DISSERTATION

Comparative Analysis of
Computer-Based Nutrition Education in Primary Schools of
Lahore and Vienna

Angestrebter akademischer Grad
Doktorin der Naturwissenschaften (Dr.rer.nat)

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Wien, December 2010
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Acknowledgements

All praise and gratitude is due, first and foremost, to Almighty Allah, who granted me the ability, knowledge and perseverance to complete this study.

I would like to express my sincere gratitude to my supervisor Prof. Ibrahim Elmadfa, for providing me much needed support and guidance throughout this project and above all for his confidence in me.

My deepest appreciation goes to the 'Cool Food Planet Kidz' study team for granting me the permission to adapt the nutrition education material and affording me full cooperation in the use of their study data.

I am highly grateful to the Higher Education Commission of Pakistan for awarding me the four-year scholarship for my studies, making this entire endeavour possible.

I would also like to sincerely thank the school principals, student teachers and school children whose participation and cooperation made this research project possible.

I am deeply indebted to my husband, Rizwan Nazir, for his affection, cooperation and patience. Finally yet most importantly, I would love to express my deepest admiration for my children, Haris and Sabrina, for their love and encouragement. I acknowledge their generosity for allowing me to spend so much of their share of time on my doctoral studies.
1 Introduction

The present chapter presents brief overview of the background information, purpose and hypothesis of the study.

1.1 Background of the study

Pakistan is facing double burden of malnutrition; both in the form of under-nutrition and over-nutrition. Pakistan, along with India and Bangladesh, is acknowledged to have more than half of the world’s under-nourished children. In Pakistan 38% children are under-weight, 37% are stunted and 13% are wasted (UNICEF, 2008). 30% of school-age children are moderately or severely mal-nourished (Jafar et al, 2007; Khuwaja et al, 2005; Mian et al, 2002). Children who are under-weight or stunted are at increased risk for childhood mortality and morbidity. In South Asian countries one child out of 12 died before the age of five (UNICEF, 2008). Pakistan ranked 42 worldwide in under five mortality rate (UNICEF, 2008).

Under-nutrition is a part of vicious cycle including, poverty and disease. In children, it is the result of many factors like poor food quality, inappropriate food intake and infection diseases or combination of all three. These factors are embedded in the overall standard of living like availability and access to food, sanitation and health facilities. Several studies report that despite food availability and accessibility, lack of nutrition knowledge (Shepherd et al, 2006), awareness (Gupta and Kochar, 2009) and faulty concepts towards certain food items remain important impediment in the achievement of a healthy and varied diet (Hughes et al, 2010).

A review of various studies related to nutritional status of Pakistani children highlighted that a large number of children are suffering from different nutrition related problems including under-nutrition; stunting, wasting, anemia,
and over-nutrition (Khan and Ali, 2010; Jafar et al, 2007; Khuwaja et al, 2005; Mian et al, 2002). However, literature is devoid of any mention about the nutrition knowledge of these children. Nutrition related problems are presumably due to the lack of awareness and knowledge about nutrition and healthy eating in addition to the non-availability and accessibility of food.

Parents, being the foremost socializing agent, are responsible for promoting and sustaining healthy eating habits in children. A strong coherence between the education level of parents, especially mothers, and eating habits of children is amply documented in relevant literature. Unfortunately, however, the low adult literacy rate (53%) in the country is depriving Pakistani children from this provision. As a result, children in Pakistan exhibit unhealthy eating habits (Jafar et al, 2007).

Besides parents, schools are also considered to be equally conducive towards disseminating nutrition knowledge and developing healthy eating habits in children (Pérez-Rodrigo and Aranceta, 2003). A review of the primary schools’ curricula in Pakistan reveals that these do not impart sufficient knowledge regarding nutrition. This further limits children’s opportunities to learn about a healthy diet thus making them nutritionally vulnerable.

Eating habits developed in early life continue later to persist. Unhealthy eating habits lead to chronic diseases in adulthood. For the life-long good health, children must be made aware of nutritional concepts and healthy eating habits since the beginning (Perez-Rodrigo and Aranceta, 2001; Auld et al, 1998). Childhood is the critical period during which foundation for healthy dietary behaviour is laid down. Therefore, it is important to disseminate knowledge about health and nutrition to children as early as possible. Nutrition education empowers children to choose the healthy food whenever they have the opportunity to select. (Matvienko O, 2007).
In this regard, due to school’s systematic environment, school-based nutrition education intervention provides an opportunity to develop healthy eating habits in children (Auld et al, 1998). Given the food preferences developed early, school age is the critical time to teach children about healthful diets. But children find nutrition concepts incomprehensible as well. Nutrition education programs that are age-appropriate, creative and interesting are known to be fruitful (Lytle and Achterberg, 1995).

The computer-based programmes constitute of multiple interactive elements including audio, text, simulation and graphics and provide opportunities for two-way communication. Therefore, they become ideal tool to educate children about nutrition. Previous studies with children using computer-based nutrition education tools reported the effectiveness of these programs in increasing the nutrition knowledge (Serrano and Anderson, 2004; Valadez A, 2004; Turnin et al, 2001). But this medium is lacking application in Pakistani schools.

Most of the research on the use of computer-based tools in nutrition education has been conducted in the developed countries including USA (Serrano and Anderson, 2004; Valadez A, 2004; Jantz et al, 2002) and Europe (Gorely et al, 2009; Turnin et al, 2001). In order to generalize these findings outside the developed countries, there is a strong need to build a similar evidence base in the developing countries as well. Furthermore, The scenario mentioned above i.e. high rate of mal-nutrition, low literacy rate in adults and lack of nutrition education programs for school-age children calls for an urgent implementation of effective nutrition education programs in order to educate Pakistani children about healthy eating habits. Nutrition education alone is not sufficient to bring changes in individuals’ eating habits. However, it is considered to be the first step towards the adoption of healthy eating habits (Powers et al, 2005).
1.2 Purpose of the study

The purpose of the present study is twofold:

a. To implement and evaluate a computer-based nutrition education intervention in the primary schools of Pakistan and to explore the acceptability of such a program in the Pakistani context.

b. To compare the result of present study with the study results of ‘Cool Food Planet Kidz’ (Kreisel K, 2004).

The study ‘Cool Food Planet Kidz’ (named as Vienna study in the realm of this study) was carried out in Vienna, Austria to evaluate the efficacy of the website ‘Cool Food Planet Kidz’ developed by the European Food Information Council (EUFIC). The website is developed to act as a teaching tool for disseminating nutrition information and developing healthy lifestyles in schoolchildren.

The purpose of comparative analysis is to explore whether the computer-based nutrition education tool i.e. Cool Food Planet Kidz and other related materials designed for children in developed countries could be as effectively implemented and whether they would be appropriate for children in developing countries. Furthermore, the comparative analysis with data from the Vienna study helps contextualize the results from Pakistan within the broader global context. Taking up this framework, the following main directions are considered to commence the comparative analysis: (a) to explore similarities (b) to determine line of fraction and (c) to propose suggestions. Therefore, in line with this background the adapted model of the Vienna study was implemented in the selected primary schools of Lahore and the present study investigated the same associations in a comparable sample in Lahore, Pakistan.
1.3 Study hypotheses

In the present study, for the first time ever, a computer-based nutrition education-intervention was implemented and evaluated in the Pakistani primary school setting and the acceptability of computer-based nutrition education was also explored.

The following hypotheses were formulated:

1. Nutrition knowledge (measured as the mean number of correct answers) is expected to increase by 20% from a mean of 10 correct answers at baseline to 12 at post-intervention with a maximum of 22 achievable correct answers, a standard deviation SD=3, alpha=0.05, power=0.8 and estimated effect size d=0.3, in all four and fifth grade children taking part in the nutrition project, irrespective of the teaching tool used.

2. Nutrition knowledge is expected to be higher in the group using computer-based nutrition education tool in addition to non computer-based materials as compared to the group using only non computer-based materials at post-intervention and three months’ follow-up.

3.a. Nutrition knowledge is associated with indicators of children’s socio-economic status.

3.b. The gain in nutrition knowledge is associated with indicators of children’s socio-economic status.


2 Literature Review

This chapter mainly explores relevant literature for the comprehensive understanding of the issue under discussion. First section will provide a brief summary of the literature on prevalence of poor nutrition in Pakistan along with reasons and effects of poor nutrition on schoolchildren. Second section provides literature review on development of food choices and preferences. Third section provides brief overview about the barriers that effects eating habits in order to better understand food related behaviors. The subsequent section deals with nutrition education, relevance of theory-based nutrition education and summarizes various school-based nutrition education interventions conducted in developed and developing countries. Finally, scope of computer-based nutrition education in schools and review of computer-based nutrition education interventions will be provided in the fifth section.

2.1 Prevalence of poor nutrition among children

Pakistan is facing double burden of mal-nutrition; both in the form of under-nutrition and over-nutrition. Along with India and Bangladesh, Pakistan is acknowledged to have more than half of the world’s under-nourished children. In Pakistan at least 38% children are under-weight, 37% are stunted and 13% are wasted (UNICEF, 2008). 30% of school-age children are moderately or severely mal-nourished (Jafar et al, 2007; Khuwaja et al, 2005; Mian et al, 2002). Children who are under-weight or stunted are at increased risk for childhood mortality and morbidity. In South Asian countries, 1 child out of 12 died before the age of five (UNICEF, 2008). Pakistan ranked 42 worldwide in under five mortality rate (UNICEF, 2008).

From the published research, it is evident that poor nutrition affects the children under five years of age more adversely. Therefore, a large body of
programs and intervention in Pakistan targeted the infant and children less than five years of age. Consequently, school-aged children received less attention by researchers and policy makers and are perceived as less effected or had overcome the effects of malnutrition. However, recent studies reported high prevalence (44%) of malnutrition in this age group (Jafar et al, 2007; Khuwaja et al, 2005; Mian et al, 2002).

Generally, under-nutrition has been the major health issue for children in developing countries, like Pakistan. However, due to the urbanisation, changes in life styles and nutrition transition, the over-nutrition and obesity is also emerging as a formidable problem. A rapid twofold (3% to 5.5%) increase in obese school-age children was observed by Jafar in his study carried out in Karachi, Pakistan (Jafar et al, 2008). This situation is conformable with global trends in childhood obesity. In United States 18.8% children of 6-11 years of age are overweight, which is three times more than the target prevalence of 5% (Centers, 2006). In Austria 20% children of age 10-14 years are overweight and 2% are obese. Similarly, in United Kingdom 17% boys and 16% girls of aged 2-15 years are obese (Elmadfa et al, 2009).

2.1.1 Reasons for poor nutrition

The human body utilizes carbohydrates, proteins and fats from the food to produce energy. As long as the body’s energy requirement is met adequately, which is dependant on adequate nutrition, the growth takes place in a normal manner. When the food consumed is unable to provide sufficient energy to meet the body’s requirements, it results in under-nutrition. A diet that is deficient in macronutrients, which include carbohydrates, proteins and fats, causes protein-calorie malnutrition. While a diet that is deficient in micronutrients, which include minerals, vitamins and electrolytes causes micronutrient deficiencies. The deficiency or excess of macro or micro nutrients or both adversely affects the growth process of children.
The imbalance between energy intake and energy expenditure can be the result of various factors. All these factors are interrelated and each one assists in the existence and persistence of the other. In children, the energy imbalance is the result of many factors like poor food quality, inappropriate food intake and infection diseases or a combination of all three. These factors are embedded in the overall standard of living such as availability and access to food, sanitation and health facilities.

