Enhancing Healthy Dietary Habits in Adolescents through Innovative Technology in Pakistani Community

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In the Name of Allāh, the Most Gracious, the Most Merciful

Declaration

I hereby declare that this thesis titled "***Enhancing Healthy Dietary Habits in Adolescents through Innovative Technology in Pakistani Community***" is my own work and to the best of my knowledge. It contains no materials previously published or written by another person, except where due acknowledgement, is made in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic is acknowledged. I also verified the originality of contents through plagiarism software.

Aliya Azam

Approval

It is certified that the contents and form of the thesis entitled **"Enhancing Healthy Dietary Habits in Adolescents through Innovative Technology in Pakistani Community"** submitted by **Aliya Azam** have been found satisfactory for the requirement of the degree.

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Dedication

Dedicated to ones who gave me life and grew me up

Those angels who were always my supportive.

I owe them each moments of my life and praise

them in every breath.

Dedicated to the most holy person, Mother

And the dearest person, Father.

Acknowledgement

In the name of ALLAH, the Most Gracious and the Most Merciful Alhamdulillah, all praises to ALLAH for the strengths and His blessings in completing this thesis.

I might want to spread my appreciation to the numerous individuals who served to convey this research project to finish. To begin with, I might want to thank my supervisor **Dr. Sharifullah Khan** for helping me. I am so profoundly thankful for his help, significant direction all through this research; I do not have enough words to express my profound and sincere gratefulness.

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Lastly, I must express my extremely significant gratitude to my family for providing me consistent backing and persistent support during my time of study and through the procedure of inquiring about and composing this research write up. This achievement would not have been possible without them.

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Abstract

Nutrition is known as the science of nutrients to nourish the body by all essential nutrients such as calcium, proteins, fats and minerals. Good nutrition is the right amount of nutrients from healthy foods in the right combinations. Particular consumption of healthy nutrients during adulthood can reduces constant sickness, chronic diseases, metabolic syndrome; stunted growth and other illnesses. Various junk food items attract more towards unhealthy food. The fast food businesses have been exceptionally replacing healthy food with fast and pre-processed food. Improving healthy eating in children is a major public health issue that requires effective actions in order to avoid adverse short, medium and longer term consequences.

In order to enhance nutritional knowledge and healthy dietary behavior, innovative technology was used in this research. Quasi-experimental research was adopted. The study design was mainly quantitative; however, in order to triangulate the data to maintain reliability, qualitative as well as quantitative data collection techniques were used. The research sample was a total of 70 students (i.e. 29 girls, 41 boys) and five teachers. Data was collected from Fauji Foundation School Gilgit-Baltistan. Duration of the study was 2 weeks. It has been made sure that students have played interactive video game five to six times in two weeks' duration. Learning outcomes were measured through students' pre and post-tests, however change in dietary behavior was also measured from teachers' feedback questionnaire. To further investigate the qualitative data, it was also analyzed to find out what changes teachers have found in their students' eating behavior. The responses of teachers validated our research results. The hypotheses designed for our study were both accepted showing positive results of intervention. This shows that innovative technologies can enhance nutrition education in a better way than traditional methods.

Keywords

Innovative Technology, Dietary Habits, Nutrition, Junk Food

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List of Abbreviations

UNICEF	United Nations International Children's Emergency
WHO	World Health Organization
EFA	Education for All
ICT	Information and Communications Technology
SPSS	Statistical Package for the Social Sciences
TPACK	Technological Pedagogical Content Knowledge
UN	United Nations
BMI	Body Mass Index

Chapter 1: Introduction

1.1 Background Information

Healthy eating is very important for better mental and physical health of upcoming generations; it has been long known that early education about nutrition is very important for good health (Pérez-Rodrigo and Aranceta, 2001). The significance of emerging healthful eating habits during childhood and adolescence is undeniable. For the healthy growth and development, diet should be healthy during adolescence (Spear, 2002). Chronic diseases, metabolic syndrome, stunted growth and other illness are results of unhealthy food habits that are developed during their early development years (The World Bank Group, 2011). There is a dire need of nutrition knowledge among adolescents for food selection. Various junk food items attract more towards unhealthy food. This is due to deficiency of awareness about nutrition and their independent food selection in their early age of life (Tomkins, 2001). Clearly, improving healthy eating in children is a major public health issue that requires effective action in order to avoid adverse short, medium and longer term consequences (Waddingham et al., 2015).

1.2 Importance of Nutrition

Nutrition is known as the science of nutrients to nourish the body by all essential nutrients like calcium, proteins, fats & minerals. Good nutrition is the right amount of nutrients from healthy foods in the right combinations. Particular consumption of healthy nutrients during adulthood can reduces constant sickness chronic diseases, metabolic syndrome, stunted, growth and other illness. One of the most common diseases among adolescents is obesity which is one of the consequences of unhealthy food (Marotz, 2014).

The fast food business has been exceptionally replacing healthy food from users with fast and pre-processed food. According to the English dictionary fast food is a kind of food that is regularly pre-prepared and served rapidly. Merriam-Webster online defines fast food word as a quick food prepared for intake with little priority given to its quality. According to Oxford dictionary fast food is a quick baked food served in cafes or in restaurants or packed for home. Dietary habits have been changed due to rapid expansions

in the fast food business, as well as sociological and technological growths; people are more prone to eat fast food (Horinger and Imoberdorf, 2000).

According to WHO (World Health Organization), “Adolescence is a chapter in human growth and development that starts after childhood and before adulthood, age ranges 10 to 19. It is one of the vital phases due to remarkable evolutions in the life span and can be characterized by its rapid rate in growth and changes”. More than 1.5 billion individuals of the world's aggregate 6.7 billion are between the ages of 10 and 24 years. Around 70 percent of the youngsters live in developing countries where social, financial and health difficulties are more noteworthy, when compared with industrialized states (United Nations, 2015)

According to United Nations of Pakistan report, our country has one of the world’s largest youth bulges, with 35 percent of the population aged 18 or under. Pakistan is among those countries, which are facing challenges in recognition, awareness and promotion of its health necessitates (United Nations of Pakistan, 2013). It is assumed that for ideal development and advancement appropriate nourishment and normal physical movement among adolescents are vital for developing good health for the short and long run (Patrick et al., 2004). Healthy nutrients requirement in pre-adulthood are higher than any other stages of life (Giovannini et al., 2000). It is thought that healthy dietary nourishment is the one of the critical component in quick development and improvement of youth (Yannakoulia et al., 2004). Research has proven that building healthy eating behavior in early growth of life and continuing these habits in adulthood can reduces most cardiovascular diseases (McNaughton et al., 2008).

1.3 Nutrition Education Programs in Schools of Pakistan

Studies shows that children dietary habits are mostly developed in their childhood it can be from environment, media and siblings and most of these habits last to their adulthood (Powers et al., 2005), researches in the developing countries concludes that major factor that influences child’s eating behavior is from family (Barroso, Sichieri and Salles-Costa, 2012). One of the major factor that develops healthy eating behavior in children are parent’s education (Agha, Maqbool and Anwar, 2005); But this doesn’t fit in Pakistan due to its low literacy rate (53%) (Agha, Maqbool and Anwar, 2005). Parents as well schools

both are equally responsible for disseminating early nutrition education (Pérez-Rodrigo and Aranceta, 2001). It is demonstrated in an analysis that there is insufficient nourishment information in schools of Pakistan. This concludes that most noticeably bad state of nutrition education (Siddique, 2013).

1.4 Motivation

Literature survey concluded that not only in Pakistan, health issues are biggest growing problem in the world due to highly easy excess and affordable prices of junk food. It has been concluded that knowledge is highly correlated to dietary behaviors (Nyapera, 2012); there is dire need of introducing effective ways to reduce the health issues which are growing among most in adolescents. The reason behind this is limited knowledge through which they cannot give priority to healthy food and ineffectual nutritional education and less time given to this subject. The nutritional knowledge, attitudes and behaviors of students cannot be changed efficiently and permanently until and unless effective nutrition education programs are introduced that are of adolescent's interest. There are lots of effective ways used to teach healthy diet food to gain interest of students like garden base activities, animated videos and video apps (Powers et al., 2005) (Siddique, 2013) (McAleese and Rankin, 2007).

1.5 Problem Statement

The most common problem that has been found among people is that they don't have enough knowledge about nutrition, they don't know what to eat, when to eat and what is good for them. However, what if they are adolescents as this stage is considered to be one of the most important phase of life where higher rate of change in growth and development occurs. It is observed in Education for All 2015 National Review Report: Pakistan, EFA six goals are developed by considering quality of education however health and hygiene factors are still ignored which is one of the emerging issues in schools. In research it has been found that in Pakistani school curriculum, nutrition education has not been given importance (Siddique, 2013). Their improper diet will not only affect their physical growth but also mental health. The current challenges in schools are: How to correct their eating

habit? How to increase their nutrition knowledge? How to gain their interest while teaching healthy habits? Will gaining nutrition knowledge can change their eating behavior?

Keeping in view all above factors, this research is carried out to find out ways and means to use interactive apps in health sector. This research illustrates benefits of innovative technology in improving nutritional knowledge and dietary habits among adolescents by keeping their interest. Furthermore, current study aims to find out the relationship between nutritional knowledge and dietary behavior.

1.6 Research Objectives

Research objective of this study is to enhancing nutrition knowledge and healthy dietary habits in adolescents through innovative technology in Pakistani community. There are two hypothesis developed for this study:

- **Hypothesis #1**:

The 'null hypothesis' might be:

H0: Innovative technology can’t enhance nutritional knowledge in adolescents in Pakistani community?

And an 'alternative hypothesis' might be:

H1: Innovative technology can enhance nutritional knowledge in adolescents in Pakistani community

- **Hypothesis #2**:

The 'null hypothesis' might be:

H0: There is negative correlation between gain in nutritional knowledge and change in dietary behavior.

And an 'alternative hypothesis' might be:

H1: There is a positive correlation between gain in nutritional knowledge and change in dietary behavior.

1.7 Thesis Outline

The remaining thesis is organized as follows: Chapter two defines the background study of the importance of nutrition and ICT contribution towards health education. Chapter three describes the adopted research methodology, multimedia and app structure, sample size,

intervention flow chart, data collection and procedures. Chapter four provides details about statistical analysis and proposed SPSS tests which are used for evaluation and results comparison. Chapter five finally concludes the work done in this thesis. It describes research contribution and defines future work of the thesis.

Chapter 2: Literature Review

This chapter will give an overview of related work and analyze the existing work in importance of nutrition education and effectiveness of technology in health sector.

2.1 Food Essentials

Health, safety, and nutrition are firmly related and reliant on each other. These variables directly affect nature of each other (Jyoti, Frongillo and Jones, 2005). It is observed that children who have healthy eating behavior have a low risk of illness and very active in social activities as compared to those children who have an unhealthy eating behavior. Moreover, this unhealthy nutritional behavior can result in loss of appetite, laziness, fatigue, inability to focus on study (Whitaker, Phillips and Orzol, 2006) (Kennedy, 2006). In other words, "Nourishing status influences the nature of kids' wellbeing which thus, impacts nourishing necessities expected to restore and keep up great wellbeing (Jyoti, Frongillo and Jones, 2005). Healthy nutritional preferences include, providing nutritional information and introducing good nutritional habits to children when they are young (Jyoti, Frongillo and Jones, 2005).

