.
- Otherwise no star will be awarded.

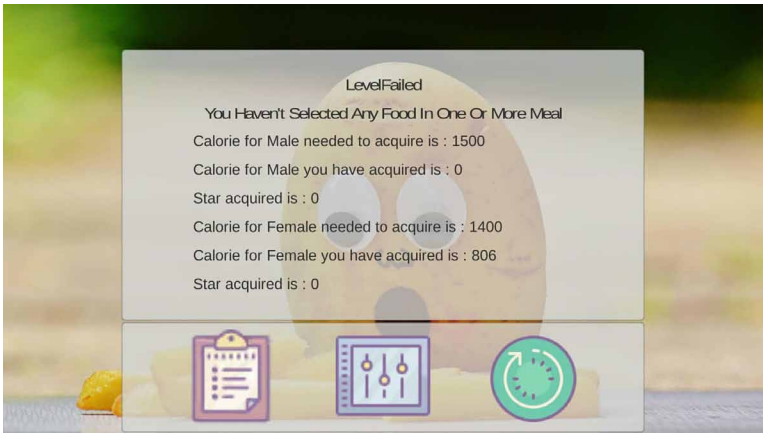
EMPIRICAL EVALUATION

We have conducted an empirical study to evaluate our developed game. In this section, we have described the study procedure. We have quantified and presented participants' knowledge enhancement, progression rate, conceptual understanding and satisfaction. We have also analyzed the impact of participants' age, profession and smartphone proficiency levels on their learning experience.

Participants

We ran our empirical study on twenty participants (female only) in Bangladesh, aged between 23 to 54 years. The participants were recruited through mailing lists as well as publicizing in

Figure 7. Window for showing the result



online social networks such as Facebook. Those who use smartphones and can install our game, were selected as participants. To analyze the impact of participants' professions on their learning experience, we have chosen the participants from five different professions (four participants from each profession): students, doctors, service holders, teachers, and housewives. Most of our participants have basic knowledge about using an Android phone and some of the participants regularly play games on their phones.

Study Setup

First, we informed the participants about the purpose of our study and introduced our game. We provided them with questionnaires and asked them to answer as best they could. Afterward, we asked them to play our "Food Calorie" game. When a user opens the game at the very first time, a demo is shown where the basic idea and instructions to play the game are clearly explained. We asked participants to play five particular levels: level 5, level 20, level 35, level 46, and level 65 – which covers different age groups with diverse calorie requirements. The participants were given two months to complete those levels and the condition was to acquire at least four stars in each level. After completing all the levels, the participants were asked to answer the post-test questions.

Table 3 (see in the Appendix) shows the description of the pre-test and post-test questions sets used in our study. We have categorized the questionnaires into five types: information, knowledge, usefulness, conceptual understanding, and user satisfaction. The "information" questions are for acquiring the participants' biography related information such as age, profession, etc. The "knowledge" questions are for identifying whether the participants have learned by playing our game. The "usefulness" questions are set to evaluate how useful the participants felt the game was. The "conceptual understanding" questions are introduced to evaluate participants' understanding of the game. The "user satisfaction" questions are set to evaluate how satisfied the participants are after playing the game. There are two columns representing pre-test and post-test questions. The very last column in the table describes the importance of asking these questions to the participants.

Results and Discussions

There were some questions common in both pre and post-tests that we set to find out how effective our game was (see Table 3 in the Appendix). We have come to know the following perceptions, which we have classified into five sections described below.