In developing countries, low birth weight is considered a major contributor to poor nutrition in children (Fikree et al, 2000). In Pakistan, nearly 19% of newborn infants have low weight at birth (UNICEF, 2004). Low weight at birth could be a result of mother’s poor nutrition before and during pregnancy, the intrauterine growth retardation (IUGR) or both. IUGR is the manifestation of mother’s poor health, which is a direct result of mother’s small body size, low birth weight at her birth and a malnourished life. Thus, the cycle of malnourished child from one generation to another continues.

Poverty and food insecurity have been documented in the literature as fundamental attributing factors for poor nutrition. However, many children in food-secure and affluent households are found to be under-weight and stunted vis-à-vis. Therefore, lack of food availability and access is only one part of the problem, other factors such as nutrition knowledge (Hakeem et al, 2004), lack of awareness (Agha et al, 2005), unhygienic conditions (Baig-Ansari et al, 2006), childcare practices (Khan and Ali, 2010) and maternal education (Shah et al, 2003) are equally responsible for the present situation in Pakistan. The nutritional status of large number of Pakistan’s population is unsatisfactory (Agha et al, 2005) mainly owing to unhealthy diets. In fact, poor diets as the result of poor eating habits are the major reasons for the poor nutrition status of Pakistani children. The intake of both macro and micronutrients particularly in school going children was very low and reported
as one of the leading cause of stunting and underweight (Hakeem et al, 2002).

Even though, a large number of people in Pakistan are poor, it is not a food deficient country. Food is abundantly available yet nutrition status of a large segment of population is considerably low. In this context, nutrition education can be of great significance to make people aware to getting maximum benefit from the available food resources.

### 2.1.2 Effect of poor nutrition on children

Malnutrition is a complex issue and affects all health indicators including growth, cognition, social and motor development of children. Under-nutrition both, protein energy malnutrition and micronutrient deficiencies, affect children’s development adversely. Under-nutrition limits the individual’s developmental potential. It stunts growth physically (Bryce et al, 2008) and as well as intellectually (Bhutta et al, 2004). Protein energy malnutrition weakens the immune system of children and increases their susceptibility to infections (Pelletier and Frongillo, 2003). As a result, undernourished children are more likely to suffer from diarrhea and pneumonia.

Recent studies show a strong association in babies born with low birth weight and non-communicable diseases in adult life. These include coronary artery disease, hypertension and diabetes mellitus (Bhutta et al, 2004). On the other hand, obese children suffer from various physical, emotional and psychosocial problems including physical ailments (Veugelers and Fitzgerald, 2005), low self esteem, low body image (Hesketh et al, 2004) and self–perception (Kemp and Pienaar, 2010).
2.1.2.1 Poor nutrition and children’s cognitive development

Poor nutrition significantly effects children’s brain development which in turns affects cognitive development (Bryan et al, 2004). Protein-energy malnutrition profoundly affects children’s learning abilities. A strong association between stunting, IQ and school performance has been reported in literature (Shariff et al, 2000). In a study in Vietnam, Hall et al (2001) analyzed the data from 3,055 third grade students and reported significantly low scores in math and language test in both short-term and chronic under-nourished children. Low birth-weight babies are at increased risk of developing weak immune system and infectious diseases. They also have impaired cognitive development and poor school performance that limit their job chances as an adult.

Impaired intellectual functions have been reported in children belonging to Iodine deficient areas. In a double-blind intervention trial, 10-12 years old moderately iodine deficient schoolchildren received 400 mg I (as oral iodized oil) or placebo. As a result of the intervention, improvement in information processing and fine motor skills of children were reported (Zimmermann et al, 2006). It is a well-established fact that iron deficient children exhibit reduced attention span, low IQ scores and poor psychosocial development. In a review Grantham-McGregor and Ani (2001) reports that 18 studies show association between iron deficiency anemia and poor cognitive and motor development or school achievements. Research has consistently reported that zinc deficiency adversely affects children’s cognitive functions, in particular attention and short-term memory (Bhatnagar and Taneja, 2001).

2.1.2.2 Poor nutrition and children’s school performance

Generally, demographic and socio-economic characteristics of a household are considered as important factors effecting school enrollment and academic achievements. Interestingly, besides age and gender, other individual characteristics like health and nutrition status are not recognized as potential
contributors in low school achievements. In fact, the poor physical, cognition and behavior development, as a consequent of under-nutrition, has serious effect on school life. Diet quality is an important predictor of a child’s scholastic performance. Literature highlights the negative impact of malnutrition related problems on a child’s school performance (Berkman et al. 2002). Florence reports that pupils who consume more fruits and vegetables and less fat are, significantly, more likely to pass the assessment. According to her, besides the socio-economic factors diet quality plays a fundamental role in children’s school achievements (Florence et al, 2008). High rate of absenteeism, low school enrolment, low cognitive abilities and low school achievements are found in under-nourished children (Grantham-McGregor, 2005).

To conclude, without educational strategies, which develop awareness and healthy dietary behaviours that are needed to combat poor nutrition, Pakistan will continue to face the similar pattern of poor-nutrition. In order to consume healthy diets, people need to have proper information about what makes a healthy diet. Therefore, there is need to put more emphasis on promotion of healthy eating habits along with prevention of dietary deficiencies.

2.2 Food choice and preference

Food preference means choosing one food item over the other (Birch LL, 1999). Food preferences are determined by the interaction of a child’s genetic predisposition, physical and social environment (Wardley and Cooke, 2008; Story et al, 2002). With regard to genetics, food preferences develop very early. Even newborns have an innate preference for a sweet taste and dislike foods that are sour and bitter in taste (Birch LL, 1999). Children also have an innate preference for energy dense foods. Universally, children show preference for energy dense and fat foods including pizza, French fries, sweets and cakes (Cooke and Wardley, 2005; Skinner et al, 2002). Energy-dense foods provide the feeling of fullness, known as satiating, which in turn
develops the preference for that particular food. Adults’ selection of food is largely influenced by the cost and health factor of the food. However, children only consider personal likes and dislikes while choosing a food item. Therefore, their food preferences are good predictors of their food intake (Pérez-Rodrigo et al, 2003a). Innate food preferences begin to be altered through learning and social facilitation (Wardley and Cooke, 2008).

Physical environment strongly influences a person’s eating habits. Children’s food preferences are largely dependant on availability and accessibility of the food items. Cullen et al (2003), in order to determine the relationship between fruit and vegetable consumption and in their availability and accessibility, recruited 225 children of 4th, 5th and 6th grades as well as 88 parents in his study. He reported significant correlation between food preferences, consumption and availability, and accessibility of fruits and vegetables. People’s food purchase is largely dependant upon the types of food sold at the local food shops. French identified availability and pricing of food items in school as important determinants affecting children’s food purchase (French et al, 2001).

Additionally, social environment, including parents’ eating patterns, their education, socio-economic status and time, determine the foods children eat (Patrick and Nicklas, 2005). Parents, as the foremost socializing agent, are responsible for providing a conducive food environment, in order to develop acceptance for varied foods. Parents have the ability to influence children’s food intake by offering a role model of healthy eating patterns. Studies reveal a strong correlation between parents’ fruit intake and their children’s intake (Wardle et al, 2005; Cooke et al, 2003). Furthermore, parents can develop healthy eating habits by controlling what, where and with whom to eat.

Food-related parenting styles profoundly influence children’s food intake (Wardle et al, 2005). In a study Nicklas et al (2001) identifies three parental
feeding styles namely, authoritarian, permissive and authoritative. Most commonly, these styles are entrenched in the realm of nurturance and structure (Black and Hurley, 2007) as depicted in Figure 1.

![Figure 1: Patterns of parenting and feeding styles (Source: Black and Hurley, 2007)](image)

Authoritarian style mainly constitutes of controlling the child’s eating without any cognizance of child preferences and choices. In a study, Birch et al (2001) highlighted restriction and pressure to eat as two imperative ways of parental control. Restriction means restricting child from eating unhealthy foods like restriction on sweets and fatty foods intake and while pressure means to force child to eat healthy foods. Lower intake of fruit and vegetables is reported in children whose parents practice authoritarian feeding style (Cullen et al, 2000).

The lack of structure is the emblem of permissive feeding style. Because, it allows children to eat what they want, when they want and how much they want. Permissive feeding style is found concomitant with more consumption of sweet and fat foods and less healthy eating (De Bourdeaudhuij et al, 2000). Authoritative feeding style is a blend of authoritarian and permissive feeding styles. In the way that parents decide which food to provide and children get the chance to select the food they want to eat. Authoritative
parents use questions, discussions and logic to encourage children to eat healthful diets (Nicklas et al, 2001). This feeding style has been shown to ensure lesser intake of junk food and higher intake of healthy foods (Gable and Lutz, 2000). Vereecken et al (2009) reported authoritative food-related parenting style as positively associated where as, pressure and permissiveness as negatively associated with children’s eating habits.

In addition to feeding styles, many socio-economic factors including parental education and income also affect eating habits and preferences of children. A strong association has been reported between parental education and consumption of more healthful diets. Xie et al (2003) reported that parental education level is associated with higher intake of carbohydrates, proteins, calcium and fruits and vegetables in adolescents. In particular, a mother’s education is considered as an important determinant of children’s health and healthful diet. Children of less educated mothers are reported to consume more unhealthy foods as compared to more educated mothers (Vereecken et al, 2004a). Family income is also associated with eating patterns. In literature, it is amply documented that children from high socio-economic status depict more healthy eating habits (Xie et al, 2003). On the other hand, children of low socio-economic status exhibit poor dietary intake (Wyatt and Triana, 2000).

In social environment parents are not the only ones who influence children’s eating habits. As the child enters school, food preferences are greatly influenced by the interaction with peers. Peer influence is considered a stronger determinant of food preferences of children than the parents (Cullen et al, 2001). In CATCH program children two years older apart form the target group, were educated about healthy diets. The study reported change in junior peers eating as result of the older children’s education that demonstrates the strong influence of the peers (Luepker et al, 1996).
Especially in the adolescent period, peers exert a great deal of influence on children’s preferences (Monge-Rojas et al, 2002).

Culture is another powerful determinant of food preferences. Cultural norms shape the cuisine, influence the nutritional needs and the dietary behaviour (Rozin P, 2000). Media is also a powerful determinant of food choices. Birch and Fisher (1998) have reported food advertisement on television as a strong determinant of preference development for energy dense foods.

To sum up, food choices are not simply a result of rational thinking in terms of calorie count, protein, carbohydrate and fat. They also depend largely on the interplay of various genetic predispositions, physical and social environment. Apprehension of the interplay and influence of different genetic, physical and social factors on food preferences of the children is essential in order to develop successful nutrition education program for children. Assuredly, nutritionally well-informed individuals make better food choices.

2.3 Barriers in healthy eating

The factors which determine and affect an individual’s eating habits are very complex and interrelated. Ecological model – a multilevel and interactive model – is used to identify the barriers, which effect dietary behaviour patterns. An in-depth analysis of these barriers provides an opportunity to develop nutrition education programs, which keep into account these barriers and develop long lasting changes (Edward et al, 2004; Hancock T, 1993).

2.3.1 Intrapersonal level

At the interpersonal level, there are a number of personal characteristics that effect dietary behaviour. These include biological factors like hunger, genetics like taste, and psychosocial factors like personal beliefs, attitudes, food preferences and knowledge. Lack of nutrition knowledge (Shepherd et al,
Literature Review

2006) and low level of nutrition knowledge (Wardle et al, 2000) found important impediment in healthy eating. A strong association was found in nutrition-related skills and consumption of fruits and vegetables (Petrovici and Ritson, 2006). On the other hand Fitzgerald et al (2010) reports a gap, at intra-personal level, between theory (nutritional awareness) and practice (food selection) in children. Despite the nutrition knowledge, food preferences are given more importance during the food selection.