2.1.1 Nutrition Knowledge

Dietary knowledge has directly influences on selection of nutritional choices (Akar Sahin, 2009). According to survey conducted to determine the level of nutritional knowledge among adolescents living in Pakistan; it has been found that in a population of above 180 million, middle-class is growing. About one quarter of the total population represents the possible market for fast food, and it is also rising due to increased affordability. Increased desirability of fast food in Pakistan is reflected by achievement of international fast food chains such as McDonald's, KFC, Pizza Hut, Pizza Express, Subway and others (UNICEF, 2012). Due to ineffectual nutritional education and limited curriculum time devoted to this subject; the nutritional knowledge, attitudes and behaviors of students cannot be changed efficiently and permanently (Siddique, 2013).

2.1.2 Fast Food

The fast food business has been exceptionally replacing healthy food from users with fast and pre-processed food. According to the English dictionary fast food is a kind of food that is regularly pre-prepared and served rapidly.

Merriam-Webster online defines fast food word as a quick food prepared for intake with little priority given to its quality. According to Oxford dictionary fast food is a quick baked food served in cafes or in restaurants or packed for home. Dietary habits have been changed due to rapid expansions in the fast food business, as well as sociological and technological growths; people are more prone to eat fast food (Horinger and Imoberdorf, 2000).

2.1.3 Relationship between Nutrition Knowledge and Dietary Behavior

Nutrition Education is the procedure by which individuals gain knowledge, attitudes and skills necessary for developing appropriate dietary habits. Schools, families and communities are the fundamental social contexts in which standard of living are developed (Worsley, 2002). Nutrition behavior are developed through various elements, for example, the educational programs, school environment, nourishment learning, states of mind, social convictions and standards (Glasauer and Sherman, 2006).

2.1.4 Importance of Nutrition Education in Schools

Adolescence is a time of life somewhere around 11 and 21 years old it is a period of quick physiologic, mental, and social advancement impacting supplement needs and an individual's capacity to supply those necessities (Tur et al., 2004). Many of the researches have proved that early healthy nutrition education plays a vital role in their life. Studies suggested that schools are the most appropriate place for nutrition education and for developing healthy eating habits. Since it’s the perfect age for developing healthy eating behavior to secure solid development and built up a strong immune system to fight syndromes. Moreover, it leads to maintain students’ attendance and performance in their studies (Mukhayer et al., 2013).

Moreover, Buxton (2014) in his research, concluded that Junior High Schools adolescents are involving in junk food like pizza, burger, snacks, not having proper breakfast, lunch, having such food which are unhealthy nutrients like coke, cakes during school time. It is vital to take serious measures to educate healthy food choices and behavior (Buxton, 2014).

2.1.5 Dietary Practices among Adolescents

Buxton (2014) in his research, revealed reason why adolescents' choices are unhealthy nutrients. He says that the dietary practices of young people have been portrayed as not the best, mostly as an after-effect of their busy schedules, peer pressure and their independent decision making. It is consequently essential that young people have dependable nourishment information that will control them to settle on educated choices with respect to their dietary attitudes and practices. This study was designed to find out eating practices among adolescents of junior schools in Ghana. The findings of this study have shown that Junior High School understudies, who are teenagers, don't have adhering to a good diet practices and behavior they normally skip breakfast and incline towards high sugar and fat substance nourishment items as a snack (Buxton, 2014).

2.1.6 Sources of Nutrition Education for Adolescents

There are different sources of teaching healthy nutrition education. McAleese and Rankin (2007) in their research conducted nutrition education through garden based activity, they have divided participants into two groups one is experimental and other is control group to analyze the difference of consumption of fruits and vegetables in these groups. Results have shown that the participants who were in experimental group increased their serving of healthy food.

Barak, Ashkar and Dori (2011) in their research recognized the vital role of animated movies to student learning. This research uses animated movies to teach science lesson. This study concluded that use of animated movies in learning not only gains students interest also it motivates student to learn more about it as compared to those students who studies in traditional method. Animated movies capture verbal and auditory

abilities. This research has concluded that teaching sciences through animated movies can enhance student's learning through interest and motivation.

It is essential to acquaint a multidisciplinary approach with consolidate wellbeing and nourishment subjects inside the schools' educational modules. Subsequently, an interest for complete educational modules to address healthful topics, for example, nutrition science and cleanliness, nutrition planning and food generation to incorporate nourishment planting; such projects will raise the familiarity with teenagers towards the significance of diet and nourishment (Mukhayer et al., 2013).

2.2 Use of Technology for Health Intervention

The extensive application of video game playing, beside with its use of interactivity to involve players in thought-provoking situations, generates an inimitable prospect to reach young people with health messages. Video game is an extensive application where its interactivity with players in exciting and thought-provoking situations generates inimitable circumstances, makes a remarkable chance to achieve youngsters with health messages. Children are more motivated to interactive games as compared to print or one-way mode apps (Liberman, 1998).

2.2.1 Traditional Learning Modes vs. Electronic Games

Children's absence of enthusiasm for food subject is of developing concern, since children get to be self-governing at a prior age and begin acquiring nourishments prior and all the more every now and again. Youngsters require great nutrition education and aptitudes to help them browse the uncountable number of nourishment things, which are regularly more appealing than nutritiously valuable (Tomkins, 2001). It is important to adopt those medium of instructions which gains students interest (Kreisel, 2004). Computer-based programs constitute of multiple interactive elements including audio, text, simulation and graphics. Therefore, they are becoming an integral part in health promotion and nutrition education programs. CBT (Computer-Based Tools) have also been found effective in disseminating nutrition information (Siddique, 2013). In today's electronic world young generation is approaching towards technology. PC innovation offers us a capable and

flexible instrument that can drastically change instructing and learning. The outcome of this technology is making life more easily making complex things more of interesting for students. Studies show that direction by means of PCs results in higher test scores contrasted with traditional strategies, and additionally more prominent long term retention Beerman, 1996).

2.2.2 Implementation and Evaluation of a Computer-Based Nutritional Education

Huang, Chen and Yeh (2009) in their research adopted interactive multimedia for self-care learning in patients' information of diabetes. Experimental research design was used; diabetes patients were divided into two groups. Experimental group patients were taught through interactive multimedia for duration of 3 months while control group patients were taught through traditional method. Their research findings concluded that interactive multimedia was more effective in raising awareness about disease.

Siddique (2013) has tested this concept for the first time in Pakistan. Her main objective of study was to explore the acceptability of such a program in the Pakistani context. She studied it for multi factorial with repeated measures of nutrition knowledge. She took three points in time (baseline, post-intervention and follow-up) and intervention and comparison groups. She used qualitative methods (focus group and observations of lessons). Three hundred and fourty four children (8-10 years old) of eleven primary schools of Lahore participated in that study. In a two-week school-based nutrition education intervention, comparison group received nutrition education through worksheets, card and board apps while intervention group used computer-based tool along with worksheets card and board apps and control group was not provided nutrition education. She measured baseline nutrition knowledge in each child at the end of two weeks' contribution and at three months' follow-up with a validated nutrition knowledge questionnaire. Her study demonstrated that the children could learn more about nutrition concepts and healthy eating habits in a lively and interesting environment. Her research also concluded that fusion of computer-based tools and other creative methods brings more fruitful results than using these methods in isolation.

2.2.3 Exploring the Potential of Computer and Video Apps for Health

Papastergiou (2009) tried to identify likely contribution of electronic apps as educational tools into educational and physical health. Once analytically reviewed this research has proved that computer apps have more positive outcomes for educational content than other traditional methods and turn into more physically active for life. It is anticipated that this research will direct to all the educators, practitioners, apps designers to practice in their practical life and inform others as well.

Liberman (1998) in his study provides evidence that video apps, a popular activity for young people of all socioeconomic groups, can be effective for health information. Major benefits of health intervention through using technology are youngsters are more willing to play video apps during their free time. As there is a world in a video app and it's getting more powerful day by day, it's expected that in near future more health related video apps will be developed considering learning styles, choices, and needs of individual.

2.3 Summary of the Literature Review

It has been concluded that nutrition education is highly important during early stage of development. Many of the researches have proved that early nutrition education plays a vital role in their life. Studies suggested that schools are the most appropriate place for nutrition education and for developing healthy eating habits. Since it's the perfect age for developing healthy eating behavior to secure solid development and built up a strong immune system to fight syndromes. Moreover, it leads to maintain students' attendance and performance in their studies (Mukhayer et al., 2013). Yet these researches have not produce any solutions to the problems. Dietary practices of young people have been portrayed as not the best, mostly as an aftereffect of their busy schedules, peer pressure and their independent decision making. It is consequently essential that young people have dependable nourishment information that will control them to settle on educated choices with respect to their dietary attitudes and practices (Buxton, 2014).

There are many sources of nutrition education for adolescents that has been discussed in literature as in McAleese and Rankin (2007) research a traditional method was preferred over technology during intervention. While in other research animated videos

were used to teach healthy diet (Barak, Ashkar and Dori, 2011). It was concluded in a research that interactive multimedia produced effective results while raising awareness about subject's knowledge (Huang, Chen and Yeh, 2009). Siddique (2013) in her research, health intervention was conducted first time in Pakistan. This research concluded that fusion of computer-based tools and other creative methods brings more fruitful results than using these methods in isolation.

A literature review has proved that computer apps have more positive outcomes for educational content than other traditional methods and turn into more physically active for life (Papastergiou, 2009). Findings provide evidence that video apps, a popular pastime for young people of all socioeconomic groups, can be effective health education and therapeutic interventions. A major advantage is that children play them willingly and enthusiastically during leisure time (Lieberman, 1998). As it can be seen, overall many studies have been carried out previously regarding the importance nutritional education. Delivering of the nutritional education in a traditional way can be seen. But, no or little technological intervention could be seen in Pakistani context.

Chapter 3: Methodology

Chapter three aims to describe the methods and materials used to conduct the Quasi-experimental research. This chapter also aims to describe the research design, research setting, proposed game, instruments designed, developed, used for data collection.

3.1 Research Framework and Design

The study was an experimental research. Where we will do an experiment using innovative technology in nutritional education amongst adolescents. Experimental research is divided into two categories Quasi-experimental design and True experimental design (Gribbons and Herman, 1997). The present study utilized a Quasi-experimental research framework.; in Quasi-experimental design firstly, a researcher conducts a pre-tests and do some manipulation after that conducts post-tests to see what changes occurred due to an experiment conducted on a sample (Kowalczyk, 2016).

The study design was mainly quantitative; however, in order to triangulate the data to maintain reliability, the researcher adopted qualitative as well as quantitative data collection techniques. The quantitative tools used in this study were pre-tests and post-tests student feedback questionnaire and teacher feedback questionnaire and qualitative tool was semi structured interviews from teachers participated during intervention. The student feedback questionnaire was same before and after intervention. All the responses were recorded anonymously to keep the privacy of students and teachers. The target population was school pupils having age ranging from 12 to 18 years. Considering this age group 5 to 10 grade students fall in this category. School teachers willing to participate during intervention and feel free to give their valuable feedback after intervention were eligible for this study.