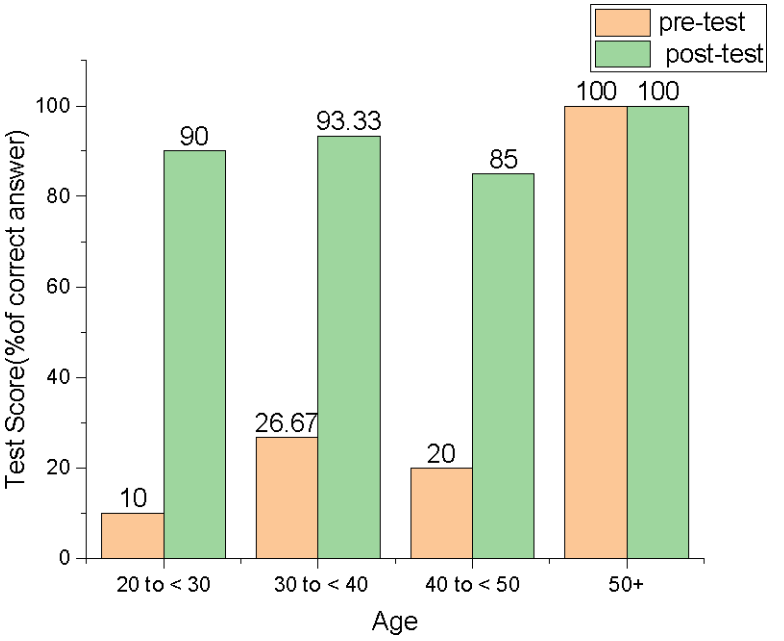
Knowledge Enhancement

We have evaluated our results by studying twenty participants where only 50% of them had some knowledge about the calorie requirement difference per age group. Only 65% of the total participants knew about calories in Bangladeshi traditional foods. We have quantified and presented the changes before and after playing the game. This helped us to understand the impact of participants' age, occupation, and smartphone proficiency in their learning experience.

Age vs. Knowledge

In Figure 8, the result for age versus knowledge gain is shown depending on the pre-test and post-test questions. Here we can see a dramatic improvement in knowledge in ages 20 to 50 years, where the participants answered incorrectly before playing the game and fixed their mistakes by almost 80% for the 20 to 30 years of age group, 66% for the 30 to 40 group, and 65%in the 40 to 50 group. The only exception was found in the 50+ age group where knowledge before and after was 100% in both pre- and post-tests. An explanation for this is that there was only one participant in this age group, a doctor by profession, and she is well aware of these calorie requirements per age group. This explains her correct answers in both tests. Thus, we can conclude that our game has enhanced knowledge within different age groups.

Figure 8. Knowledge enhancement for different age groups



Knowledge Enhancement vs. Professions

Figure 9 shows the relation between profession and knowledge enhancement. We have calculated the average pre-test and post-test scores (percentage of correct answers) of participants grouped by professions. The pre-test result shows that students, housewives, and service holders have very little knowledge (average test score 10%) about the required calorie intake, while doctors and teachers have knowledge on calorie intake due to the nature of their profession and thus scored 40% and 30% respectively. The post-test result shows that the calorie intake knowledge of all participants improved significantly (average test score was above 85%) by playing our game. This implies that this game can enhance calorie intake knowledge of people among different professions.

Knowledge Enhancement vs. Smartphone Proficiency

Figure 10 shows the relation between participants' knowledge enhancement and smartphone proficiency levels. The post-test result shows that the test scores increased with an increasing smartphone proficiency level. The knowledge enhancement of beginner, intermediate and expert users are 60% (i.e., from 15% to 75%), 72% (i.e., from 16% to 88%), and 74.37% (i.e., from 23.63% to 98%) respectively.

To demonstrate the statistical significance between the pre-test and post-test results, we have calculated mean (M), standard deviation (SD), variance (V) and also performed the t-test (Raju, 2005; Belle et al., 2004) based on twenty participants' pre-test & post-test responses. The results are reported in Table 2. t-value is calculated 13.67 (for degree of freedom 38) and p-value is 2.20767e-11 (shown in Table 2). Our calculated p-value is far less than 0.001, which indicates a striking difference in the number of correct answers and showing that participants' knowledge have significantly improved after playing the game.