2.3.2 Interpersonal level

This includes the relationship that an individual shares with his family members, peers and friends (Story et al, 2002; McLeroy et al, 1988) and which exerts a great deal of influence on the development of personal beliefs and dietary behaviour. At this level, children’s eating habits and selection was strongly influenced by peer pressure (Cullen et al, 2001). Media and food advertisement operates at both intra and inter level and affects children’s food choices drastically. Children demanded to eat advertised foods, mostly high sugar foods including drinks and candies (O'Neill et al, 2004). It is a well established fact that parental nutritional knowledge affects children’s eating habits. Due to lack of time, frequency of consuming convenience foods and prepared food increases and is considered a hindering factor in establishing healthy eating habits (Jenkins and Horner, 2005; O'Neill et al, 2004).

2.3.3 Community level

This level encompasses the places and an organization, where an individual gets involve socially and interacts with others including schools and the workplace (McLeroy et al, 1988). These play an influential role in shaping individual’s eating habits. Being socially disadvantaged at individual or/and at neighborhood level increases the risk of development of many psychosocial disorders (mental and behavioral). This directly or indirectly affects the health and development of poor eating habits like overeating and drinking (Lee &
Cubbin, 2002). Furthermore, safety situation in neighbourhood may directly influence the pattern of daily life activities, like walking to school or playing outside, resulting in obesity (Morland et al, 2002). Availability of food in the local stores has a strong impact on the food selection of residents (Horowitz et al, 2004). Occupational level of parents was also found to have association with the development of eating habits of children (Vereecken et al, 2004b).

2.3.4 Societal/Public policy level

Societal factors play an indirect role in the development of dietary behaviour. At this level, state policy, and religious and cultural beliefs determine an individual’s eating habits. State pricing policies affects an individual’s purchasing capacity, which in turn affects his consumption pattern (Monsivais and Drewnowski, 2007). People follow certain eating habits as being part of a particular religion or ethnic group.

2.4 Nutrition Education

The goal of nutrition education is to help people to attain the knowledge and skills that are essential for making healthy food choices. Childhood is the critical period during which foundation for healthy dietary behaviour is laid down. Therefore, it is important to disseminate knowledge about health and nutrition to children as early as possible. Many studies report a relationship between nutrition knowledge and eating habits (Crites and Aikman, 2005; Wardle et al, 2000). In a study, Packman reports that low fat consumers had a high level of nutritional knowledge and vice versa (Packman and Kirk, 2000). However, on the other hand, studies reported no relation between increase in nutrition knowledge and change in dietary behavior (Contento et al, 1995).

There are many factors, which could be responsible for the reported contradictions between nutrition knowledge and behavior change which restrict from comparing and generalizing the results of such studies.
Translating nutrition knowledge into practice is a complex process especially for children. Furthermore, children are not directly involved in food related issues and largely depend on their parents for their food. Sometimes, individuals do have nutrition knowledge but are unable to apply it because of various barriers (discussed in detail in the previous section see page 15).

In addition, types of knowledge presented in the intervention may produce variations in results. There are two types of knowledge: declarative and procedural. The former acquaints a person with the knowledge and processes. One acquires information that fruits and vegetables are good for health or too much sugar and fatty foods are unhealthy. The later equips a person on how to do certain thing. Nutritional behaviour encompasses both types of knowledge (Worsely A, 2002). In other words, procedural knowledge is the application of declarative knowledge.

A study carried out by Wardley et al (2000), on a 1040 participants of 18-75 years of age, assessed the nexus between nutrition knowledge and application. They reported a correlation between nutrition knowledge and healthy eating habits. Participants with higher nutrition knowledge were 25% more likely to eat fruits and vegetables. Worsley (2002) in a review of studies related to children’s healthy eating reported change in their dietary behaviour as a result of nutrition education. Therefore, the interconnection between nutrition knowledge and dietary behaviour largely depends upon the amount and kind of nutrition related information an individual possesses.

Furthermore, the interconnection between nutrition education and dietary behaviour also depends upon the approach that a nutrition education intervention incorporates. Contento (2008) identified three phases of nutrition education i.e. motivational, action and environmental phase. The motivational phase aims at increasing the awareness and knowledge and developing the skills and attitudes that are required for the understanding and selection of
the healthful diet. An action phase helps the individual to take action. People usually make intentions to develop healthy eating habits but they are never able to act upon them. An action phase relates the intention to action. The environmental component deals with nutrition educators, policymakers and their interaction in developing a conducive environment for action to take place.

All the above mentioned factors influence nutrition behaviour. However, which factor exerts more influence in altering nutrition behaviour is yet not fully determined. Nevertheless, the contention that nutrition knowledge is unable to develop better food behaviour simply does not undermine the potential of nutrition education.

2.4.1 Theory-based nutrition education

Theories contribute a great deal of knowledge on how and why an individual grows, develops and behaves in a certain manner. These provide a logical order to get a clear view on how the individual’s personal characteristics, traits, environment and the interrelationship of these factors affect his/her personality. Several reviews emphasized the need of theory based nutrition education programs (Contento et al, 1995; Lytle LA, 1994). Various educational strategies, based on developmental and behavioural theories, have been incorporated by nutrition research to teach children about nutrition. Cognitive Development Theory and Social Cognitive Theory are the two most widely used theoretical frameworks in nutrition education.

2.4.1.1 Cognitive development theory

Piaget’s theory deals with the cognitive development of children. He developed four stages and claimed that a child, according to his chronological age, passes from one stage to another.
Sensory-motor stage begins from birth and lasts approximately till the end of the second year. As the name explains, the senses and motor activities play an important role in this stage. During this time, the child explores the world around him through his senses and motor action.

Pre-operational stage starts from the end of second year and lasts till the end of six years of age. The major development of this stage is the child’s acquisition of language skills. Another important characteristic is geocentricism of the child, meaning he is unable to comprehend another person’s point of view. The child starts dramatic play.

Concrete-operational stage starts at seven and continues till the eleventh year. During this stage, the child’s reasoning becomes more logical. He can logically understand concrete events but finds difficulty in grasping abstract concepts and events. Two important developments of this stage are logic and reversibility. Logic: Child demonstrates a very good inductive logic, however finds deductive logic complicated. Reversibility: Child develops the concept that action can be reversed. Primary school children belong to the concrete-operational stage.

Former-operational stage begins around the age of twelve and continues till the end of adulthood. The major hallmark of this stage is, understanding of the abstract concepts accompanied by the ability of deductive logic.

This framework suggests that child’s age strongly affects his ability to categorize, generalize and what they are able to understand.

According to Zeinstra et al (2007) cognitive development and preferences are interrelated. In her study, she reported a relationship between children preferences and their age levels. In pre-operational stage children’s food likes and dislikes largely depend upon the appearance and texture attributes of the food. However, in concrete-operational stage children’s this trend shifts towards the taste attributes of the food, as shown in Figure 2.
Figure 2: Cognitive development and children’s perceptions about food (Adapted from Zeinstra et al, 2007)

<table>
<thead>
<tr>
<th>Pre-operational stage</th>
<th>Concrete-operational stage</th>
<th>Formal-operational stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete thinking</td>
<td>Thinking more logical, but concrete</td>
<td>Abstract thinking</td>
</tr>
<tr>
<td>Ready to try different foods</td>
<td>Ready to widen the range of acceptable foods</td>
<td>Understand that sense of taste can be modified</td>
</tr>
<tr>
<td>Unable to discriminate between foods &amp; snacks</td>
<td>Discriminate between foods and snacks</td>
<td>*</td>
</tr>
<tr>
<td>Ingested foods not changed in stomach</td>
<td>Ingested foods are changed somehow in the stomach</td>
<td>*</td>
</tr>
<tr>
<td>Can mention healthy foods, but do not explain why</td>
<td>Healthy foods make you strong, &amp; grow (do not know how)</td>
<td>*</td>
</tr>
<tr>
<td>Liking based on texture, taste and preferences</td>
<td>Liking based on texture, taste, sweetness &amp; sourness</td>
<td>Liking based on texture, taste &amp; preference for topping</td>
</tr>
<tr>
<td>Disliking based on texture, taste &amp; appearance</td>
<td>Disliking based on taste, sourness &amp; texture</td>
<td>Disliking based on sourness, bitterness &amp; negative experiences</td>
</tr>
<tr>
<td>Realize that food is required for growth</td>
<td>Realize that everybody has his/her specific need for food</td>
<td>Realize the role of food in maintaining good health</td>
</tr>
<tr>
<td>No idea of contamination</td>
<td>Basic idea of contamination</td>
<td>Full adult idea of contamination</td>
</tr>
</tbody>
</table>

* No data available; these studies did not focus on children in the formal operational stage
2.4.1.2 Social cognitive theory

Social cognitive theory (SCT) provides explanation for the multiple influences that affect the dietary behaviours of the individual. According to Social cognitive theory, personal influences, a person’s behaviour and the environment in which the behaviour is exhibited are interrelated and affect each other (Reynolds et al, 1999). This phenomenon is termed as ‘reciprocal determinism’ which implies that change in one element automatically brings change in other elements. Modelling, reinforcement, self-efficacy and self-control are the key elements of SCT that are pertinent to dietary behaviour (Story et al, 2002). It enhances our understanding in grasping the potential influences these factors independently or concurrently exert on the dietary behaviour.

Aforementioned review of the literature about theories brings forth some standard patterns that are responsible in execution of health related behaviours. These standard patterns are comprised of cognitive and social components including cognitive processes, social interactions, perception of social rules, and role of modelling and self efficacy in dietary behaviour. Therefore, nutrition education must incorporate principles from both SCT and cognitive development theory to enhance its efficacy.
2.4.2 Nutrition education in schools

School is an ideal setting to teach children about healthy eating habits due to its systematic environment (Auld et al, 1998). Schools provide potential formal and informal environment for learning and large number of children can be approached simultaneously (Pérez-Rodrigo and Aranceta, 2001; Auld et al, 1998). In literature, the effectiveness of school-based nutrition education programs is amply documented (Pérez-Rodrigo and Aranceta, 2003; 2001).

Children can be the good agent of change. Therefore, school age is the right period for children to learn about diet and nutrition (Contento et al, 2002). It is the time when they are developing eating habits that provide the basis for eating patterns through out their lives. As mentioned before, because of children’s innate preferences of sweet and high density foods, they are more susceptible to consume these foods. Furthermore, they eat foods that are available at home. Nevertheless, it is documented that despite the affordability and availability of food, children do not eat healthful food because of the lack of awareness and nutrition knowledge. Nutrition education empowers children to choose the healthy foods whenever they have the opportunity to select. (Matvienko O, 2007).

Contento et al (1995) reports knowledge-based models and behaviour change models as two very influential models used in school-based nutrition education studies. Social cognitive theory is used in the behaviourally change model. It assumes that personal factors, environmental factors and behaviour factors are three major determinants of the behaviour. Mostly, such interventions utilize multi-component approaches and are intended to change the specific behaviour. This includes increase in the consumption of fruits and vegetables, decrease in fat intake and attainment of behavioural, cognitive or physical skills such as physical activity.
In knowledge-based models, knowledge and attitudes are considered important determinants in behaviour change. Knowledge-based interventions assume that knowledge about food and diet plays an influential role in food choices and dietary behavior. Many studies report a relationship between knowledge and eating habits (Crites SL, 2005; Wardle et al, 2000; Packman and Kirk, 2000).