3.2 Research Hypothesis

The present study is followed by two research hypothesis:

Hypothesis #1:

The 'null hypothesis' might be:

H0: Innovative technology can’t enhance nutritional knowledge in adolescents in Pakistani community?

And an 'alternative hypothesis' might be:

H1: Innovative technology can enhance nutritional knowledge in adolescents in Pakistani community

Hypothesis #2:

The null hypothesis might be:

H0: There is negative correlation between gain in nutritional knowledge and change in dietary behavior.

And an alternative hypothesis might be:

H1: There is a positive correlation between gain in nutritional knowledge and change in dietary behavior.

3.3 Study Variables

The two dependent variables were measured under this study. The independent variable for hypothesis 1 were interactive app and multimedia and dependent variable was nutrition knowledge. The independent variable for hypothesis 2 was nutrition knowledge and dependent variable was dietary practices as shown in Figure 1 below:

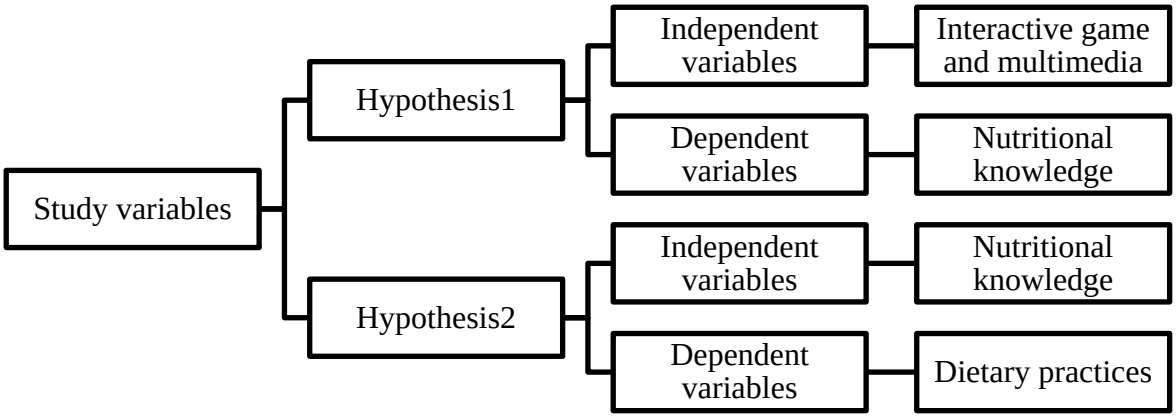


Figure 1: Study variables for hypothesis 1 & 2

3.4 Participants and Research Setting

Data was collected from Fauji foundation Gilgit-Baltistan, where majority of students belongs to army officers and government employees, who were posted there from all over the Pakistan hence the sampling represents all the population of Pakistan. The research sample was a total of 70 students. Out of 70 students, 29 were girls and 41 were boys. The principle, teachers and students' relationship with the researcher was very friendly and cooperative because all of them were very much motivated towards nutrition education. Five school teachers participated during intervention. An introductory training held with teachers in the beginning of the intervention, which made the teachers able to help the researcher during the intervention.

The age groups selected were belonging to 12 to 18 years old as this age group fall in the category of adolescents as shown in the Table 1. Table 2 shows provincial wise distribution of students this shows that this study was not limited to Gilgit-Baltistan students only, hence sample was a mix of all Pakistani adolescents. The grade selected for this study were 10^{th}, 9^{th}, 8^{th}, 7^{th}, 6^{th}, 5^{th} grade, as these students fall into age group of adolescents as shown Table 3. Table 4 shows percentage of male and female participated in the intervention.

Table 1: Break down of students according to Age

Age	Frequency	Percent
12	34	48.6
13	13	18.6
14	2	2.9
15	13	18.6
16	7	10.0
17	1	1.4
Total	70	100

Table 2: Break down of students according to Province

Province	Frequency	Percent
Gilgit-Baltistan	46	65.7
KPK	9	12.9
Punjab	13	18.6
Sindh	2	2.8
Total	70	100.0

Table 3: Break down of students according to Grade

Class	Frequency	Percent
4	13	18.6
5	13	18.6
6	22	31.4
7	3	4.3
8	3	4.3
9	8	11.4
10	8	11.4
Total	70	100.0

Table 4: Break down of students according to Gender

Gender	Frequency	Percent
Female	29	41
Male	41	58
Total	70	100.0

3.5 Designing of Interactive game and Multimedia

Before the game development phase, health practitioners were interviewed to check the desirability of the study. They were asked questions about dietary practices amongst adolescents, major issues due to these practices and reason behind that was recorded. Maximum health problems were reported due to eating practices amongst adolescents. In the school curriculum, nutrition is not considered as a core subject like Mathematics and English. In this study C# and unity 2d version 4.3 was used to design and develop interactive game. The total duration for designing and development phase took one month.

3.5.1 Learning Outcomes

The game was specifically developed for adolescents to teach healthy dietary habits. The study aims (a) to increase nutritional knowledge (b) develop healthy practices (c) recommended diet (d) awareness about diseases due to unhealthy diet.

3.5.2 Designing of Multimedia Content

The aim of motivational video was to first motivate adolescents before playing game that why there was a need of healthy nutrients in their life, and how unhealthy diet effects daily routine. This was elaborated with the help of story of a fat kid, story board was attached in appendix C. Movie maker was used as a tool for design and development of motivational video.

3.5.3 Game development phase

In this study C# and unity 2d version 4.3 was used to design and develop interactive game. We have used this platform as this was easily accessible to our end customers through their computers. The app was designed for Desktop users however in future it can be developed for mobile users as well. TPACK (technology, pedagogy, and content knowledge) framework was adopted for designing and development of the game as shown in Figure 1. The pedagogy technique used in the game was a mix of constructive and experiential learning. Considering the learning outcomes five activities were designed and developed in game. The data used in the game were verified from doctors and dietitians.

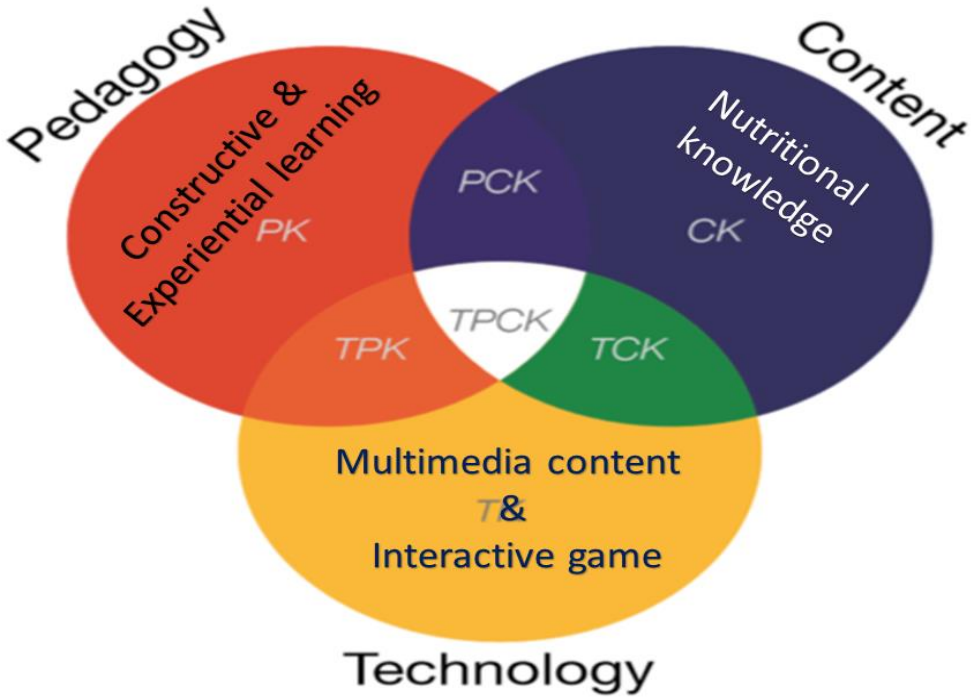


Figure 2: TPACK Framework Model

Activity 1

Human body needs specific amount of calories to stay healthy, it is important to know number calories you required for your body. However, your required calories depend on your age and gender. The first activity was designed to show required calories for each player. Additional chart provided at bottom of the screen. The aim of this chart was giving additional information regarding ideal weight with respect to age, this chart has been adopted from http://pediatrics.about.com/od/growthanddevelopment/a/510_reading_growth_charts.htm (Vincent, 2016) and verified from dietitian. In this activity background music, interactivity was embedded. Figure 3 illustrates the first activity.

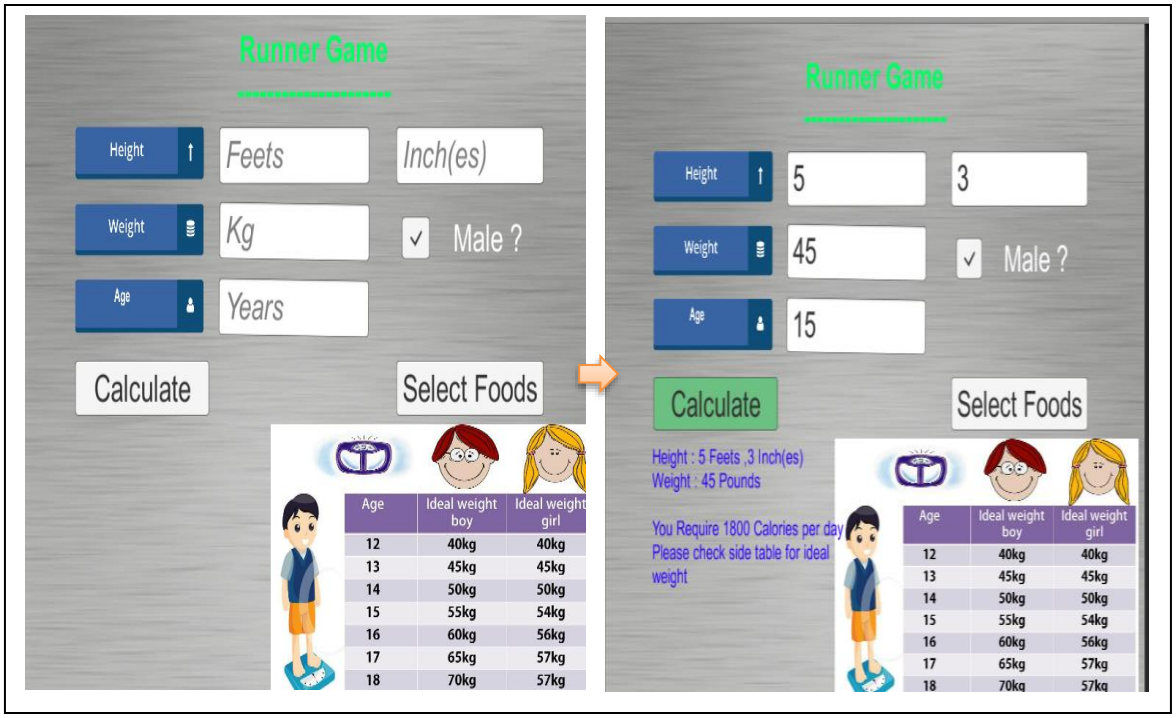


Figure 3: BMI Calculation

Activity 2

In the second activity player were asked to select their breakfast, lunch and dinner from the food images shown on the screen. This activity offers users with background music, interactivity and audio. The calories values were taken from http://www.caloriecount.com and verified from doctors and dietitian. For each selection calories of that food will be calculated in total calories moreover nutrients (calcium, fat…) were mentioned in each selection. There was a limit in food selection like for breakfast 40% of daily intake lunch 40% of daily intake and 20% of intake. The values for limit of food were set after analysis of background studies (Sjöberg et al., 2003) (Jakubowicz et al., 2013) and has been verified from doctors and dietitian. The game was designed for self-paced learning however voice overs were added in the game to make it more interactive. Figure 4 and 5 illustrates activity 2 based on food selection.