Figure 9. Knowledge enhancement for different professions

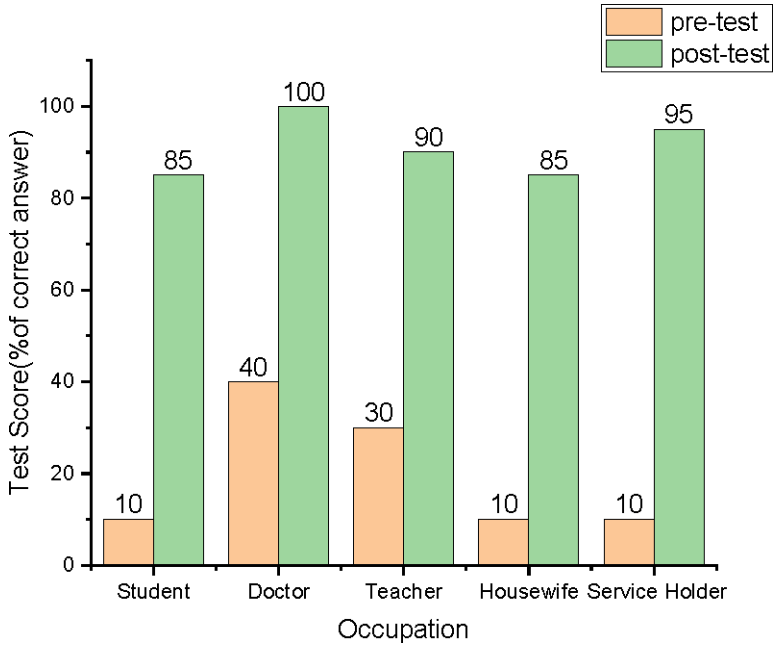


Figure 10. Knowledge enhancement for different smartphone proficiency levels

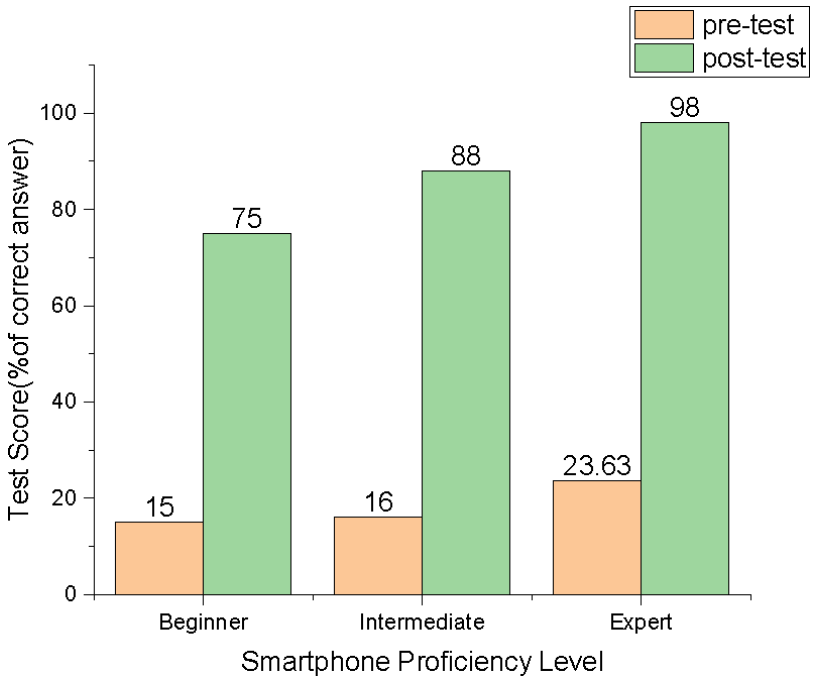


Table 2. T-test result

Values	Pre-test	Post-test
Mean (M)	0.2	0.91
Standard Deviation (SV)	0.178885438	0.147986
Variance (V)	0.032	0.0219
t-value (two-tailed)	13.67	
p-value	2.20767e-11	

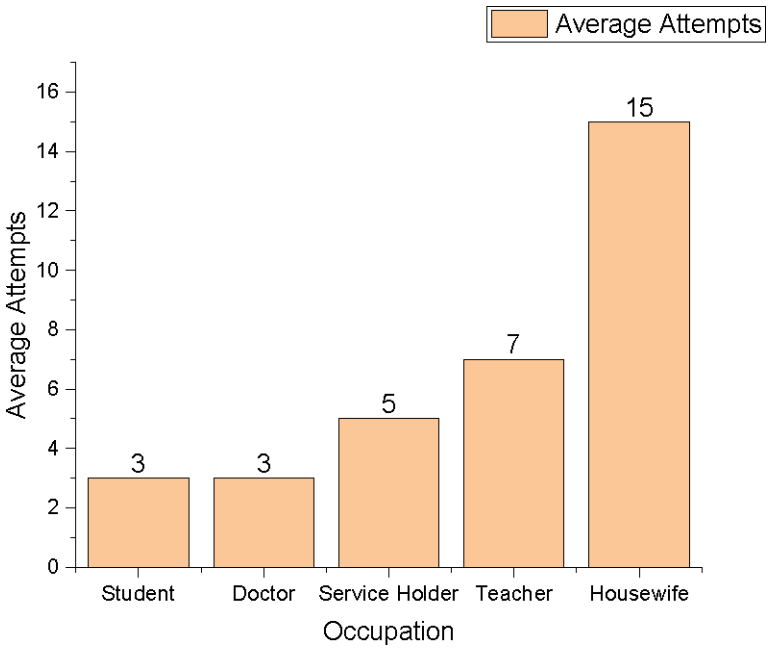
Progression Rate

We have also plotted graphs showing the average attempts for groups classified by occupations and smartphone proficiency levels. Afterwards, we have depicted the gradual progression for each level individually.