Nutrition education in schools should include both component i.e. nutrition knowledge and dietary skills, in order to bring change in dietary behaviour. In order to select and eat a healthful diet, children must apprehend what is a healthy diet and must be equipped with skills to translate that knowledge into action. Therefore, nutrition education programs which are age appropriate, based on the sound theory and involve the element of fun and interaction have proved to be successful in this regard.

The success of a school-based nutrition education depends upon the following factors. Policies at school level that facilitate adoption of healthful eating habits, incorporation of sound, age-appropriate and theory-based nutrition education in curriculum, training of school staff, involvement of family and other community resources, culturally appropriate and evaluation (Sahay et al, 2006; Pérez-Rodrigo and Aranceta, 2003, 2001,1997; Lytle and Achterberg,1995). Considering that school aged children are in the process of developing food preferences and dietary patterns, school years may prove an ideal time to provide nutrition interventions.

2.4.3 Nutrition education in Pakistani primary school curriculum

Throughout the world, schools have been considered as an important setting to disseminate knowledge about nutrition and inculcate healthy eating habits in children (Pérez-Rodrigo and Aranceta, 2003). In school settings, curriculum is the vehicle through which desired knowledge is imparted to the
students. A review of the primary school curriculum of Pakistan revealed that the school curriculum does not impart sufficient knowledge regarding the aspects of nutrition and healthy diets. Hence, hindering the schoolchildren opportunities to learn these essential basic skills required for healthy living. Very basic nutrition concepts, for instance diet and health and hygienic living are incorporated in 4th and 5th class science curriculum respectively. These topics, despite being a part of the science curriculum, do not receive desired attention. They are afforded low priority by teachers and parents as compared to other science topics. Mainly because of the time and financial resources at hand are already inadequate to meet the demands of core academic subjects. Instead of delivering information on interrelationship of diet and health, a sound nutrition education curriculum should inculcate skills of healthy food selection and preparation, develop self-efficacy and promote physical activity (Gortmaker et al, 1999; Contento et al, 1995).

2.4.4 School-based nutrition education interventions

School-based nutrition education interventions have shown promising results. De Bourdeaudhuij et al (2010) reviewed 11 school-based healthy eating and physical activity interventions implemented in Europe. The studies included vary in their components and outcome results. Out of six studies carried out in primary schools, two were education based and the other four incorporated both education and environment components in the intervention. They regarded the multi-component school based interventions as most successful because of the simultaneous utilization of varied methods to develop healthy eating and physical activity in children. Lister-Sharp et al (1999) reviewed 32 reviews of health promotion in schools and reports that the knowledge-gain has resulted in all the interventions.

In developed countries, a great deal of work has been done in this field, which incorporated very innovative approaches, targeted different health based issues and demonstrated positive results. A number of primary school-
based nutrition education interventions demonstrated improvements in nutrition knowledge and eating habits of children including Top Grub (Lakshman et al, 2010), Switch what you DO, View and Chew (Gentile et al, 2009), Smart Bodies (Tuuri et al, 2009), Food Dudes (Horne et al, 2009), Reading Across My Pyramid RAMP, (Heneman et al, 2008), Traffic Light Nutrition Tool (Ellis and Ellis, 2007), Kalèdo (Amaro et al, 2006), Salgado et al, 2005, Pizza Please (Powers et al, 2005), Be Smart (Warren et al, 2003), A Healthy Lifestyle program (Wehling Weepie and McCarthy, 2002), APPLES (Sahota et al, 2001), Gimme 5 (Baranowski et al, 2000), 5-a-Day Power Plus (Story et al, 2000) and Eat well & Keep Moving (Gortmaker et al, 1999). Table 1, page 27 provides summary of primary school-based nutrition education intervention carried out in developed countries.
Table 1: Summary of primary school-based nutrition education interventions carried out in developed countries

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Audience</th>
<th>Intervention time, approach &amp; materials</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Grub Lakshman et al, 2010</td>
<td>Cluster randomized control trial</td>
<td>5th &amp; 6th grade students</td>
<td>9 weeks Card game ‘Top Grub’ Healthy eating curriculum</td>
<td>Intervention students had significantly higher nutrition knowledge scores and more positive attitude towards healthy eating</td>
</tr>
<tr>
<td>Switch what you DO, View and Chew Gentile et al, 2009</td>
<td>Pre and post-test design</td>
<td>3rd, 4th &amp; 5th grade students</td>
<td>1 academic year Behavioral &amp; environmental strategies at multiple ecological levels</td>
<td>Intervention children showed a significant increase in fruit &amp; vegetable intake and decrease in screen time.</td>
</tr>
<tr>
<td>Samrt Bodies Tuuri et al, 2009</td>
<td>Randomized control intervention trial</td>
<td>4th &amp; 5th grade students</td>
<td>12 weeks Organ Wise Guys videos, books &amp; stickers</td>
<td>Intervention children significantly increased nutrition knowledge and self-efficacy to consume fruits &amp; vegetables</td>
</tr>
<tr>
<td>Food Dudes Hornet al, 2009</td>
<td>Pre and post-test design</td>
<td>4-11 years old school children</td>
<td>16 days Video adventure Food Dude and small rewards</td>
<td>Higher intake of fruit and vegetables in experimental schools during intervention and at 1yr follow-up</td>
</tr>
<tr>
<td>Reading Across My Pyramid (RAMP) Heneman et al, 2008</td>
<td>Pre &amp; post-test design</td>
<td>1st &amp; 2nd grade students</td>
<td>3 weeks Literacy promoting nutrition education curriculum</td>
<td>Increased nutrition knowledge &amp; positive effects on dietary and physical activity behavior</td>
</tr>
<tr>
<td>Kalèdo Amaro et al, 2006</td>
<td>Pilot cluster randomized control trial</td>
<td>11-14 years old School children</td>
<td>24 weeks (15-30 minutes/week) Kalèdo: nutrition education board game</td>
<td>Intervention children significantly increased nutrition knowledge and weekly vegetable intake as compared to control children</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Audience</td>
<td>Intervention time, approach &amp; materials</td>
<td>Result</td>
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<tr>
<td>---------------------------</td>
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<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Salgado et al, 2005</td>
<td>Experimental and longitudinal</td>
<td>Elementary School children</td>
<td>Nutrition education program</td>
<td>Food &amp; nutrition knowledge scores significantly increased from pre-test to post-test and remained quite high at 3 months' and 5 years' re-test</td>
</tr>
<tr>
<td>Pizza Please Powers et al, 2005</td>
<td>Post assessment control group design</td>
<td>2nd &amp; 3rd grade students</td>
<td>6 weeks Social cognitive theory based interactive board game</td>
<td>Treatment children showed improvement in nutrition knowledge and in dietary behavior</td>
</tr>
<tr>
<td>Be Smart Warren et al, 2003</td>
<td>Pre &amp; post-test design</td>
<td>5-7 years old school children</td>
<td>20 weeks Social learning theory based material and activities</td>
<td>Significant improvements in nutrition knowledge and fruit &amp; vegetable intake</td>
</tr>
<tr>
<td>A healthy lifestyle program Wehling weepie &amp; McCarthy, 2002</td>
<td>Quasi-experimental research design</td>
<td>4th &amp; 5th grade students</td>
<td>5 lessons during 5 weeks ‘Nutrition Jeopardy’ game, worksheets and tasting flavors</td>
<td>Knowledge about nutrition and healthy life styles significantly improved.</td>
</tr>
<tr>
<td>APPLES Sahota et al, 2001</td>
<td>Randomized control trial</td>
<td>4th &amp; 5th grade students</td>
<td>1 year Multi-disciplinary and multi-agency program</td>
<td>Intervention children had higher score for nutrition knowledge, attitudes and self reported behavior for healthy eating &amp; physical activity</td>
</tr>
<tr>
<td>Gimme 5 Baranowski et al, 2000</td>
<td>Randomized control trial</td>
<td>4th &amp; 5th grade students</td>
<td>6 weeks Social Cognitive theory based curriculum, news letters and videotapes</td>
<td>Fruit &amp; vegetable consumption increased 0.2 serving</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Audience</td>
<td>Intervention time, approach &amp; materials</td>
<td>Result</td>
</tr>
<tr>
<td>-------------------------------</td>
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<td>----------------------------------------</td>
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</tr>
<tr>
<td>5-a-day power plus Story et al, 2000</td>
<td>Randomized school-based</td>
<td>4th &amp; 5th grade students</td>
<td>8 weeks Behavioral curricula, changes in school food service</td>
<td>Intervention children increased their intake of fruits &amp; vegetables at lunch</td>
</tr>
<tr>
<td>Eat well and keep moving Gortmaker et al, 1999</td>
<td>Longitudinal pre-test post-test</td>
<td>4th &amp; 5th grade students</td>
<td>2 years Decreasing fat consumption &amp; increasing fruit &amp; vegetable intake</td>
<td>Intervention children % of total energy from fat was reduced and fruit &amp; vegetable was increased.</td>
</tr>
</tbody>
</table>

However, very few studies have been done in developing countries, particularly in South Asia region, which assess the impact of nutrition education intervention on school age children. As the present study was carried out in Pakistan, therefore it seems more appropriate to review in detail only those relevant studies that were carried out in developing countries particularly in South Asia.

Shariff et al (2008) conducted a study that measured the changes in nutrition knowledge scores as a result of six week nutrition education intervention. Students (n=355) from four primary schools were recruited in the study. The study design had a comparison and an intervention group. Intervention consisted of a specially developed module that emphasized the important topics along with a workbook, group discussions, nutrition exhibitions, video presentations, nutrition contest and singing session. Students of the intervention group received nutrition knowledge through trained school teachers. Where as, the comparison group only took part in standard health and physical education curriculum. According to the study, the intervention group at post-test demonstrated significantly higher nutrition knowledge scores as compared to the comparison group.
Ruzita et al (2007) reported that nutrition education programme was very effective in increasing the nutrition knowledge of Malaysian 8 years old children. Schoolchildren (n=418) from rural and urban areas participated in the study. A total of 237 children were included into the intervention group and 181 into the control group. The intervention material consisted of a specially developed and pre-tested video and comic named ‘Food Pyramid’. During the three week intervention period, the video was used in the first week, the comic in the second week and group work (complete a food pyramid sheet) was carried out in the third week. Children in the control group received no nutrition education. For evaluation purpose, nutrition knowledge, attitudes and practices (KAP) questionnaire was filled out by each child. This was to take place before the intervention, at the end of the three week intervention and at the six months follow-up. The result of the study implied that intervention was successful in increasing nutrition knowledge and developing positive changes in the attitudes of children in intervention group as compare to those in the control group. The study results established the fact that use of creative medium like videos and comics proved quiet helpful in the learning of children.

Comparable to the above studies, a pilot study of Sekolah Sehat programme to promote healthy life styles in schoolchildren was carried out in 12 primary schools of Kuala Lumpur and Selangor in Malaysia (Koon et al, 2006). A total of 786 children aged 7-12 years old participated at the baseline while 635 were present at the follow-up. The intervention modules comprised of pictorial textbook and workbook, one interactive computer game about nutrients and their functions, one video promoting healthy food choices in the form of a sketch, a comic book about healthy eating, and flip charts related to exercise. The intervention was carried out for six weeks during the physical and health education period. The study demonstrated significant (p<0.001) increment in nutrition knowledge scores at the follow-up and also reported positive changes in certain dietary habits. Teachers and principals reported certain
limitation in implementation including time shortage and lack of resources. Despite these hindrances, the Sekolah Sehat programme did increase student's nutrition knowledge and made improvements in their dietary habits.