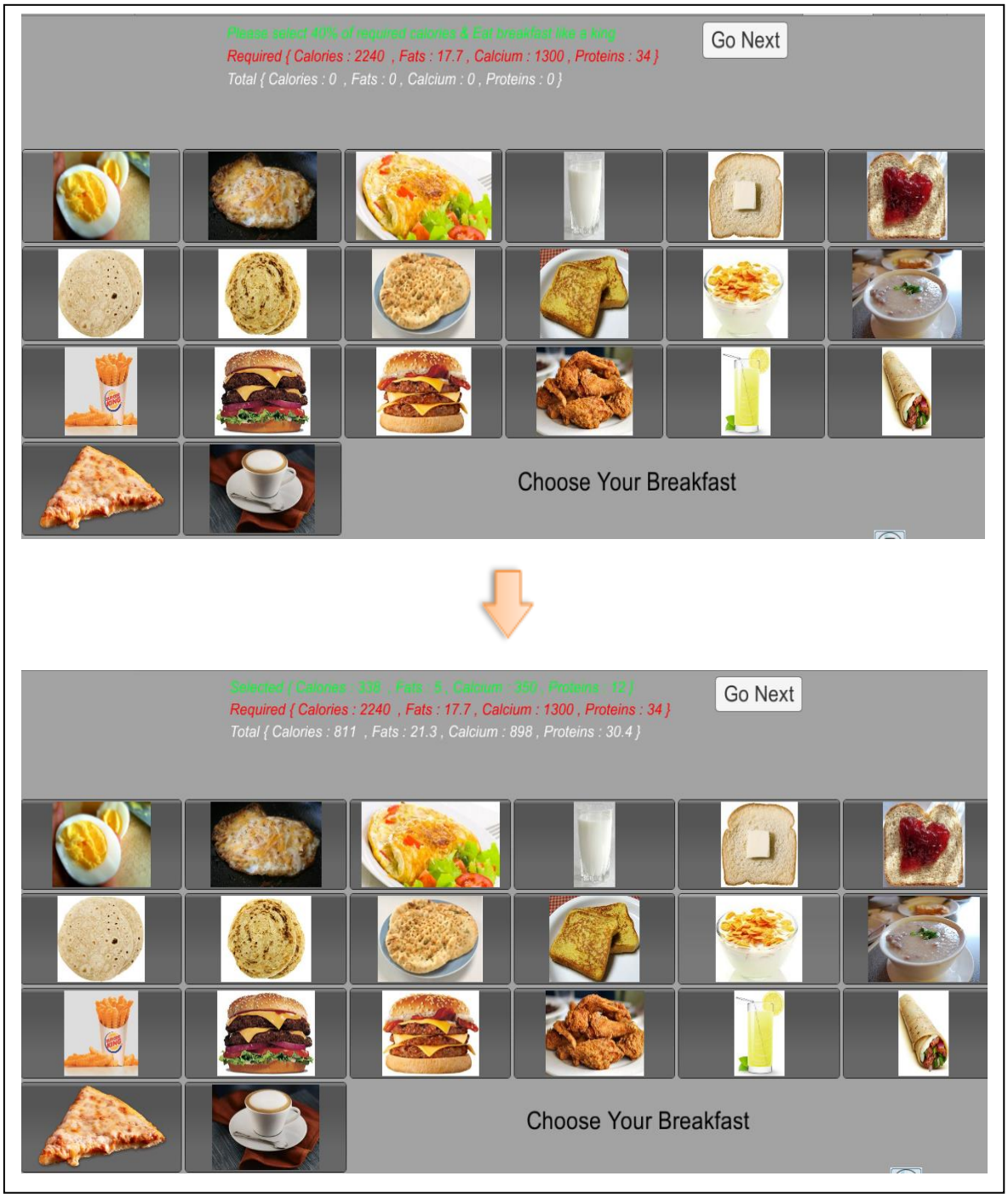


Figure 4:Food selection (a)

Figure 5: Food selection (b)

Activity 3

Next activity was running game. This activity aims to add some excitement and fun, as well as some practical experience. If player has chosen healthy food, he/she will run for long time. If he/she has chosen more junk food in his/her meal, he/she will run for short time. Running duration is shown with the help of nutritional status shown in Figure 6(a) and 6(b) based on food selection. To make players more excited running cartoon will appear according to details entered in first activity like gender and weight if player was a male, boy animation will appear as shown in Figure 6(a). If the player was a female, girl animation will appear shown in Figure 6(b).

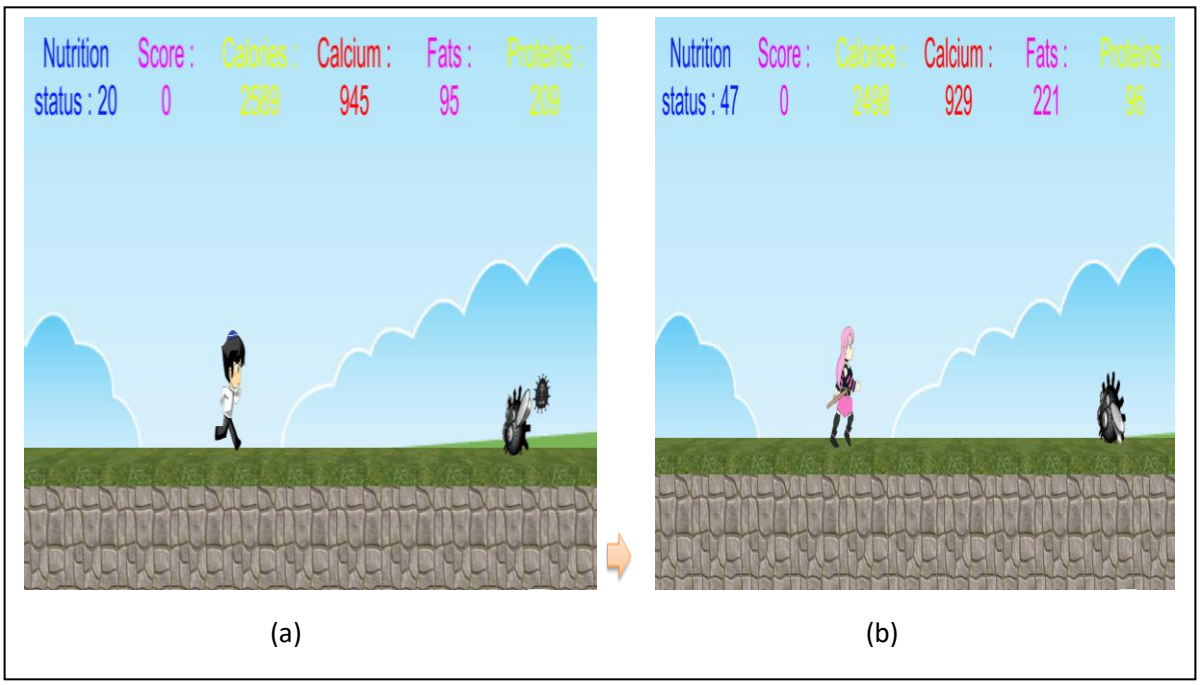


Figure 6: Screen for Male and Female

Nutrition status will decrease according to running and game will stop as shown in Figure 7 if nutrition status goes to zero. There will be hurdles in the game like virus if player collides with virus the score will be minus to 3. If he/she saves her/himself from viruses score will increases as shown in Figure 7 showing nutrition status and score on the app screen. Background music, feedback and interactivity has been embedded in this activity.