Average Attempt to Complete Game Levels

Figure 11 shows the average attempts of participants required to complete all the game levels for different occupations. The result shows that, in general, doctors and students required comparatively fewer attempts (i.e., 3 attempts) due to their nature of profession and learning capability. A moderate number of attempts are required for service holders and teachers (i.e., 5 attempts and 7 attempts, respectively). On the other hand, the average number of attempts by housewives is higher (i.e., 15 attempts), which implies that housewives need more time to learn through the game.

Figure 11. Statistics of average group attempt



Progression Rate vs. Profession

We have identified a relationship between participants' progression rate and profession that helps to see the gradual decrease of the number of attempts for each profession. From Figure 12, we can see that each profession group needs gradually less time while proceeding, which implies that users are gradually learning faster while completing the levels. This also explains why students and doctors are able to understand the game faster than the other groups. Teachers and service holders take a moderate number of attempts, whereas, homemakers need a higher number of attempts on average.

Progression Rate vs. Smartphone Proficiency Level

Furthermore, we can see that there is a relation between smartphone proficiency level and progression rate. Figure 13 shows that participants who have no smartphone proficiency require much more time than the participants having proficiency. The beginner group has a high average number of attempts (i.e., 19 attempts) in comparison to the expert group (i.e., 2 attempts). The intermediate group has a moderate number of attempts (i.e., 5 attempts).

Conceptual Understanding

We have measured the participants' conceptual understanding of the game by asking them a few questions about the parameters of healthy food, the parameters for the division of levels, how many times per day food needed to be selected, and what changes were noticed between male and female calorie requirements. We meant them as conceptual understanding because those pieces of information were not directly given in the game and the participants had to figure out the answers from their experience playing the game. What we found that 91% of participants have given the correct answers, while only 9% of them were incorrect. Based on this result we argue that our game is understandable to different ages and professions, and can contribute towards learning at greater success. It also confirms the state-of-the-art findings of game-based learning approach.

Figure 12. Statistics of progression rate

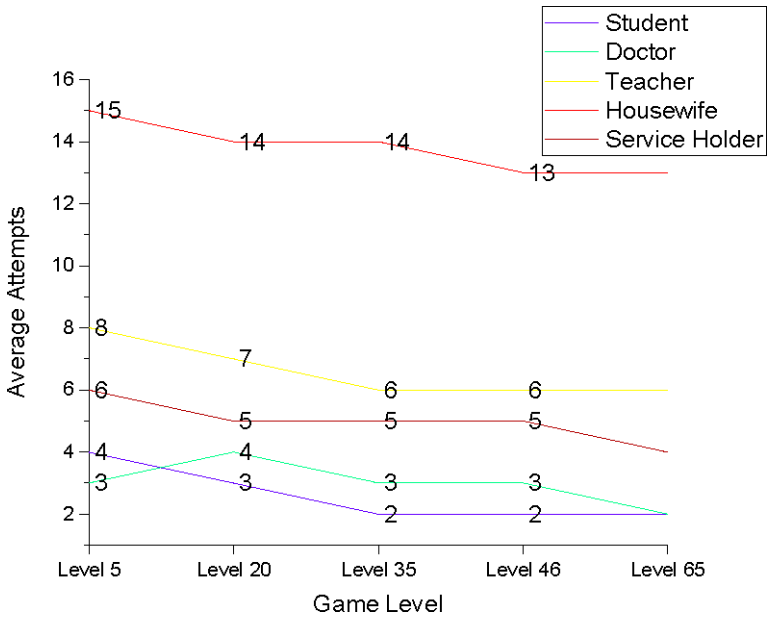
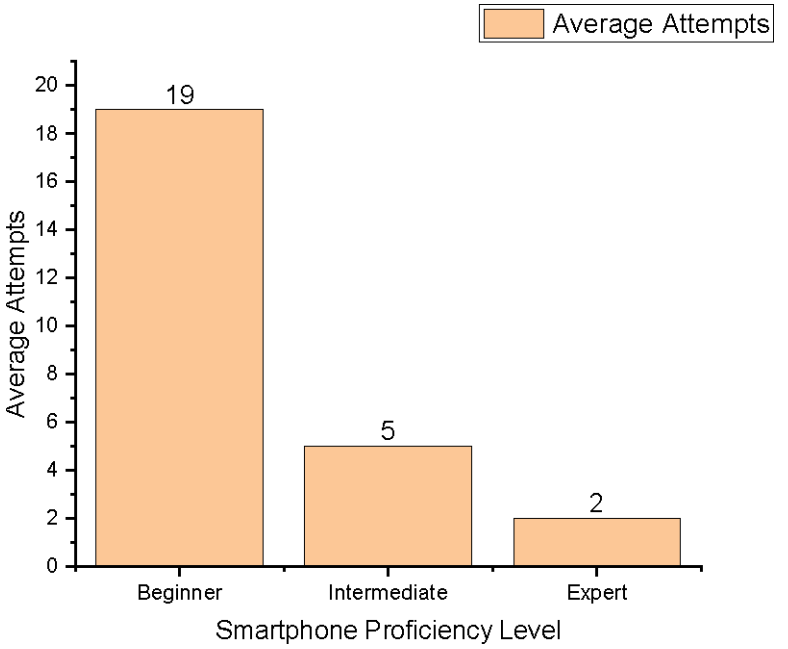