Feeding Minds and Fighting Hunger (FMFH) developed by the Food and Agriculture Organization was implemented in the rural schools of India (Bamji and Murthy, 2006). Three government schools, which were attended by children whose families were living below the poverty line, were recruited in the study. A one day training workshop was arranged for three teachers i.e. one form each school. The FMFH lessons were translated into the local language. Many classroom based activities for instance discussions, drawing competition, a message of the day and vegetable plantation were used to deliver the nutrition message. A nutrition questionnaire was implemented before and after the intervention. The results showed a significant (p<0.001) increase in the nutrition knowledge of children. The study concluded that the nutrition education intervention based on the FMFH model can be helpful in inculcating awareness among children about hunger, nutrition and malnutrition.

Taken together, these studies show that school-based nutrition education approaches can significantly increase nutrition knowledge and to some extent dietary behaviour of children as well.

2.5 Computer-based education

In recent years, the use of computers as an educational tool has increased due to its promising benefits. Evidence-based research in various subjects, has reported that computer-based education increases students’ learning outcomes (Chang CY, 2002; Jantz et al, 2002; Yildrim et al, 2001). Skinner D (1997) in the Meta analysis of 500 studies, which investigated the effect of computer-based instructions, inferred that computer-based instructions
enhance students learning. Furthermore, they also learn the material in relatively less time.

The computer-based programs constitute of multiple interactive elements including audio, text, simulation, colour and graphics and provide opportunities for two-way communication. In the learning process, interaction is of great importance as interactivity motivates children to participate actively in the learning process. It is evident from the research that during the lecture, children’s attention span lasts for 10-18 minutes. Therefore, it is advised to use some activities to capture the attention of students (Stone LL, 1999). However, computer-based education has an edge due to its interactive nature over other traditional mediums. As a matter of fact, when more senses are involved in the process of learning, people learn more correspondingly. The computer involves and stimulates many senses at the same time. As a result, it can accelerate the learning process and increase retention.

Computer-based programmes offer self-paced learning i.e. the learners can proceed gradually or swiftly through the program. If they desire; they can make as many repetitions as they want. Furthermore, they can skip a certain topic completely or only take on a part of it, skipping the rest of the material. As compared to teacher-led instructions computer-based programs afford more autonomy and independence to the user. Another important aspect of computer-based programs is self-directed learning. It provides the learner an opportunity to choose and control learning activities according to his own learning style and by use of different learning strategies (Beerman et al, 1998). When learners have the opportunity to learn what appeals them it results in advancement in learning.

An increase in student’s attendance rates, decrease in drop out rates and higher academic achievements is associated with schools that integrated computers in their curriculum, owning to the positive aspects of computer-
based tools. Furthermore, computer-based tools help the students to understand abstract and complex concepts (Matheson and Achterberg, 1999).

2.5.1 Use of computer and computer assisted instruction in Pakistan


In the National education Policy 1992, computers were acknowledged as a potential contributor in the enhancement of quality of instruction for the first time. National Education Policy 1998-2010 also emphasized the integration of information technology in educational settings. Many steps were outlined to increase computer literacy and computer education. The framework includes equipping secondary schools with computers, establishing computer laboratories in 1000 schools and introduction of computer as an optional subject (Government of Pakistan, 1998a). The Ninth Five Year Plan was based on the guidance provided by the Pakistan 2010 programme and National Education Policy 1998-2010. The focal point of the plan was information technology, computer literacy and computer education. The term Computer Assisted Instruction was recognized and incorporation of it at secondary level through smart schools was also proposed for the first time (Government of Pakistan, 1998b).

2.5.1.1 Present situation of infrastructure for computers

The Government has taken initiatives for the integration of computer assisted education in schools. For this purpose, computer laboratories have been set up in ninety-four public secondary schools belonging to all the four provinces and Azad Jammu Kashmir. All the laboratories are provided with nine to thirteen network computers. Although, the number of computers in Pakistan schools is bound to increase, however, the present situation is quite different.
from the aims of ‘The ninth five year plan’, which have not yet been fully realized. Due to this reason, Computer Assisted Education is not a very common practice in Pakistan’s education setting. Computer Assisted Education in Pakistan is still in its infancy stage as compared to the more developed countries.

Several limitations have hampered the integration of computers in schools in Pakistan including lack of finances, lack of computer-literate teachers, lack of administrative support and most of all, lack of interest by the government.

2.5.2 Computer-based nutrition education

Computers are becoming an integral part in health promotion and nutrition education programs. Children at the concrete-operational stage find most nutrition concepts abstract; therefore, methods which enhance their comprehension must be incorporated in the teaching. As mentioned before, the computer-based programs constitute of multiple interactive elements including audio, text, simulation and graphics. These provide opportunities for two-way communication and thus become an ideal tool to educate children about nutrition. Matheson and Spranger (2001), in a review of 30 nutrition academic curricula, suggest that half of the programs incorporated the element of curiosity and challenge to convey the nutrition content.

Health literature documented various researches that successfully investigate the effects of computer-based tools with a variety of issues. Some deal with the use of computer software for the delivery of tailored nutrition education messages (Mangunkusumo et al, 2006). Others investigate the effect of multimedia software such as CD-ROM on disease prevention (Hewitt et al 2001), nutrition knowledge (Silk et al, 2008; Jantz et al, 2002; Turnin et al 2001), physical education (Yildrim, 2001) and behavioural change (Baranowski T, 2003) among children, adolescents and adults. Many of these interventions have been carried out in developed countries.
However, discrepancies prevail in the literature about the effectiveness of computer-based nutrition education tools alone over traditional methods. An analysis of research literature, which explored the effects of computer-based tools on nutrition knowledge of children, displayed mixed results.

While some studies suggest that computer-based tools are more effective in comparison to traditional methods. The evaluation study of Food Pyramid Games was based on a pre and post-test design with a control group (Serrano and Anderson, 2004). The study took place in four schools in the United States, 115 children aged between 10-13 years were included in the study. 52 children were assigned to the control group and 63 children to the experiment group. The experiment group used Food Pyramid Games in one class of 45 minutes for three consecutive weeks. The control group only took part in pre and post-tests. The study reported significant increase in knowledge of both the experiment and control groups. However, the post-test scores of the experiment group were significantly higher than the control group.

A formative assessment of Nutrition Jam was carried out in 6 different schools. An interactive CD-ROM was developed to increase the nutrition knowledge of students (Valdez A 2004). Eight classrooms (6 treatment and 2 control) and 222 fourth grade students participated in the research. This was a pre and post-test design study. The results demonstrated a significant nutrition knowledge gain in the students who used Nutrition Jam.

Kim and Hyun (2006) investigated the effects of nutrition education website ‘ifood’ on nutrition knowledge, dietary attitudes and dietary behaviours of 262 children of 5th and 6th classes. Children navigated the website by themselves in order to gain knowledge. Pre-test and post-test were given to the children. The results of the study demonstrated a significant increase in nutrition
knowledge scores from 10.9 to 13.1. Kim sun also indicated improvements in some dietary behaviour and attitudes.

On the contrary, other studies reported no difference between computer-based tools and traditional methods. A study conducted in Brazil recruited 200 children of 8-10 years of age. Munguba et al (2008) compared the effects of two interactive games, video game and board game, based on the food pyramid theme. The video game consisted of six stages and each child had to organize his daily diet in six meals. The board game also followed the same theme. He reported that the children in both groups showed increase in learning of nutritional concepts. However, children in the video games group demonstrated attitudes of winning, planning and amusement while children of the board game group mostly exhibited an attitude of competition. The study proposed the use of both videogame and board game in nutrition education.

Kreisel K (2004) did not find a significant difference in mean number of correct answers between control (traditional methods) and intervention (computer-based) groups at post-intervention and follow-up. Instead, the study reported significant increase in both groups.

In a study by Hewitt et al (2001), effectiveness of a computer based recourse ‘Sun Safe’ was assessed as change in levels of knowledge. The program was developed for children of 10-11 years of age. Intervention group 1 used computer based resource ‘Sun Safe’, intervention group 2 used specially developed workbook while the control group received no intervention. All three groups demonstrated significant increase in knowledge scores. However, no significant difference between the two intervention groups was found.

Moreover, another study reports that traditional methods are more effective in increasing nutrition knowledge in comparison to computer-based tools. The
evaluation study of two different educational tools on nutrition knowledge in India found traditional method more effective in increasing the nutrition knowledge of respondents than CD-Room Rughunatha et al (2007), further more reported that the attention of respondents was very high during the increment 1 (traditional method) as compared to intervention2 (CD-ROM) and regarded it a contributing factor of low increment of nutrition knowledge in intervention2. However the low increment in intervention 2 could be due to the same respondents participation in intervention 1 and intervention 2 and they did not find second intervention very informative and challenging.

The above review points out that literature is inconclusive in establishing the comparative effectiveness of computer-based tools over traditional methods. Several factors could be responsible for the observed variations and hinder from generalization of the results. The computer-based tools may vary in their presentation mode (animation, colors and text), learning content, time for working with the tool, learner’s computer related skills and willingness and methodological differences between studies. These are all contributors in the observed variations. Therefore, these inconsistent results documented in literature require more research to explain the contradictory results.

To conclude, a retrospective look at childhood malnutrition and the various factors contributing to this epidemic demonstrate that without controlling nutritional disorders and unhealthy dietary behaviors, Pakistan will continue to face a generalized pattern of malnutrition. It is clear that learning plays a major role in the development of a child's eating behaviour. School-based nutrition education programs provide an opportunity to teach children about healthy eating. In addition, computer-based tools have a strong potential to deliver nutrition education in an interesting and motivating manner.
3 Methodology

The purpose of the research was to implement and evaluate nutrition education intervention in primary schools of Lahore and to compare the results with the results of Vienna study. In line with this framework, to make the comparison effective and reduce the element of bias, study protocol of the present study was kept as similar as possible with the Vienna study (Murrey and Ehrenberg, 1993). The evaluation methodology comprised both quantitative and qualitative methods. Incorporation of both qualitative and quantitative methods assured better interpretation of the study results and further validates the findings. (Campbell et al, 2000)

Study design is described in the first section of this chapter. Sample size and sample selection is discussed in the second and third section, respectively. These are followed by sections dealing with intervention material, teachers training, intervention and data collection instruments as well as data analysis.

3.1 Study design

The study design was multi-factorial with repeated measurements (baseline, post-intervention and follow-up) of dependant samples from intervention and comparison groups as depicted in Figure 3. The study was a two-week school based nutrition education intervention. The comparison group received nutrition education through worksheets, board and card games. The intervention group received nutrition education through computer-based nutrition education tool ‘Cool Food Planet Kidz’ along with worksheets, board and card games. The control group received no nutrition education. The purpose of the control group was to control the influence of extraneous variables on nutrition knowledge. Nutrition knowledge as mean number of correct answers was measured at baseline (t0), post-intervention (t1) and follow-up (t2) with a validated nutrition knowledge questionnaire. Quantitative
evaluation included the instruments that measure nutrition knowledge and assess the content and usability of intervention material. Qualitative information was gathered through observing the nutrition lessons and through focus group discussion with student teachers and children in order to explore their opinions about the applicability and appropriateness of the intervention.

Figure 3: Study Design

### 3.2 Sample size

The power analysis program G*Power was used to calculate the sample size (Erdfelder et al, 1996). It was hypothesized that in all children nutrition knowledge will increase 20% from baseline to post-intervention. Using the
0.05 level of significance, 80% power with standard deviation of 3 and an estimated medium effect size of $d=0.3$, a total of 278 children were required. In the a priori sample size calculations the expected difference in knowledge gain between intervention and comparison groups was not considered. Therefore, post hoc analysis was used to determine power and the effect size of the actual difference in knowledge gain at post-intervention between intervention and comparison groups.