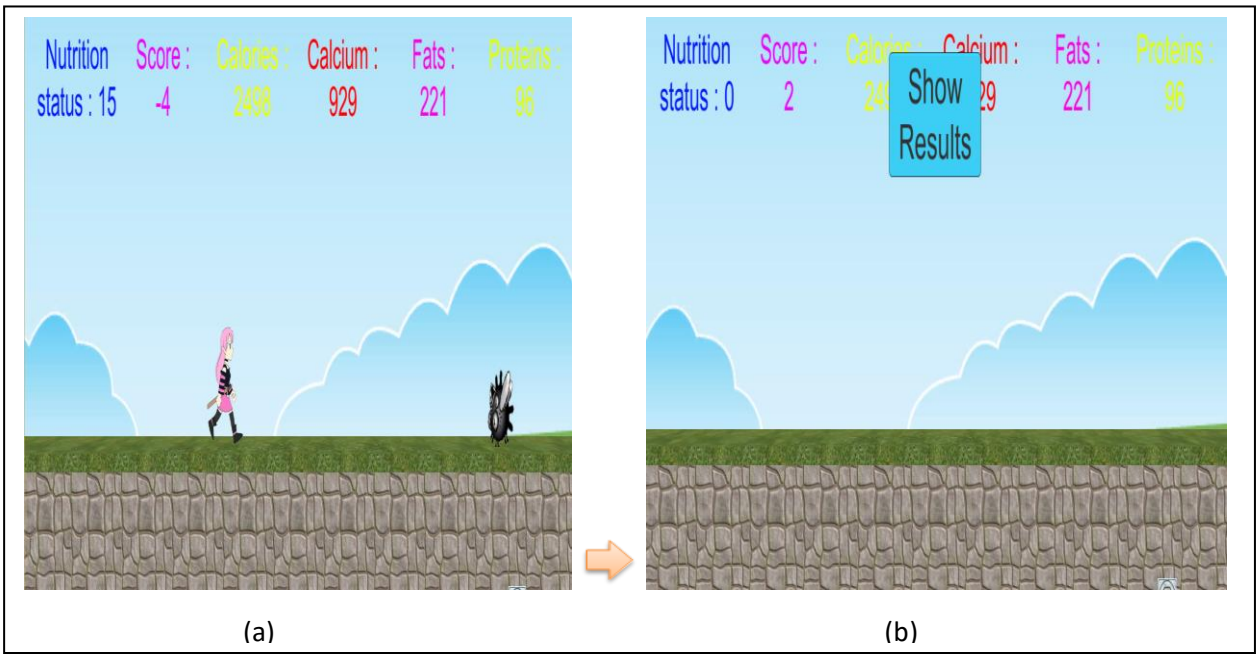
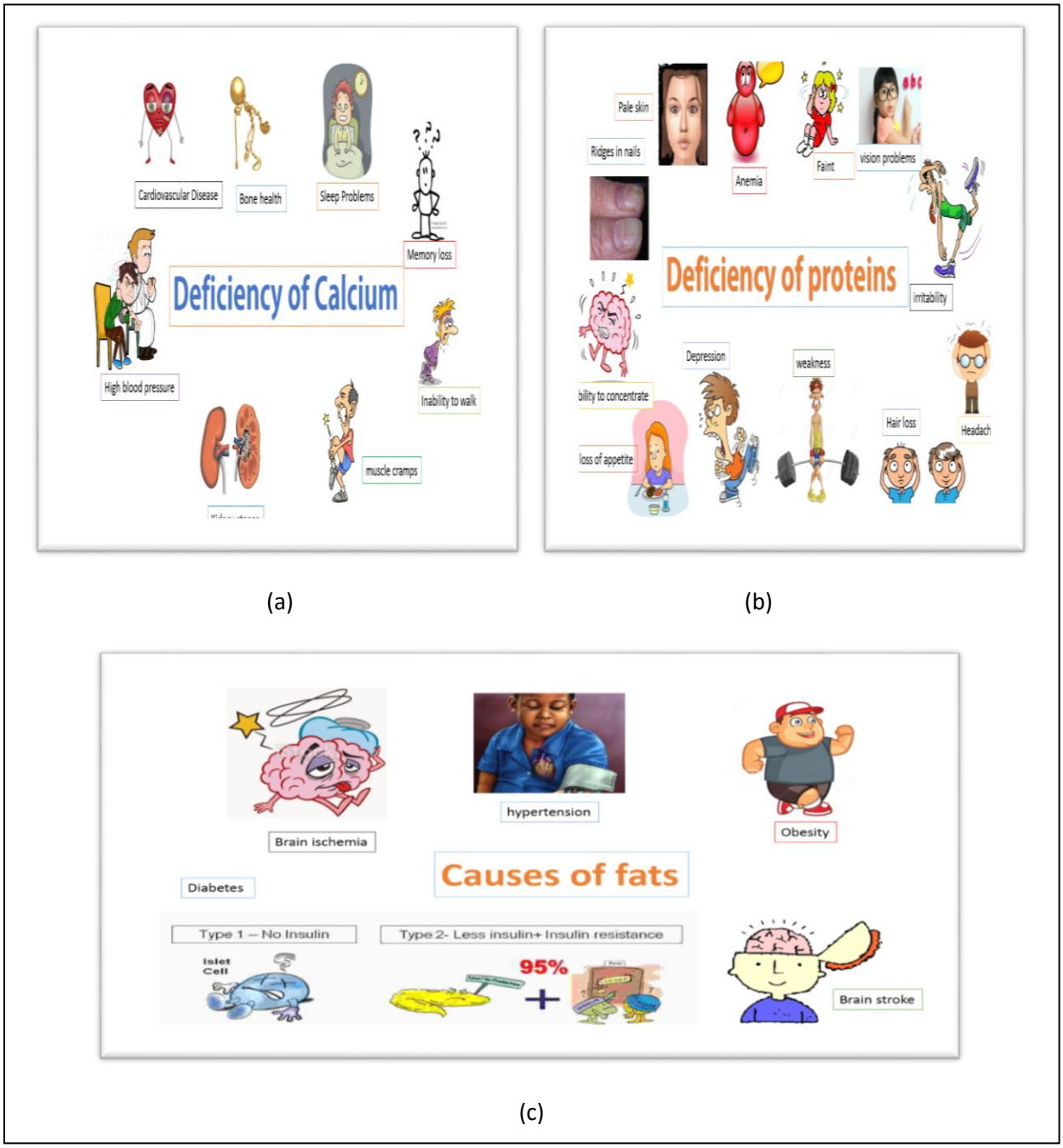


Figure 7: Virus Collision

Activity 4

The aim of this game phase was to make player aware of various diseases that may occur due to deficiency of various nutrients, diseases were mentioned in the form of picture and texts. Voice over was also used to make game more interactive. Diseases due to defiency of various nutrients were concluded from previous literature (Med-health.net, 2016) (Despres, 2012) (Ods.od.nih.gov, 2016) and has been verified from doctors and dietitian.

There are specific amount of nutrients required for body depending on age and gender. There are number of diseases that may occur due to defieceny or excess of nutrients. In this activity player will be shown diseases on the basis of his/her food selected.Figure 8 illustrates activity 4 with help of images however voice overs were used for more interactivity.



(a) (b)

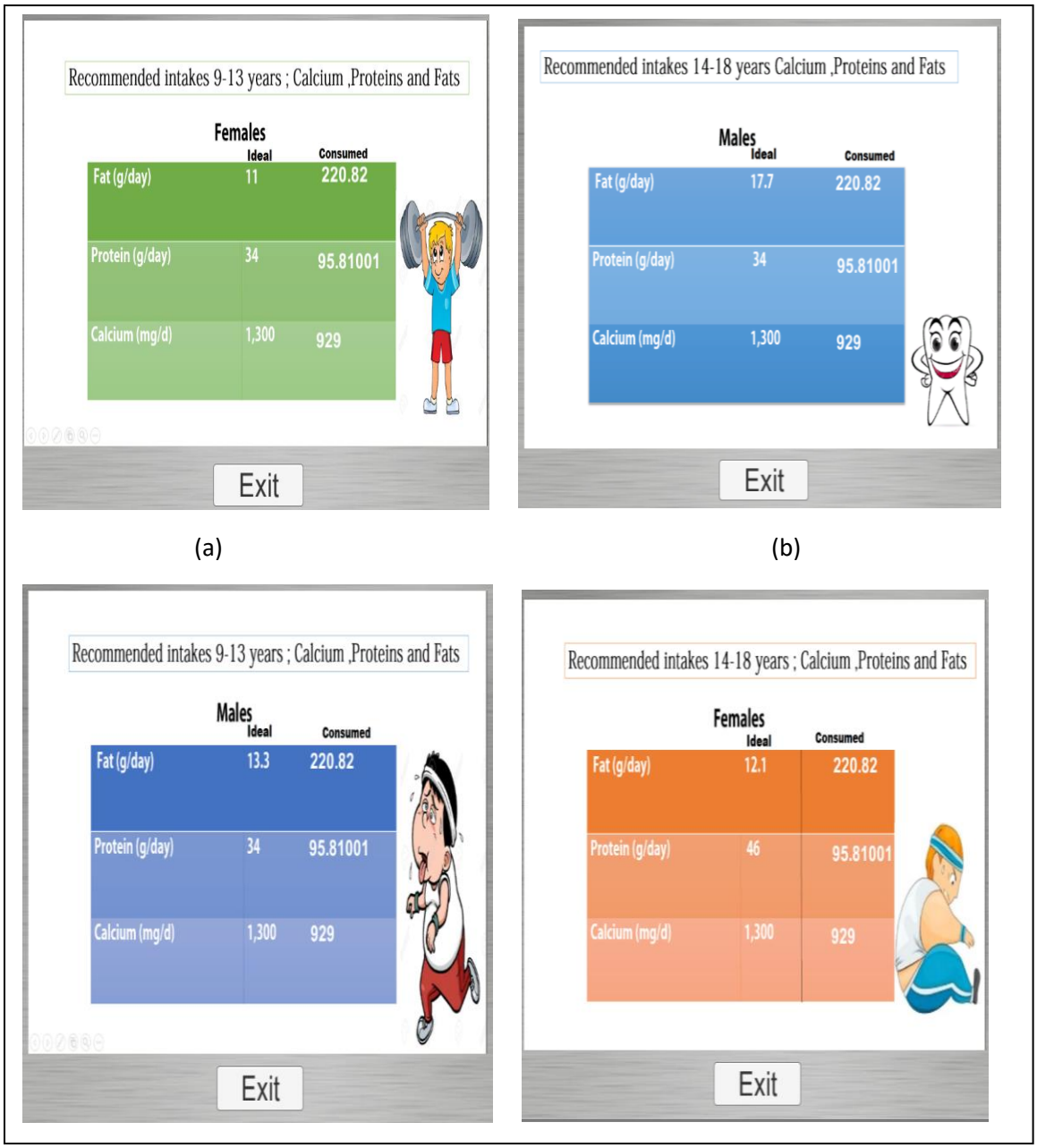
(c)

Figure 8:Deficiency of Nutrients

Activity 5

The last activity of the game was designed to demonstrate recommended intake depending upon age comparing with what they have consumed in the app. Recommended intake values were adopted from Stang and Story (2005). Activity 5 was illustrated in Figure 9.

Figure 9: Daily Recommended Intake



3.6 Intervention Phase

The intervention was carried out after filling student feedback questionnaire. Intervention included motivational video and video game to improve knowledge about healthy food. The motivational video was shown to students in the start of intervention and students played video game five to six times in two weeks of intervention. Intervention flow chart was illustrated with help of Figure 10.

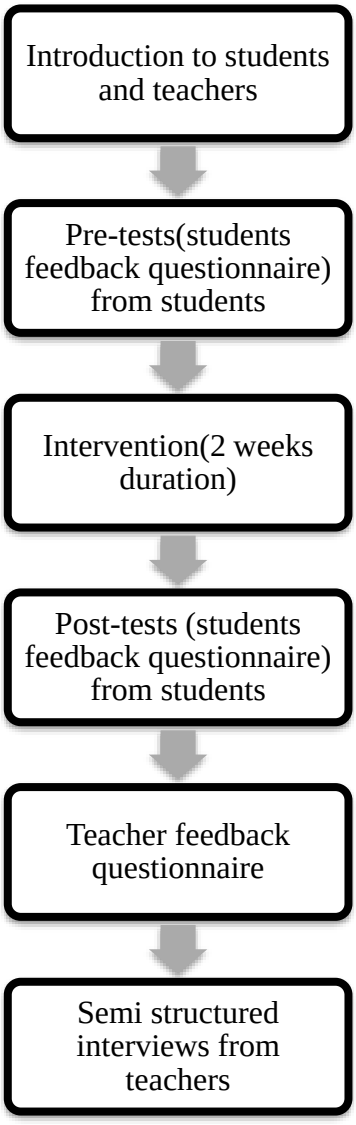


Figure 10: Intervention flowchart

3.7 Instrumentation

To collect the data for the research the following instruments were used.

3.7.1 Student feedback questionnaire

A student feedback questionnaire was designed to measure change in nutritional knowledge before and after intervention. Student feedback questionnaire was adopted and modified from thesis of Velma Nyapera (Nyapera, 2012) attached in appendix A.

3.7.2 Teacher feedback questionnaire

The teachers who have participated during intervention were given teacher feedback questionnaires at the end of intervention. The aim of this questionnaire was to find the relationship between nutritional knowledge and dietary practices. First five questions were relevant to students' knowledge and last seven questions were relevant to students' dietary practices. The teacher feedback questionnaire was adopted and modified from thesis of Sarah L. Paugh (Paugh, 2005) attached in appendix B. The questionnaire consists of total twelve questions and total twelve maximum marks were allocated.

3.7.3 Semi structured interviews

In order to verify results of quantitative data (student feedback questionnaire and teacher feedback questionnaire) semi structured interviews were conducted from five class teachers participated during the intervention. Teachers were interviewed to know the positive impact of this intervention and their suggestion for further improvement for future studies.

3.8 Procedure

The study was conducted for a period of two weeks in Fauji Foundation School Gilgit-Baltistan, Pakistan from August 31, 2015 to September 11, 2015. Permission was taken from school administration to conduct this study in their school. The teachers and students were given an orientation about our study and their role was explained to them in start of the orientation. The teachers and students were given freedom if they do not want to participate this study, they can withdraw.