Figure 13. Statistics of average attempt for smartphone proficiency level



Usefulness

For evaluating the usefulness of our game, we asked participants some questions to understand their perceptions about this game. In particular, we wanted to know how useful the game is for learning calorie values of traditional foods with regard to calorie requirements by age and gender. Almost 94% of participants gave positive responses while 6% of them gave negative responses. This implies that our game is worth playing, not only for learning purposes, but also for selecting healthy food for all members of the family, including the person who plays the game.

User Satisfaction

We have quantified user satisfaction through the rating system. We have calculated the percentage of the provided ratings and found that, the majority of our participants have given a 5-star rating (55%), which is an achievement to our research. The 4-star rating was given by 40% of the respondents. Very few rated the game as 3-star (5%). We also asked our participants what developments they would suggest to improve the usefulness of the game, where, 45% suggested an easier game environment, 40% suggested including more food varieties, and 15% of the participants wished for better user-friendly graphics.

CONCLUSION AND FUTURE WORK

In this paper, we have developed and evaluated a game for learning calorie intake standard. We have conducted an empirical study to investigate how this game can enhance food calorie knowledge of the players, in particular, women in Bangladesh. The results of our empirical study show that the calorie intake knowledge of all participants improved above 85% by playing our game. The t-test result of our study shows that the knowledge enhancement of participants (with p value $<< 0.001$) was significant. The game also enhanced the conceptual understanding of all participants above 91%. 94% of participants found this game is useful for learning healthy food habits. 95% of participants

have rated our game 4 stars and above. We have also found that participants who are a doctor in the profession have achieved higher learning experience compared to other professions and the participants with the highest smartphone proficiency level have a higher progression rate.

As future work, our aim is to run a longitudinal study to investigate how this game can gradually encourages players/women to make better food choices for their family. Besides, we will explore how this game change the eating habits of individual players over the time.

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ENDNOTE

[1] https://firebase.google.com/

APPENDIX

Table 3. Survey Questions

Question No.	Question Type	Question Description	Is this a Pre-test Question	Is this a Post-test Question	Why this question was asked
Q1	I1	Age?	Y	Y	For identification and use in statistics
Q2	I2	Occupation?	Y	Y	For identification and use in statistics
Q3	I3	How do you think of yourself as a smartphone user (beginner, intermediate, expert)?	Y	Y	For identification and use in statistics
Q4	K1	What are the required calories for 7-year-old male and female?	Y	Y	To compare the knowledge difference between before and after playing the game
Q5	K2	What are the required calories for 22-year-old male and female?	Y	Y	To compare the knowledge difference between before and after playing the game
Q6	K3	What are the required calories for 37-year-old male and female?	Y	Y	To compare the knowledge difference between before and after playing the game
Q7	K4	What are the required calories for 48-year-old male and female?	Y	Y	To compare the knowledge difference between before and after playing the game
Q8	K5	What are the required calories for 67-year-old male and female?	Y	Y	To compare the knowledge difference between before and after playing the game
Q9	K6	Do you have any idea about the calorie requirement difference per age?	Y	N	To get information on previous knowledge
Q10	K7	Do have any idea about our traditional foods and how many calories they contain?	Y	N	To get information on previous knowledge
Q11	U1	Do you support the concept of learning about proper calorie intake method using recreation?	Y	N	To know if the user supports our research concept
Q12	U2	Did you find this game useful?	N	Y	To know how involved the user was
Q13	U3	What development ideas do you suggest for this game?	N	Y	To know how involved the user was
Q14	U4	Do you have a clear idea about calorie requirement differences per age after playing this game?	N	Y	To know how involved the user was