### 3.3 Sample selection

The following basis was employed to select the student teachers and collect the sample of the study. The intervention was intended to implement through the student teachers (teachers who were in the process of training, which are named as student teachers in the realm of this study). The rationale behind this approach was to reduce the teaching bias. These student teachers were selected from Ali Institute of Education (AIE), a private teachers’ training academy at Lahore, Pakistan. There were two main reasons to select the student teachers from AIE. Generally, teachers’ training institutes in the public sector offer practical experience in the months of January and February, which the researcher could not avail. This study was scheduled in the month of October 2008 due to time constraints. Due to this reason, it was not possible to carry out this research with the public sector teachers training system.

Secondly, as the student teachers of public sector institutions are required to fulfil their practical teaching experience in public schools, this meant that the criteria set for this study regarding basic school infrastructure (availability of computers) and varied socio-economic status of the students was not met. The academic literature, generally available on the infrastructure of Pakistani public sector schools, indicates that these schools lack adequate computer facilities, which was one of the main requirements for the successful implementation of the intervention in this research. Furthermore, only the
children from lower socio-economic status attend these schools, due to which it was not possible to compare the affects of intervention between the children belonging to varied socio-economic status.

The computer-based nutrition education tool ‘Cool Food Planet Kidz’ was developed for children 8-10 years old, thus children from the fourth and fifth classes were recruited in the study.

To determine the effects of indicators of socio-economic status (SES) on nutrition knowledge, another important criterion considered while selecting the schools was the SES of the children. Three important procedures were carried out to determine the SES of the children of a particular school. The locality of the school is an important indicator of the SES of the children. Lahore is sub divided into nine towns (Appendix 1: Map of Lahore). On the basis of multiple indicator cluster survey 2004, Bukahri and Sikandar (2007) ranked these towns as low SES and high. From these nine towns two towns, one from low SES and one from high SES were randomly selected. Secondly, the SES of each school was determined by giving the questionnaire to school principals in which they mentioned the SES of the children as low or high (Appendix 2: Questionnaire for school principals). In addition, school fees were also used as an indicator of the SES. The schools that charge fees more than Rs 3,000 were considered as high SES schools. Whereas, schools with less than or equal to Rs 1,000 were regarded as low SES schools (Rehman T, 2005).

Altogether 50 schools, 25 from each town were randomly selected and contacted. The principals of these schools were given the questionnaire in order to get the information about the school. Based on information gathered with the help of the procedures mentioned above, the selection of schools was carried out. To summarize, the school selection was based on four criteria. These were namely schools that (a) offered the two-week practical
experience for student teachers, (b) used worksheets and games in their teaching practices, (c) had at least two computers and (d) either belonged to low or high SES.

Out of the 50 schools contacted, only 22 of them were in accordance with the selection criterion. From these 22 schools, children in 11 schools mostly belonged to low SES and in other 11 schools mostly belonged to higher SES. From these 11 low SES and 11 High SES schools, two schools (one from each SES) were randomly chosen and grouped together as control schools. The control group was provided with no nutrition education. As mentioned earlier that the purpose of the control group was to control the influence of extraneous variables on nutrition knowledge. The flow of schools and children in the study is depicted in Figure 4.

At the next step, from the rest of the 10 low SES schools, five were chosen randomly and grouped as comparison schools and the remaining five as intervention schools. Similarly, from the 10 high SES schools, half were chosen randomly and grouped as comparison schools and the rest as intervention schools.

3.4 Intervention material

The intervention material was based on the Vienna study, Kreisel K (2004), which was used with due permission. The teaching material consisted of 12 worksheets, two board games and one card game. In order to help the intervention children to navigate through the ‘Cool Food Planet Kidz’ CD-ROM, five worksheets were separately developed. The worksheets covered the following topics: healthy breakfast, healthy snacks, good food choices, teeth, fruits and vegetables and nutrients in food (see page 45 for detailed description of the topics). The material on worksheets was presented in the form of a pictorial textbook.
The teaching materials (worksheets and CD-ROM) were translated into the local language (Urdu) by two native Urdu speakers and reviewed by a third translator for accuracy. Additionally, culturally appropriate modifications were also made in the content.

3.5 Teachers’ training

Before the implementation of the program, two workshops were conducted. A one-day workshop was held for the class teachers. They were oriented to the core philosophy of the study and briefed about the basic concepts of nutrition. A two-day training workshop was held for the student teachers. It comprised of lectures on basic nutrition, healthy eating habits and nutrients (see page 45 for details).
for detailed description of the topics). The purpose of the training workshop was to (a) build their capacity in nutrition and healthy eating habits (b) brief them about the purpose of intervention (c) discuss and gather ideas on how to incorporate nutrition lessons in the classroom. They were also given instructions about the nutrition worksheets and games. In addition, student teachers for the intervention group received training on the specifics of using the interactive CD-ROM in the classroom.

Each student teacher was given the nutrition knowledge questionnaire before and after the training session in order to assess their nutrition knowledge before and after the workshop.

All student teachers were given worksheets, games and a detailed instruction module, which described the purpose of each teaching lesson and a paper sheet for the documentation of the whole process of the lesson. Considering that, schools do not have access to the internet, the website ‘Cool Food Planet Kidz’ was provided in the form of CD-ROM.

**3.6 Intervention**

Keeping the student teachers’ interest in mind, they were given the opportunity to choose whether they wanted to work with an intervention group or a comparison group.

The intervention was carried out during the two-week practical training of student teachers (6-17 October, 2008). Student teachers were instructed to spend five hours on nutrition education. Considering the difference in time schedule and administrative issues of each school, the intervention was intended to be as flexible as possible so that student teachers could determine when and how to use the provided material.
Student teachers were briefed to cover the following topics during the intervention:

- Importance of balance diet and being able to make healthy choices for a balanced diet
- Importance of breakfast and being able to choose healthy foods for breakfast
- Being able to choose healthy snacks
- Eating at least five servings of fruits and vegetables
- Recognizing foods rich in proteins, carbohydrates, fats (hidden fat) and calcium
- Knowing the body’s requirement of carbohydrates, proteins, vitamins and calcium
- Taking a lot of fluids, specially water, minimum 5 glasses per day
- Exercising and calorie expenditure

In the Comparison group, student teachers used the given worksheets and games. In the Intervention group, student teachers used the provided CD-ROM in addition to the worksheets and games.

### 3.7 Instruments for data collection

A total of nine data collection instruments were used. They are described separately as follows:

- Questionnaire for the school principals
- Nutrition knowledge questionnaire
- Evaluation questionnaire for children of the comparison group
- Evaluation questionnaire for children of the intervention group
- Evaluation questionnaire for student teachers of the comparison group
- Evaluation questionnaire for student teachers of the intervention group
- Teaching protocol
- Guidelines for focus group discussion with children
Guidelines for focus group discussion with student teachers (Table 2, page 50 shows the time at which each data collection instrument was employed)

### 3.7.1 Questionnaire for the school principals

The rationale for the questionnaire intended for the school principals was to get baseline information about the school characteristics. The principals were asked to provide information about the age, gender, use of worksheets and fee structure of fourth and fifth class children. In addition, they were required to mention the socio-economic status of the schoolchildren as ‘high’ or ‘low’. They were also required to state the number of computers available in the school for children’s use. Furthermore, they were inquired about the prospect of allowing student teachers to practice their lessons for two weeks in the respective schools.

### 3.7.2 Nutrition knowledge questionnaire

Nutrition knowledge was assessed by the use of the validated Nutrition Knowledge Questionnaire (NKQ). The NKQ was based on the Vienna study implemented by Kreisel K, (2004). The use of validated and standardised research instruments ensures validity and enables to compare the results of different studies (Laake and Benestad, 2007). Considering the previously validated instruments do not ensure their validity in different cultures and cross-cultural adaptation is essential in order to reduce the risk of bias in the study (Herdman et al, 1998), certain culturally appropriate adaptations were made. The NKQ was translated into the local language (Urdu) by two native Urdu speakers and reviewed by a third translator for accuracy.

NKQ was pre-tested on 35 schoolchildren to determine the internal reliability. Initially the reliability coefficient Cornbach’s alpha was 0.58. According to the literature, the questionnaire should have the reliability level of at least 0.70 (Parmenter and Wardle, 1999). Ambiguous food items were identified and were replaced with appropriate modifications. The NKQ was pre-tested again
on a set of 41 different schoolchildren and yielded the reliability coefficient, Cornbach’s alpha of 0.71.

The NKQ comprised of two parts: The nutrition knowledge part and the demographic part. The nutrition knowledge part consisted of 22 multiple-choice questions. Each question had four responses, including one correct answer, two distracters and one ‘I do not know’ response. Each correct answer scored 1 point, wrong and ‘I do not know’ responses scored 0. The questions were related to the topics taught during the two-week intervention (Appendix 3: Nutrition Knowledge Questionnaire).

The demographic part collected information about the age, gender, class level and country of origin. Two indicators, Family Affluence Scale (FAS), and the father’s and the mother’s occupational level were used in this study to assess the socio-economic status of the children. A FAS (Currie et al, 1997), is a non-occupational indicator consisting of variables including computers at home, car ownership, own bedroom and how many times the child went on holiday in the previous year. Therefore, to compute FAS questions about these variables and mothers and fathers occupational level were incorporated in this part (Appendix 4: Protocol and Variable Coding).

The same nutrition knowledge questionnaire was administered at baseline post-intervention and follow-up in order to collect the data. All student teachers were provided with the NKQ for baseline and post-intervention three days before the intervention. The student teachers administered the NKQ, under examination conditions, in one school period i.e. 45 minutes. They were asked to administer the NKQ for baseline one day before the commencement of the nutrition intervention and the NKQ for post-intervention on the last day of the nutrition intervention.
There was a need for a coding scheme i.e. to allot a code to each student that made sure later on that NKQ at baseline, post-intervention and follow-up belonged to the same child. Considering that each child has allotted a roll number in classroom, the student teachers were asked to use the same coding scheme for the identification prior to distribution of NKQ.

In order to collect data at the three months follow-up, NKQ was given to the concerned class teachers. They were instructed to administer the NKQ under the same conditions and to follow the same coding scheme strictly. The NKQ was collected on the next day from the concerned class teachers.

3.7.3 Evaluation questionnaire for children of the comparison group

The Evaluation questionnaire (Eq) for the children of the comparison group consisted of four questions (Appendix 5: Evaluation questionnaire for children of the comparison group). Children were asked about their experience while working with nutrition worksheets. The purpose was to gather information about the text of nutrition worksheets, their intention to use nutrition worksheets again and whether or not they had fun while working with nutrition worksheets. The Eq was administered along with NKQ at post-intervention.

3.7.4 Evaluation questionnaire for children of the intervention group

The Eq for intervention children had twelve questions. Seven questions were about the CD-ROM (Appendix 6: Evaluation questionnaire for children of the intervention group). The purpose was to gather information about the wording, graphics and colours of the CD-ROM and their enjoyment while learning with the CD-ROM. Furthermore, their computer knowledge and availability of computers and internet in the classrooms was determined. The Eq was administered along with NKQ of post-intervention.
3.7.5 Evaluation questionnaire for student teachers and teaching protocol

The evaluation questionnaire was filled out by student teachers of both control and intervention groups. The purpose of the Eq of the control student teachers was to obtain their opinion about the worksheet materials as a teaching tool, utility and suggestion or critical comment about the worksheets. The Eq for the intervention student teachers acquired the student teachers opinion about CD-ROM as a teaching tool, its content and utility (Appendix 7: Evaluation questionnaire for student teachers of the intervention group).