The students were given access to the proposed interactive app for two weeks. In the start of intervention students' pre-tests questionnaire were distributed in all participants. After filling the questionnaires, they were collected back and sealed. Students have played interactive game minimum five times in two weeks. After two weeks again, students' post-tests questionnaire was distributed. After that class teachers from 5^{th} to 10^{th} were given teachers' feedback questionnaire to share their observations about the knowledge students have gained and practices about healthy food. The semi structured interviews were conducted from teachers for the validity of the quantitative results and to know their perceptions about intervention, their experiences during the intervention phase and their suggestions for the improvement in the intervention.

3.9 Pilot Testing

To improve the design and validity of a survey questionnaire, it was necessary that it should be pilot tested. To check the performance of the questionnaire a small group of 7 students (n=7) was selected from a different class in that school for pilot testing. In start of pilot testing, the students were given a briefing about the original study and they were asked to give proper responses and comments too if possible to further improve the questionnaire. It was also made sure that any ambiguities in student's minds were clarified and the students were encouraged to ask questions if they face any difficulty in the questionnaire. Many of the students asked questions for translations into Urdu. The feedback of the students was very effective and the language questionnaire was more simplified to make it easy for students of that level.

3.9.1 Limitations

The possible limitations of the study may be participants may have got any kind of assistance from any other source while question answering.

3.9.2 Basic Assumptions

In this study following assumptions can be made:

1.Students responded all questions fairly and to the greatest of their knowledge.

2.All the teachers answered their feedback after thoughtful observation.

3.There was no assistance given to any individual during question answering.

4.The sampling represents all the population of Pakistan.

3.10 Summary

In this chapter methodology and research design of this chapter has been discussed. At first hypothesis and study variables of this study has been determined then we have discussed research design, in research design Quasi-experimental design was used mix method approach was used for data collection. Research sample was a total of 70 students age ranges from 12-18 years. Data was collected from Fauji Foundation School Gilgit-Baltistan, where majority of students belongs to retired and serving army officers and government employees, who were posted there from all over the Pakistan. Implementation phase has been discussed through steps. Design of motivational media content and proposed interactive game was discussed briefly. In the end of the chapter, instruments used for data collection and procedures for this study were discussed.

Chapter 4: Statistical Analysis

Chapter four provides details about statistical analysis and proposed SPSS tests which used for evaluation and results comparison. This chapter is also going to present the analysis of quantitative and qualitative data collected for our study.

4.1 Student Feedback Questionnaire

Students' feedback questionnaire was designed to measure change in nutritional knowledge of students before and after intervention. The students' feedback questionnaire was used twice in our research, once before intervention named as pre-test and once after intervention named as post-test. Nutrition knowledge of students was based on nutrition knowledge scores which they have achieved in pre and post-tests. Students' pre and post-tests scores were coded as 1 for a correct answer and 0 for an incorrect answer. The total nutrition knowledge scores in pre or post-tests for each pupil was determined by the number of correct answers; those with higher scores in pre or post-tests reflected higher nutrition knowledge. It consisted of 15 questions which were based on nutritional knowledge students' have gained while playing proposed game. The aim of this questionnaire was to test hypothesis 1 designed for current study.

Hypothesis 1:

The 'null hypothesis' might be:

H0: Innovative technology can't enhance nutritional knowledge in adolescents in Pakistani community.

And an 'alternative hypothesis' might be:

H1: Innovative technology can enhance nutritional knowledge in in adolescents in Pakistani community.

4.1.1 Study Variables

The study variable for hypothesis 1 was interactive game, multimedia content and nutritional knowledge. Interactive game and multimedia were considered independent variable and nutritional knowledge was considered as a dependent variable.

4.1.2 Readability of Student Feedback Questionnaire

A Flesch-Kincaid Readability was used to check the readability; it means how easy the content is for the target reader. The Flesch-Kincaid provides a numeric value ranges from 0-12. This numeric value signifies the readability level of students ranging from Kindergarten to 12 grades (Si & Callan, 2001). A Flesch-Kincaid readability score for the student feedback questionnaire was approximately 75.4 as shown Table 5; which means easily understood by 12- to 15-year-old students as shown Table 6. Furthermore, grade level was approximately 5.1 which mean students of grade 5 or above this grade can read this questionnaire easily. In addition, teachers were asked to read aloud questionnaire once in a class to help students which were below this level.

Table 5: Flesch-Kincaid readability statistics

Flesch Reading Ease	75.5
Flesch-Kincaid Grade level	5.1

Table 6: Flesch Reading Ease Score Table has been adopted from [DuBay, 2004]

Reading Ease Score	Readability level	Education level
0-29	Very Confusing	College Graduates
30-49	Difficult	College
50-59	Fairly Difficult	High school senior
60-69	Standard	13 to 15 years' old
70-79	Fairly Easy	12 years' old
80-89	Easy	11 years' old
90-100	Very Easy	10 years' old

4.1.3 Reliability

Kuder Richardson coefficient was used to check the reliability of the student feedback questionnaire, it contains binary questions like Yes/No, 0, 1 (Zaiontz, 2013). Kuder Richardson coefficient values range from 0 to 1. A high value indicates reliability; while too high a value (in excess of.90) indicates a homogeneous test. Values for KR-21 count coefficients range from 0.00 to 1.00. Values more like 1.00 notice to the way that the test items are homogeneous and firmly correlated; while, if the approximation of the coefficient is more like 0.00, the test items are nearly related and varying with each other (Chang, 2014). In the next section we have found out the reliability of pre and post-tests of student feedback questionnaire.

4.1.3.1 Pre-test Reliability

Kuder Richardson coefficient was applied on student pre-tests and results showed that the value was 0.392 as shown in Table 7 which was near to 1.00 so the test items were homogeneous and strongly correlated.

Table 7: Reliability statistics of student pre-test questionnaire

Kuder Richardson Coefficient	No of items
0.392	15

4.1.3.2 Post-test Reliability

Kuder Richardson coefficient was applied on student post-tests questionnaire and results showed that the value was 0.556 as shown in Table 8 which was near to 1.00 so the test items are homogeneous and strongly correlated.

Table 8: Reliability statistics of student post-tests questionnaire

Kuder Richardson Coefficient	No of items
0.556	15

4.1.4 Parametric or non-Parametric Tests

After data collection from students, in order to determine whether data of pre and post-tests of students' feedback questionnaire was normally distributed, normality tests were applied. For parametric data, skewness and kurtosis values should lie between (-1.96) to (+1.96) and Shapiro-Wilk test significance value should be greater than 0.05, in other words data should be normal (Ghasemi and Zahediasl, 2012).

Pre-tests of Student Feedback Questionnaire:

- Significance of skewness is -0.1291 so it's between (-1.96) - 1.96
- Significance of kurtosis is -0.059 it's between (-1.96) - 1.96
- Shapiro-wilk test is a test of normality hence significance value is less than.078 it prevents us from performing parametric tests.

Post-tests of Student Feedback Questionnaire:

- Significance of skewness is -0.171 so it's between (-1.96) - 1.96
- Significance of kurtosis is -0.034 it's between (-1.96) - 1.96
- Shapiro-wilk test is a test of normality hence significance value is 0.001is less than.05 it prevents us from performing parametric tests.

Considering values of skewness, kurtosis and shapiro-wilk test it has been found that data was not normal, so non-parametric test alternate of paired t-test Wilcoxon signed ranks test was applied (Fagerland and Sandvik, 2009). The Wilcoxon signed-rank test is the non-parametric test equal to the dependent t-test. Dependent t-test is used when data fall into the category of normality if data found to be violated this assumption then Wilcoxon signed-rank test is used because it is inappropriate to use dependent t-test. This type of test is used in researches where researcher wants to compare two sets of data come from same sample and wish to investigate any changes in scores from one point to another point (Lund and Lund, 2013). The process of choosing appropriate test was shown with the help of Figure 11 shown below:

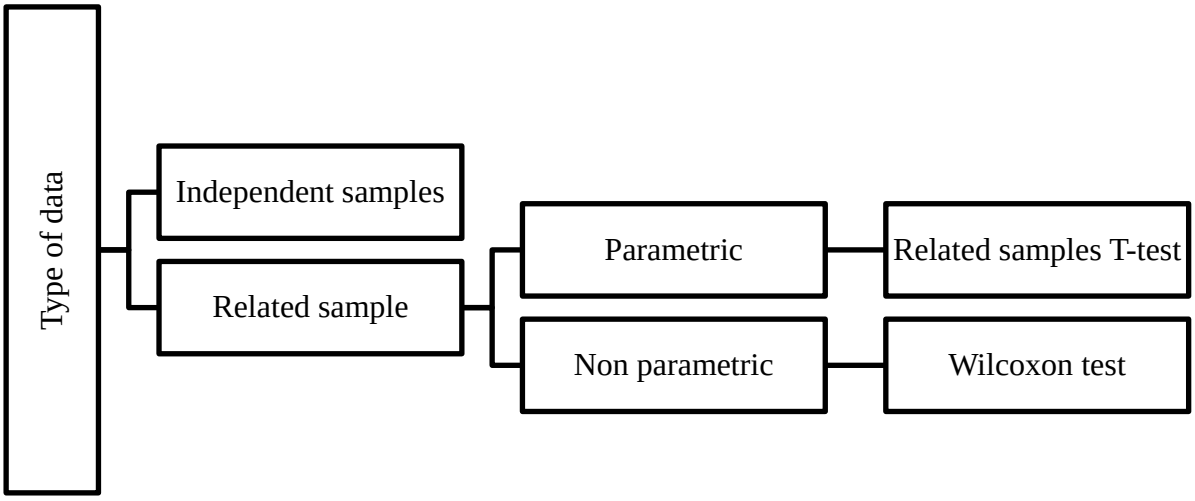


Figure 11: The process of choosing appropriate test

SPSS Statistics Output of the Wilcoxon Signed-Rank Test

SPSS Statistics generates a number of tables in the output viewer. In this section, we had focused on these three tables to illustrate our results. The data was interpreted with the help of Laerd statistics (Lund and Lund, 2013).

Descriptive Table

The descriptive statistics Table 9 shows the quartiles information of both tests.

Table 9: Descriptive statistics of Wilcoxon Signed-Rank Test of both tests (pre and post-tests)

Score	N	Total Marks	Mean	Min Marks	Max Marks	Percentiles		
						25^{th}	50^{th} median	75^{th}
Pre-tests	70	15	8.57	3	13	7	8	10
Post-tests	70	15	11.92	7	15	10	12	14

Ranks Table

The ranks Table 10 provides data on the comparison of participants' before (pre) and after post-tests score. As shown in the Table 10 that 4 participants had a negative score after intervention. However, 61 participants had increased their score after intervention and 5 participants saw no change in their pre and post-tests score.

Table 10: Ranks Table of pre and post-tests score of student feedback questionnaire

Score		N	Mean
Post-tests	Negative ranks	4^a	16.3
Pre-tests	Positive ranks	61^b	34
	Ties	5^c	-
	Total	70	-

a= Post-tests score<pre-tests score

b= Post-tests score>pre-tests score

c= Post-tests score = pre-tests test score

Test Statistics

Based on the results above the significance level is 0.000, which means the relationship is highly significant and therefore it is likely that intervention has increased their knowledge. So here null hypothesis rejected.