continued on following page

Table 3. Continued

Question No.	Question Type	Question Description	Is this a Pre-test Question	Is this a Post-test Question	Why this question was asked
Q15	U5	Do you have a better idea about our traditional foods and how many calories they contain after the game?	N	Y	To know how involved the user was
Q16	CU1	What do you think is the main concept of the game?	N	Y	To know what the user has learnt after playing the game
Q17	CU2	What was the parameter of healthy food here?	N	Y	To know what the user has learnt after playing the game
Q18	CU3	How were the levels divided?	N	Y	To know what the user has learnt after playing the game
Q19	CU4	How many times are given for food choice?	N	Y	To know what the user has learnt after playing the game
Q20	CU5	What change did you notice in male and female calorie intake?	N	Y	To know what the user has learnt after playing the game
Q21	US1	How many ratings will you give to this game out of five?	N	Y	To know how deeply involved the user was
Q22	US2	Was the game environment comfortable for you?	N	Y	To know how deeply involved the user was
Q23	US3	Do you think this game will help you to choose food for your family members?	N	Y	To know how deeply involved the user was
Q24	US4	Would you encourage others to play this game?	N	Y	To know how deeply involved the user was
Q25	US5	Does this game seem good at teaching technique as well as mind relaxation?	N	Y	To know how deeply involved the user was

Note: Here, in the 'Question Type' column, 'I' indicates 'Information', 'K' indicates 'Knowledge', 'U' indicates 'Usefulness', 'CU' indicates 'Conceptual Understanding' and 'US' indicates 'User Satisfaction'. In the 'Is this a Pre-test/Post-test Question' column, 'Y' indicates 'Yes' and 'N' indicates 'No'

Anik Das is a Lecturer in Computer Science and Engineering at Bangladesh University, Dhaka, Bangladesh. Earlier, he has completed his Bachelor of Science (B.Sc.) in Computer Science and Engineering from Chittagong University of Engineering and Technology in the year 2019. He is a promising young scholar who has been involved in multiple research collaborations with some eminent researchers around the world. He possesses a strong interest in Data Mining, Human-Computer Interaction, Machine Learning, Data Science, Social Media Analysis, Game AI, Bioinformatics, Neuroscience, Educational & Health Games and Multimedia Systems.

Sumaiya Amin is an MSc student of Computer Science at St. Francis Xavier University, Canada. She is a former Lecturer of Computer Science and Engineering at the University of Information Technology and Sciences (UITS) in Bangladesh. Earlier she has completed her Bachelor of Science (B.Sc.) in Computer Science and Engineering from Chittagong University of Engineering and Technology(CUET) in 2019. She is a promising young researcher who has been involved in multiple research collaborations with some eminent researchers around the world. Her research interests include Human-Computer Interaction, Persuasive Computing, Machine Learning, Health Informatics, Computer Visualization, Gamification and Behavioral Analysis.

Ashad Kabir is a Senior Lecturer at Charles Sturt University, Australia. He has more than ten years of teaching and research experience in a number of universities including Nanyang Technological University (Singapore), Deakin University (Australia), Swinburne University (Australia), University of Nantes (France) and Pusan National University (South Korea). Over the years, Dr Kabir has been involved in a number of projects from different industries, including Rolls-Royce (Singapore), Samsung (South Korea), INRIA (France) and Computer Associate (Australia). Dr Kabir received his PhD in Software Engineering from Swinburne University of Technology, Melbourne, Australia. He is a member of IEEE and ACM. Dr. Kabir has research experience in a range of areas of computer science. His research interests include mobile health, mobile data mining, human-computer interactions, context-aware adaptive systems, social context awareness, data/software behavior mining, smart mobile applications, and pervasive/ubiquitous computing.

Md. Sabir Hossain received his bachelor degree in computer science and engineering from Chittagong University of Engineering & Technology (2015) with an outstanding result. He has also completed his M.Sc. degree in computer science and engineering in 2019 from the same university. His research interests are algorithmic complexity analysis, data mining, machine learning, big data, and software engineering. He is currently working as a faculty member (Assistant Professor) in the same department of his university. He has a number of publications in international conferences as well as journals. Besides teaching and research activities, he also works as an independent freelancer.