The student teachers of both groups were given a teaching protocol. They were instructed to write down every detail of the lesson they delivered, material they used, days on which they delivered the lesson and how many hours they spent on intervention (Appendix 8: Teaching protocol). The student teachers of intervention group were also required to mention the amount of time children spent on CD-ROM.

3.7.6 Focus group discussions with children of the comparison and the intervention groups

Focus group discussions were held with the children of both intervention and control group. The two comparison schools in which focus group discussions were conducted were selected randomly. The purpose was to get in-depth information about the children’s experience with nutrition worksheets particularly and about intervention generally.

The three intervention schools were also selected randomly for the focus group discussions. The purpose for the focus group discussion was to get information about their experience of learning nutrition concepts with CD-ROM specially and about computers generally. Furthermore, to encompass the problems they encountered while using computers.
3.7.7 Focus group discussions with student teachers

Three focus group discussions were carried out with student teachers of both groups. The purpose of the focus group discussions was to get in-depth information about the intervention materials (worksheets and CD-ROM), the problems they faced during the implementation period with regard to computer and CD-ROM, and their views about the use of computers in education in Pakistan.

Table 2: Data collection instruments and time table of data collection

<table>
<thead>
<tr>
<th>Data collection instrument</th>
<th>Month</th>
<th>October 2008</th>
<th>November 2008</th>
<th>December 2008</th>
<th>January 2009</th>
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</thead>
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<tr>
<td>Questionnaire for school principal</td>
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<td>Week 1</td>
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<td>3</td>
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<td>Nutrition knowledge questionnaire</td>
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<td></td>
<td>collected</td>
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<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td></td>
<td>t1 distributed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>collected</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>t2 distributed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>collected</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Evaluation questionnaire for children</td>
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<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>collected</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Evaluation questionnaire for student teachers</td>
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</tr>
<tr>
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</tbody>
</table>
3.8 Data analysis

3.8.1 Quantitative analysis

Responses to the nutrition knowledge questionnaire were double entered, in order to enhance quality of the data. The data was analyzed using the SPSS Version 15.0, SPSS Inc., 2006. Strict protocol was followed in recoding of some variables (Appendix 4: Protocol and variable coding). Those schools and children who conformed to the protocol were included into the data analysis (Appendix 9: Criteria for schools’ and children's inclusion). G*Power program was used for the sample size calculation and post hoc analysis.

The assumption of symmetry and normality of data was determined by using the Kolmogorov-Smirnov test, kurtosis and skewness. Non-parametric tests (Chi-square and Mann Whitney-U test) and parametric test General Linear Model (pair-wise comparison) were used to determine the homogeneity across variables (nutrition knowledge, age, gender, class levels and socio-economic status) at baseline. At post-intervention and follow-up, in GLM for repeated measures, independent variables; group [intervention and comparison group], age [8-9 and 10-11] and gender [boys and girls] were used as the between-subject-variables and dependant variable; nutrition knowledge (measured as mean number of correct answers) as the withinsubject-variable. Levene’s test in GLM was performed to determine the equality of variance in each case. Pair wise comparisons were performed on the data to determine the nature of the repeated measure effects wherever required. The rational for using the pair wise comparisons (p value adjusted with Bonferroni) is to control the Type 1 error across the comparisons. An alpha level of significance 0.05 was used to test each variable.

Kruskal-Wallis test and subsequent Mann Whitney U-test was performed to determine the change in nutrition knowledge at 3 points of time (baseline, post-intervention and follow-up) between intervention, comparison and
Methodology

control groups. The rationale for using these tests is the non normal distribution of the data of control group.

Concerning the third hypothesis i.e. nutrition knowledge is associated with indicators of socio-economic status, the Family Affluence Scale (FAS), Mother’s occupational level (MOL) and Father’s occupational level (FOL), were utilized as indicators of socio-economic status. As variables FAS, MOL, FOL violated the parametric assumptions i.e. the data is non normally distributed and cell counts of certain items were very small, therefore, non parametric test (Kruskal-Wallis test and Mann Whitney U-tests) were used to test the hypothesis that nutrition knowledge is associated with socio-economic status’ indicators. The comparison was made between children’s nutrition knowledge collected at three points of time, baseline (t0), post-intervention (t1) and follow-up (t2), and the six levels of MOL and FOL and between the three levels of FAS with the above-mentioned tests.

Pakistan standard classification of occupation (1994) was used to categorize the respondents’ job description of their respective fathers and mothers. The nominal codes are in accordance with the international standard of classification of occupations. These codes were assorted into six categories i.e. ‘very high’, ‘high’, ‘medium’, ‘low’, ‘very low’, and ‘economically inactive’ (see Appendix 4: Protocol and variable coding).

The knowledge gain was measured as:
- **Short-term knowledge gain**: Difference between the nutrition knowledge at post-intervention and baseline (t1- t0)
- **Long-term knowledge gain**: Difference between the nutrition knowledge at follow-up and baseline (t2 - t0)
- **Retention of knowledge**: Difference between the nutrition knowledge at post-intervention and follow-up (t2 - t1)

(see figure 3 page 39 for knowledge gain variables)
Statistical program G*Power was used, for the post hoc analysis, to determine the power and effect size of the actual difference between intervention and comparison groups at post-intervention.

### 3.8.2 Qualitative analysis

The purpose of qualitative evaluation was to get a detailed in-sight into quantitative results as well as to determine the acceptability of computer-based nutrition education. It consisted of focus group discussions and classroom observations.

Focus group discussions were conducted within the study framework. Exact transcriptions of the recorded discussions were generated and coded according to the developed guidelines. Furthermore, observations made during the nutrition lessons were also summed up.
3.9 Study limitations

Like many other school-based nutrition education intervention, the present study also faced certain limitations. The schools that used worksheets for imparting knowledge to the children were included in the study. Later on, it was discovered that teaching children through worksheets and board games was not a general practice in some of the selected schools. During the focus group discussions, children of certain comparison schools also mentioned and complained about the infrequent use of worksheets in classrooms. The children of the comparison group enjoyed working with nutrition worksheets and learning nutrition concepts through board and card games and found them very interesting. In line with the prevailing situation, it can be inferred that the medium of worksheets contributed in the significant resultant increase in nutrition knowledge of the comparison group children. This could be the possible reason for the lack of the observed difference between comparison and intervention groups.

Another limitation found was that two classrooms from each school participated in the study. Initially, in order to reduce the likely contamination effects, one classroom from each school was selected. However, due to the refusal and non-adherence to the study protocol, some schools were excluded from the study; as depicted in figure 4 page 43. This awkward situation resulted in the selection of two classes from the same school, which might have possibly affected the tenacity of the findings.

Children in intervention group used the computer-based tool in addition to the worksheets and board games. The children might not have had appropriate time to explore the CD-ROM and learn at their on pace. Furthermore, frequent power failures interrupted the time schedule and consequently reduced the time that the children had allocated to explore the CD-ROM. This might have negatively affected children’s learning through computers,
considering that the success of the intervention also depends upon the available time to explore the CD-ROM.

The level of computer skills is directly related to the effective use of computers. The lack of computer skills, as reported by the children, might have proved a strong barrier in attaining the maximum benefit from the computer-based tool.

Same amount of nutrition education was provided to the children of all classes. However, the methods and exact content differed depending upon the different strategies employed by the student teachers. This represented variation in the presentation of the nutrition education materials that the children received.

The present study only included children of fourth and fifth classes due to which, results could not be generalized to the whole population.
4 Results

The first section of the results chapter reports the response rate and inclusion rate of schools and children. The comparison of baseline characteristics with regard to children included into and excluded from the data analysis and intervention and comparison children who were included into the data analysis is presented in the second section.

The findings of general linear model (GLM) for repeated measures related to the first two study hypothesis are presented in the third section. Difference in nutrition knowledge between intervention, comparison and control groups found at baseline, post-intervention and follow-up are reported in the fourth section. The findings related to the third study hypothesis i.e. measurement of indicators of socio-economic status (Parental Occupation Level and Family Affluence Scale) and their association with the nutrition knowledge of intervention and comparison group children’s at baseline, post-intervention and follow-up are reported in the fifth section. The effect size, replies given to NKQ items and student teachers’ nutrition knowledge are presented in the sixth, seventh and eighth sections respectively. Results related to the evaluation questionnaire and focus group discussions with student teachers, intervention and comparison children are presented in the ninth, tenth and eleventh sections respectively. Summary of the observations of nutrition education lessons and teaching protocol are presented in the twelfth and thirteenth sections respectively.

4.1 Response rate and inclusion rate

A total of 13 primary schools (631 children) were selected for the study. Later two schools, one intervention and one comparison school, refused to allow student teachers to work in their premises. These schools were, therefore, excluded from the study. A total of 11 schools (522 children); 4 intervention (213 children), 5 comparison (249 children) and 2 control (60 children)
schools participated in the study (see Figure 4 at page 43 for flow of schools and children through the study). Finally, 344 children from 11 primary schools; 147 children from 4 intervention schools, 156 children from 5 comparison schools and 41 children from two control schools were included into the data analysis. Only those children were included into the data analysis that completed all three questionnaires i.e. baseline, post-intervention and follow-up (see Appendix 8 for inclusion criteria for schools and children into data analysis). A high (83%) response rate was received. However, only 55% of the children finally completed the study.

### 4.2 Baseline characteristics

#### 4.2.1 Comparison of baseline characteristics between children included into and children excluded from the data analysis

A total of 522 children participated in baseline measurement. Out of these 522 children, 344 children were included into and 178 children were excluded from the data analysis. Baseline characteristics were compared between children who were excluded from and included into the data analysis. There was no significant difference between children included into the data analysis and excluded from the data analysis with regard to age (Chi-square, p=0.83), gender (Chi-square, p=0.75) and class level (Chi-square, p=0.33) as depicted in Table 3.
Table 3: Comparison of age, gender and class level between children included into and excluded from the data analysis.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Excluded from the data (ED)</th>
<th>Included into the data (ID)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>% within variable</td>
<td>% within (ED)</td>
</tr>
<tr>
<td>8-9 years</td>
<td>78</td>
<td>33.80</td>
<td>43.80</td>
</tr>
<tr>
<td>10-11 years</td>
<td>100</td>
<td>34.40</td>
<td>56.20</td>
</tr>
<tr>
<td>Total</td>
<td>178</td>
<td>344</td>
<td>522</td>
</tr>
<tr>
<td>Girl</td>
<td>71</td>
<td>33.30</td>
<td>39.90</td>
</tr>
<tr>
<td>Boy</td>
<td>107</td>
<td>34.60</td>
<td>60.10</td>
</tr>
<tr>
<td>Total</td>
<td>178</td>
<td>344</td>
<td>522</td>
</tr>
<tr>
<td>4th Class</td>
<td>97</td>
<td>36.10</td>
<td>54.50</td>
</tr>
<tr>
<td>5th Class</td>
<td>81</td>
<td>32.00</td>
<td>45.50</td>
</tr>
<tr>
<td>Total</td>
<td>178</td>
<td>344</td>
<td>522</td>
</tr>
</tbody>
</table>

No substantial difference (Man Whitney U-test, p=0.073) was detected between children who were included and children who were excluded from the study with regard to the Family Affluence Scale, which is used as an indicator of children’s socio-economic status (Table 4).