H1: Innovative technology can enhance healthy dietary habits in adolescents in Pakistani community.

4.2 Teacher Feedback Questionnaire

Techer feedback questionnaire consisted of two clusters nutritional knowledge questions and dietary behavior questions. Teacher feedback questionnaire was designed to determine relationship between gain in nutritional knowledge and change in dietary practices among students. Teacher feedback questionnaire was measured by using a five point Likert scale ranging from 5=Strongly Agree, 4=Agree, 3=Undecided, 2= Disagree, 1= Strongly Disagree.

Hypothesis 2:

The 'null hypothesis' might be:

H0: There is no correlation between gain in nutrition knowledge and change in dietary behavior.

And an 'alternative hypothesis' might be:

H1: There is a correlation between gain in nutrition knowledge and change in dietary behavior.

4.2.1 Study Variable

The study variable for hypothesis 2 was nutritional knowledge and dietary practices. In this hypothesis 2 nutritional knowledge was independent variable and dietary practices was considered dependent variable.

4.2.2 Reliability of Teacher Feedback Questionnaire

No reliability test was used to determine reliability of teacher feedback questionnaire as sample size was a total of five teachers and minimum sample size requirements were at least 30 respondents, as peter Samuel cited in his technical report (Samuels, 2015).

4.2.3 Relationships between Knowledge and Behavior

“Exploring the relationship (linear) between 2 variables; e.g., as variable A increases, does variable B increase or decrease? The relationship was measured by a quantity called correlation” (Simon, 2010). Pearson’s correlation technique was used to determine the relationship between knowledge and behavior of adolescent’s. 2 x variables A and B were defined. Variable A represents nutritional knowledge gained from app while variable B represents behavior changes. The relationship was measured by a quantity called Pearson’s correlation coefficient. A correlation coefficient is a number between -1 and +1 that measures the degree of association between two variables. A positive value implies a positive association as both are directly proportional while a negative value implies a negative or inverse association (Chowdhury, Debsarkar and Chakrabarty, 2015).

Following was the interpretation for correlation, the closer the correlation is to +/-1, the closer to a perfect association (Chowdhury, Debsarkar and Chakrabarty, 2015):

- -1.0 to -0.80 very strong negative associations.
- -0.60 to -0.79 strong negative association.
- -0.40 to -0.59 moderate negative association.
- -0.20 to -0.39 weak negative association.
- 0.00 to -0.19 very weak negative association
- 0.00 to 0.19 very weak positive association.
- 0.20 to 0.39 weak positive associations.
- 0.40 to 0.59 moderate positive association.
- 0.60 to 0.79 strong positive association.
- 1.0 to 0.80 very strong positive association.

As the value in the Table 11 Pearson correlation p value is 0.46 there is a weak positive association between gain in knowledge and dietary behavior.

Table 11: Pearson correlation value between gain in knowledge and dietary practices

	Gain in knowledge	Change in dietary behavior
Pearson correlation	1	0.46

4.3 Teachers Interviews

In order to verify results of quantitative data, semi structured interviews were conducted from 5 class teachers participated during intervention at Fauji Foundation School Gilgit-Baltistan. Teachers were interviewed to know the positive impact of this proposed game and their suggestion for further improvement for future studies. First of all, the teachers were asked to give a value to this game on a scale of 5 based on gaining nutrition knowledge and change in dietary behavior. The Table 12 below is showing the teacher rating of this app.

Table 12: Game Rating out of 5

Teachers	Rating out of 5
Teacher1	5
Teacher2	4
Teacher3	5
Teacher4	5
Teacher5	5

1 = Not Satisfactory, 2 = Little Satisfactory, 3 = Good, 4 = Very Good, 5 = Best

The next question asked is there any significant change in nutrition knowledge gain among students?

4.3.1 Nutritional Knowledge Gain

Teachers appreciated the blend of motivational video and interactive game together in one platform. They further added that nutrition knowledge that was in app was very useful for all of the students.

"School curriculum is not enough for nutrition education these types of apps can help in increase in nutrition knowledge among students of this age [Teacher 1]"

"These kinds of apps can add more knowledge while gaining interest of students as compared to traditional methods [Teacher2]"

"I have found huge difference in nutrition knowledge before and after intervention [Teacher3]"

Teachers remarks were evidence that these types of apps should be develop to enhance nutrition knowledge of students.

4.3.2 Change in Dietary Practices

With response to this question "*have you found any change in dietary behavior that may occur due to gain in nutrition knowledge"?* Teachers responded in a very positive way that these types of apps can also change the eating behavior however it is one of the factor of changing eating behavior.

4.3.3 Additional Information

Teachers pointed out few additional points that may help in improving nutrition education. Few of the teachers recommended that science curriculum should be redesign in order to enhance nutrition knowledge and behavior. All of the teachers suggested that these types of interventions should be conducted in schools to enhance learning of students using technology.

4.4 Summary

This chapter presented the analysis of quantitative and qualitative data collected for our study. The quantitative data was collected with the help of survey questionnaires from students age ranges from 12-18 years and class teacher and was analyzed with the help of SPSS. SPSS is a Windows application used to perform data entry and to analyze statistical data, it can handle a large amount of data and capable to perform statistical analysis (Green and Salkind, 2011). The qualitative data was collected with the help of teacher interviews; qualitative data was collected to support results of quantitative data of our research.

Chapter 5: Discussion

Chapter five is going to discuss the research results given in chapter four, conclusion, recommendations, suggestions for further research and chapter summary.

5.1 Discussion

The first section will cover the research hypothesis of the study, which are:

- H1: Innovative technology can enhance nutritional knowledge in adolescents in Pakistani community.
- H1: There is a positive correlation between gain in nutrition knowledge and change in dietary behavior.

This section is further divided into two subsections. Every subsection will discuss separate research hypothesis. The first subsection will discuss use of innovative technology to enhance nutritional knowledge in adolescents, while the second will discuss the correlation between gain in nutritional knowledge and change in dietary behavior.

Hypothesis 1

Hypothesis 1 stated that innovative technology can enhance nutritional knowledge in adolescents in Pakistani community, has been strongly accepted. Based on the results the significance level is 0.000, which means the relationship is highly significant and therefore it is likely that intervention has increased nutritional knowledge of students. So here null hypothesis rejected.

Hypothesis 2

2nd hypothesis, stated that there is a positive relationship between nutritional knowledge gain from proposed game and change in dietary habits. Relationship further more indicates a substantial linear relationship between these two variables. Adolescents' who practice better dietary habits also have a better understanding of nutrition. Similarly, a poor level of nutritional knowledge could potentially indicate poor dietary habits. The study variable for hypothesis 2 is nutritional knowledge (independent variable) has shown a weak positive

relationship with dietary practices (dependent variable). However, it is considered to be the important factor in changing dietary behaviors.

To further investigate, the qualitative data was also analyzed to find out what changes teachers have found in their students eating behavior. The responses of teachers validated our research results.

5.2 Conclusion

Computer technology has given new direction to learning; it is a time to use ICT in health sector especially for adolescents for better results. The study successfully evaluated the use of technology among adolescents to increase their nutritional knowledge and healthy dietary habits. It has proven through our research that an amalgam of computer-based tools like video apps brings more fruitful results than traditional methods for nutrition education. Associated studies in Pakistan, presented that nutritional knowledge among children is very low scoring (Siddique, 2013). However, this problem can be cater using technology among children, that can be through interactive apps, which are considered to be highly interesting for children (Powers et al., 2005). Literature justifies that there is a critical need, for addition of nutrition education in the schools' basic curriculum at primary and secondary level (Siddique, 2013) (Nyapera, 2012). Findings suggests for creation of similar programs, which can potentially improve nutrition knowledge and dietary behaviors in adolescents. There are varieties of health games offered on the Internet for the purpose of increasing physical activity and encouraging better personal health. Educators and other school health officials can positively influence the dietary behavior of adolescents by implementing a similar nutrition education program in their schools.

5.3 Significance of the Study

Nutrition education makes adolescents' life better in many ways. The aim of this study was giving proper nutrition education to adolescents through innovative technology. Interactive app and multimedia was used in this study which was found to be very famous among adolescents. Nutritional knowledge will teach what to eat and when to, this will be

beneficial for adolescent's mental and physical health. Proper nutrition knowledge will save adolescents from many serious diseases that may cause due to unhealthy eating habits.

The findings may be useful to the school's administration, Ministry of Education, other development partners dealing with education and health of school going children in order to design interventions to improve nutrition-related practices. The findings may be used to review or redesign policies and in implementing strategies related to nutrition and health of school children. The findings will also contribute to the on-going research efforts on the role of nutrition education in improving nutritional status of school children. It is also expected that the findings will be disseminated through publication in peer reviewed journals and references.

5.4 Recommendations

Interactive video games are significantly important way, to transfer health related information to adolescents' while keeping interest. The current study of health related games in schools is a unique idea and useful intervention. The intervention has increased nutritional knowledge and also changed dietary practices amongst adolescents. Our research, proposed following recommendations to policy makers, schools and for parents that might help in disseminating health information amongst adolescents.

5.4.1 Recommendations for Policy Makers

As the health issues are very common among adolescents in Pakistan. Students have started use of junk food in access amount in schools. ICT is the most effective way to create awareness about draw backs of the junk food and motivating students' in a friendly way towards healthy food. The policy makers are considered to use the ICT in maximum possible schools to improve the dietary habits and get fruitful results for this new decision about change in dietary habits

The training sessions are also necessary to be conducted for teachers to motivate them for the use of computer technologies in classroom especially for health games. Computer should be provided to every school and dedicated periods need to be allotted for health games, so that everyone can be benefited from these games.

Nutritional knowledge should be considered as a core part in making education policies. In EFA 2015 Report education was only limited to quality of education at schools however nutritional knowledge factor was completely ignored.

5.4.2 Recommendations for Schools

It is recommended that use of interactive apps should be inculcated in school for health interventions. Schools should invest in computer-based activities to increase learning among students. Different activities related to dietary practices should be conducted in schools to teach the importance of healthy eating. Health interventions should be done by school authorities.

There is dire need of developing health apps considering major health problems in Pakistan. To lessen the problem interactive multimedia education should be incorporated in schools as well at home.

Associated studies have demonstrated that school curricula are not enough for teaching healthy habits. It should be redesign and science and computer teacher should take extra measures for nutrition education. Schools should conduct health related seminars frequently for parents so that they will develop healthy dietary practices at home.

5.4.3 Recommendations for Parents

Home is the most appropriate place for nutrition education and for developing healthy eating habits. Since 12- 18 is a perfect age for developing healthy eating behavior to secure solid development and built up a strong immune system to fight diseases.

Parents should practice healthy eating behavior at home. They can motivate their kids towards healthy eating behavior by using health games and apps which are easily available on google play store. As research proved that these game are more effective in increasing nutritional knowledge and changing dietary behavior than traditional method.

5.5 Future Directions

1. Relevant studies should be done in other provinces of Pakistan in order to validate research findings.
2. Other similar researches to be conducted to determine factors that may changes dietary behaviors such as family background, mother education, as findings shows there is positive weak relationship found between nutrition knowledge and healthy diet practices.
3. This is a prototype game we can develop more levels to keep interest of players. Furthermore, we can use video gaming trends while developing new health games.

5.6 Summary

This study was conducted for a period of 2 weeks in Fauji Foundation School Gilgit-Baltistan, Pakistan from August 31, 2015 to September 11, 2015. The aim of the study was to increase nutritional knowledge and to investigate the relationship between nutrition practices, and nutrition knowledge.

The hypotheses designed for our study, are both accepted showing positive results of intervention. This shows that innovative technologies can enhance nutrition education in a better way than traditional methods. Mix method approach was applied to investigate research results both study methods showed positive results. Education about nutrition is a key factor for adolescents and it needs to play a continual role in their lives. However, educating the adolescents is only half of the problem. Parents and teachers need to have knowledge about nutrition because adolescents tend to ask people to whom they are most comfortable with.

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Appendix A

Student Feedback Questionnaire

ENHANCING HEALTHY DIETARY HABITS IN ADOLESENTS THROUGH INNOVATIVE TECHNOLOGY IN PAKISTANI COMMUNITY

Name:	Gender:
Class	Age:

PLEASE CIRCLE A RESPONSE FOR EACH QUESTION

1. Do you know how many Calories; you should eat per day?

a) Yes
b) No

2. How much fat do you need per day?

a) 11g/day
b) 12.1 g/day
c) 13.3 g/day
d) 17.7 g/day
e) Don't know

3. How much Calcium do you need per day?

a) 1,800 mg/day
b) 1,300 mg/day
c) 1,500 mg/day
d) 1,000 mg/day
e) Don't know

4. How much protein do you need per day?

a) 34 g/day
b) 46 g/day
c) 39 g/day
d) 40 g/day
e) Don’t know

5. Why do we need Calcium?

a) For healthy bones
b) For healthy muscles
c) Don’t know

6. Why do we need protein?

a) For healthy bones
b) For healthy muscles
c) Don’t know

7. Over eating of fat can cause?

a) Bone health
b) Ridges in nails
c) Obesity
d) Muscle cramps

8. Deficiency of protein can cause?

a) Muscle cramps
b) Ridges in nails
c) Brain stroke
d) Bone health

9. Deficiency of calcium can cause?

a) Hypertension
b) Obesity
c) Diabetes
d) Bone health

10. Do we need ideal nutrients (fats, calcium, and proteins) to maintain our health?

a) Yes b) No

11. Is it healthy to eat Junk food?

a) Yes b) No

12. Is it healthy to eat fresh food?

a) Yes b) No

13. Do all foods have healthy nutrients (fats, calcium, and proteins)?

a) Yes b) No

14. Burger carries healthier nutrients than almonds?

a) Yes b) No

15. We need to have heavy portion of breakfast and smaller portion of dinner for good health?

a) Yes b) No

16. We need to have heavy portion of lunch and smaller portion of dinner for good health?

a) Yes b) No

Appendix B:

Teacher Feedback Questionnaire

ENHANCING HEALTHY DIETARY HABITS IN ADOLESENTS THROUGH INNOVATIVE TECHNOLOGY IN PAKISTANI COMMUNITY

TEACHER NAME:	
CLASS:	

Guidelines:

Use Likert scale of 1 to 5 while observing the classroom during implementation phase. Use the following key:

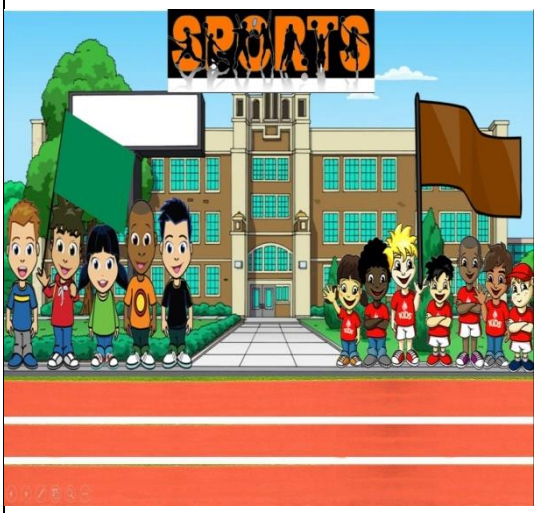
1=strongly disagree, **2**=Disagree, **3**=Not sure, **4**=Agree, **5**=Strongly Agree

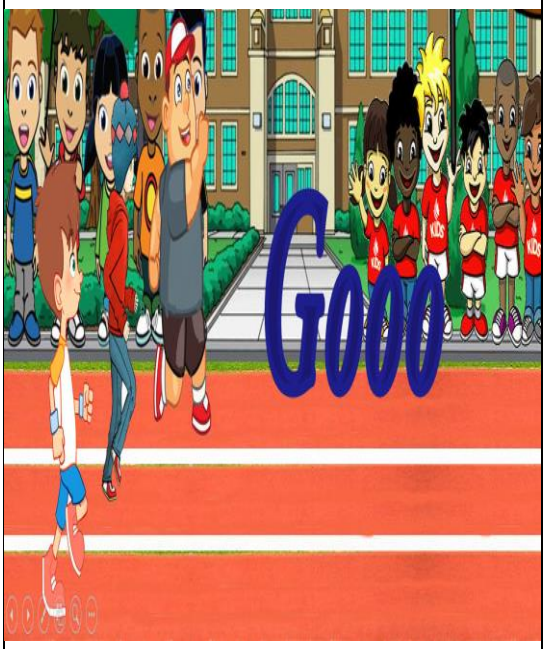
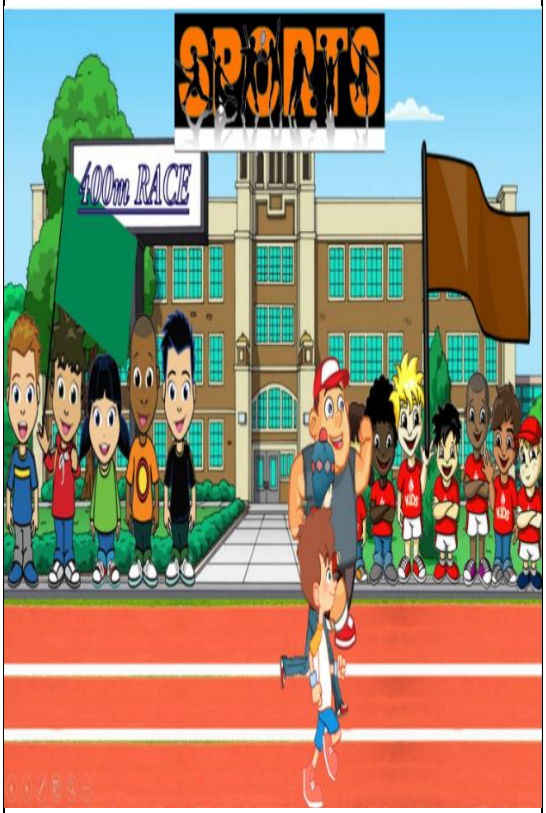
Knowledge questions	
1. Students have gained informative nutritional knowledge from this app.	1 2 3 4 5
2. Students are aware of unhealthy foods after using this app.	1 2 3 4 5
3. Students learnt excessive consumption of fats is unhealthy.	1 2 3 4 5
4. Students learnt how much daily nutrients intake they require.	1 2 3 4 5
5. Students learnt about the importance of breakfast after using this app.	1 2 3 4 5
Dietary behavior changes questions after intervention	
6. Did students learn nutrients affect their mental performances?	1 2 3 4 5
7. Did students take breakfast daily in the morning?	1 2 3 4 5

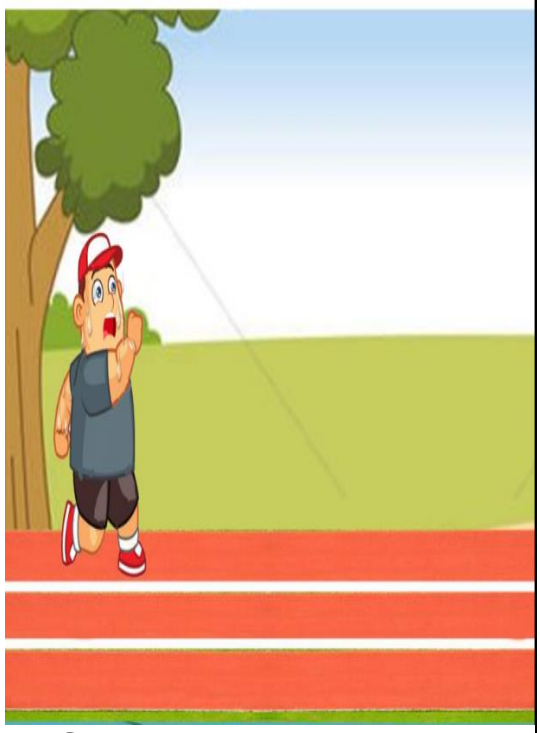
8. Did students more willing to have healthy food?	1 2 3 4 5
9. Did Students share their knowledge which they have acquired from this app with peers?	1 2 3 4 5
10. Did students make healthy choices?	1 2 3 4 5
11. Did students eat more burger/chips?	1 2 3 4 5
12. Did students drink more fresh juices?	1 2 3 4 5

Appendix C

Story Board of Motivational Video

Scenes	Description	Dialogues	Actions
Scene #1 	Scene starts with a sports day, background students in the ground, music and a commentary in the background.	Commentator: bachay boht khush nazar arahay hn, her team apnay players ko support karahy hay humara agla game hay 400 m race.	Students, ground, Music.
Scene#2 	Three boys Vicky, Salar and Ali will be on the race line	Commentator: Ali, Vicky or salar race kay liayay line pay ayay hn aur tayar horahay hn chand e minute main race shuru kar dain gay	Racing ground, 3 boys

Scene#3  	Three boys Vicky, Salar and Ali will be on the race line.	Commentator: Yahan pay race shuru hota hay 123 go.	Racing ground, 3 boys.
 **Scene#4**	Boys are running all are equal in the same line	Commentator: boht sakht muqabila hay teeno barabar jarahay hn ab dekhna yay hay k kon jeetay ga	Racing ground, 3 boys

 **Scene#5**	Suddenly Ali feels so tired drowsy		Racing ground, Ali only
 **Scene#6**	Other guys almost reach the end line	Commentator: abi game khatam honay e wala hay Vicky aur salar nay Ali ko boht peechay chor dya hay	Racing Ground, Ali and 2 boys

Scene #7 	Ali started feeling guilty started to asking himself	Ali: main q thak gya itni jaldi har saal tou main e jeeta tha ☹	Racing ground, Ali only

Scene #8 	Ali sits in the middle of the ground very disappointingly		Racing ground, Ali only
Scene#9 	A voice over in background	Voice over: Ali yay sb kuch ap ki giza ki waja say hay jo ap laitay hn ao hm apko batain achi ghiza kia hoti hay jo apko taqwar or her maidan main jeeta sakti hay	Racing ground, Ali only

Scene #10 	Ali looks like he is looking for a hope	Kia waqiy, chalooo chalain.	Racing ground, Ali only