Table 4: Comparison of Family Affluence Scale between children included into and excluded from the data analysis

<table>
<thead>
<tr>
<th>Group</th>
<th>Family Affluence Scale (FAS)</th>
<th>Group Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Least Wealthy (LW)</td>
<td>Average wealthy (AW)</td>
</tr>
<tr>
<td>Excluded from the data analysis</td>
<td>105</td>
<td>37.60</td>
</tr>
<tr>
<td>Included into the data analysis</td>
<td>174</td>
<td>62.40</td>
</tr>
<tr>
<td>FAS Total</td>
<td>279</td>
<td></td>
</tr>
</tbody>
</table>

Baseline nutrition knowledge between children included into and children excluded from the data analysis is comparable (Man Whitney U-test, p=0.25) as shown in Table 5.
Table 5: Comparison of baseline nutrition knowledge as mean number of correct answers between children included into and excluded from the data analysis

<table>
<thead>
<tr>
<th>Study Groups</th>
<th>Excluded from the data analysis</th>
<th>Included into the data analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>mean</td>
</tr>
<tr>
<td>Intervention</td>
<td>43</td>
<td>9.77</td>
</tr>
<tr>
<td>group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>58</td>
<td>9.52</td>
</tr>
<tr>
<td>group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>16</td>
<td>9.19</td>
</tr>
<tr>
<td>group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined Total</td>
<td>117</td>
<td>9.56</td>
</tr>
</tbody>
</table>

+ Standard Deviation
++ Minimum number of correct answers
+++ Maximum number of correct answers

4.2.2 Comparison of baseline characteristics between intervention and comparison groups

The baseline characteristics between intervention and comparison groups demonstrated no significant difference in respect of age (Chi-square, p=0.56), gender (Chi-square, p=0.56) and class (Chi-square, p=0.085), indicating homogeneity in the groups.

Table 6: Comparison of age, gender and class level between intervention group and comparison group
Results

Family Affluence Scale is comparable between intervention and comparison groups (Man Whitney U-test, p=0.89).

Table 7: Comparison of Family Affluence Scale between intervention and comparison groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>Family Affluence Scale (FAS)</th>
<th>Group Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Least Wealthy (LW)</td>
<td>Average wealthy (AW)</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>% within LW</td>
</tr>
<tr>
<td>Intervention</td>
<td>75</td>
<td>48.10</td>
</tr>
<tr>
<td>Comparison</td>
<td>81</td>
<td>51.90</td>
</tr>
<tr>
<td>FAS Total</td>
<td>157</td>
<td>115</td>
</tr>
</tbody>
</table>

The levels of mother’s occupation and father’s occupation are comparable between intervention group and comparison group (Man Whitney U-test, p=0.86 and p=0.13 respectively), as shown in Table 8.

Table 8: Comparison of mother’s and father’s occupation level between intervention and comparison groups

<table>
<thead>
<tr>
<th>Level of parental occupation (LPO)*</th>
<th>Intervention group</th>
<th>Comparison group</th>
<th>LPO Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>% within LPO</td>
<td>% within Group</td>
</tr>
<tr>
<td>Mother’s Occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economically inactive</td>
<td>35</td>
<td>55.60</td>
<td>23.80</td>
</tr>
<tr>
<td>Very Low</td>
<td>68</td>
<td>44.70</td>
<td>46.30</td>
</tr>
<tr>
<td>Low</td>
<td>11</td>
<td>42.30</td>
<td>7.50</td>
</tr>
<tr>
<td>Medium</td>
<td>30</td>
<td>58.80</td>
<td>20.40</td>
</tr>
<tr>
<td>High</td>
<td>2</td>
<td>33.30</td>
<td>1.40</td>
</tr>
<tr>
<td>Very High</td>
<td>1</td>
<td>20.0</td>
<td>0.70</td>
</tr>
<tr>
<td>Group Total</td>
<td>147</td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>Father’s Occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economically inactive</td>
<td>17</td>
<td>60.70</td>
<td>11.60</td>
</tr>
<tr>
<td>Very Low</td>
<td>20</td>
<td>45.50</td>
<td>13.60</td>
</tr>
<tr>
<td>Low</td>
<td>19</td>
<td>34.50</td>
<td>12.90</td>
</tr>
<tr>
<td>Medium</td>
<td>44</td>
<td>45.80</td>
<td>29.90</td>
</tr>
<tr>
<td>High</td>
<td>41</td>
<td>58.60</td>
<td>27.90</td>
</tr>
<tr>
<td>Very High</td>
<td>6</td>
<td>60.0</td>
<td>4.10</td>
</tr>
<tr>
<td>Group Total</td>
<td>147</td>
<td>156</td>
<td></td>
</tr>
</tbody>
</table>

* Appendix 4 for detailed description of occupations
The results of pair wise comparison as calculated in General linear model (GLM) was used to compare the baseline nutrition knowledge between intervention and comparison groups, age and gender.

GLM pair wise comparison \((p=0.73)\) showed no significant difference in correct answers at baseline between the intervention and comparison groups, indicating homogeneity in groups.

Table 9: Comparison of baseline nutrition knowledge as mean number of correct answers between intervention group and comparison group

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mean number of correct answers</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention group</td>
<td>147</td>
<td>10.01</td>
<td>3.01</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>Comparison group</td>
<td>156</td>
<td>10.12</td>
<td>2.99</td>
<td>2</td>
<td>17</td>
</tr>
</tbody>
</table>

The nutrition knowledge at baseline is also comparable between the gender, age groups and grade levels (GLM pair wise comparison \(p=0.26, p=0.38, p=0.71\) respectively), as depicted in Table 10.

Table 10: Comparison of baseline nutrition knowledge with regard to gender, age and class between intervention and comparison groups

<table>
<thead>
<tr>
<th>Variables</th>
<th>Intervention group</th>
<th></th>
<th>Comparison group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
<td>SD</td>
<td>Min</td>
</tr>
<tr>
<td>Girls</td>
<td>69</td>
<td>10.06</td>
<td>3.03</td>
<td>3</td>
</tr>
<tr>
<td>Boys</td>
<td>78</td>
<td>9.96</td>
<td>3.01</td>
<td>2</td>
</tr>
<tr>
<td>8-9 years</td>
<td>70</td>
<td>10.16</td>
<td>2.92</td>
<td>2</td>
</tr>
<tr>
<td>10-11 years</td>
<td>77</td>
<td>9.87</td>
<td>3.10</td>
<td>3</td>
</tr>
<tr>
<td>4th class</td>
<td>78</td>
<td>9.92</td>
<td>3.04</td>
<td>3</td>
</tr>
<tr>
<td>5th class</td>
<td>69</td>
<td>10.10</td>
<td>3.00</td>
<td>2</td>
</tr>
</tbody>
</table>
4.3 Results of general linear model for repeated measures

General linear model for repeated measures indicates that nutrition education intervention was helpful in increasing nutrition knowledge regardless of the teaching method, hence supporting the first study hypothesis. The main effect of ‘time’ in GLM is statistically significant (p<0.001). Table 11 and Graph 1 depict the mean number of correct answers received at baseline, post-intervention and follow-up from intervention and comparison groups.

The results of pair wise comparison (p value adjusted with Bonferroni) reveals that the combined nutrition knowledge (intervention and comparison groups together) was significantly higher immediately after the intervention 13.76 (Standard error [SE] =0.199; p<0.001) as compared to the baseline 10.05. The mean nutrition knowledge score 13.09 three months later was also significantly (SE=0.181; p<0.001) higher than the mean nutrition knowledge scores at baseline. Furthermore, the difference between the mean of post-intervention nutrition knowledge 13.76 and the mean of follow-up nutrition knowledge 13.09 was significant (SE=0.181; p<0.05).

Table 11: Mean number of correct answer received at baseline, post-intervention and follow-up in intervention and comparison groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Correct answers baseline</th>
<th>Correct answers post-intervention</th>
<th>Correct answers follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean  SD  Min  Max</td>
<td>Mean  SD  Min  Max</td>
<td>Mean  SD  Min  Max</td>
</tr>
<tr>
<td>Intervention</td>
<td>147</td>
<td>10.01  3.01  2  17</td>
<td>13.99  3.48  5  21</td>
<td>13.47  3.22  5  21</td>
</tr>
<tr>
<td>group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>156</td>
<td>10.08  3.01  2  17</td>
<td>13.54  3.42  5  21</td>
<td>12.74  3.19  4  20</td>
</tr>
<tr>
<td>group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>303</td>
<td>10.05  3.00  2  17</td>
<td>13.76  3.46  5  21</td>
<td>13.09  3.22  4  21</td>
</tr>
</tbody>
</table>
Graph 1: Nutrition knowledge (mean number of correct answers) at baseline, post-intervention and follow-up in intervention and comparison groups.

The result of the GLM repeated measures shows that main effect of the variable ‘group’ is not statistically significant (SE=0.181; p=0.157), indicating that the intervention was effectual in increasing nutrition knowledge regardless of the teaching method. Hence, the results do not verify the second study hypothesis that ‘the gain in nutrition knowledge is higher in the intervention group than in the comparison group’.

The result of the GLM pair wise comparison shows that the variable ‘age in two categories’ is statistically significant (p=0.045). Younger children (8-9 years) significantly retained more nutrition knowledge at three months’ follow-up, as shown in Table 12 and Graph 2.
Table 12: Mean number of correct answer received from 8-9 years and 10-11 years old children at baseline, post-intervention and follow-up.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Correct answers baseline</th>
<th>Correct answers post intervention</th>
<th>Correct answers follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Min</td>
</tr>
<tr>
<td>8-9 years old</td>
<td>139</td>
<td>10.19</td>
<td>2.94</td>
<td>2</td>
</tr>
<tr>
<td>10-11 years old</td>
<td>164</td>
<td>9.93</td>
<td>3.06</td>
<td>3</td>
</tr>
</tbody>
</table>

Graph 2: Mean number of correct answers received from 8-9 years and 10-11 years old children at baseline, post-intervention and follow-up.

Nutrition knowledge at baseline, post-intervention and follow-up between intervention and comparison children of 8-9 years and 10-11 years is comparable.
4.4 Comparison of nutrition knowledge among intervention comparison and control groups

In order to compare nutrition knowledge between the children of intervention, comparison and control groups, Kruskal-Wallis and subsequently Mann Whitney U-test were used. The rationale for using these tests is non-normal distribution and small sample size of control group. The mean number of correct answers are comparable between intervention, comparison and control groups at baseline (Kruskal-Wallis, p=0.93). However, they differ significantly at post-intervention and follow-up (Kruskal-Wallis, p=0.00 and p=0.00, respectively). Mann Whitney-U test further reveal significant difference between intervention and control children’s mean number of correct answers at post-intervention and follow-up (p=0.00, p=0.00, respectively). The difference between comparison and control children’s mean number of correct answers at post-intervention and follow-up is also significant (Mann Whitney-U, p=0.00, p=0.00, respectively), as depicted in Graph 7.

Graph 3: Mean number of correct answers received at baseline, post-intervention and follow-up from children of intervention, comparison and control groups
4.5 Socio-economic status and nutrition knowledge

The socio-economic status was measured by Family Affluence Scale (FAS), Mother’s Occupational Level (MOL) and Father’s Occupational Level (FOL). See Appendix 4: Protocol and variable coding

There is significant positive correlation between FOL and FAS (Spearman’s Rho=0.60; p=0.000). The correlation between MOL and FAS is also significant (Spearman’s Rho=0.17; p=0.002). The correlation between FOL and FAS is comparatively much stronger than the correlation between MOL and FAS.

As variables FAS, MOL, FOL violated the parametric assumptions i.e. the data is non-normally distributed and cell counts of certain items were very small, therefore non-parametric tests were used to test the hypothesis that nutrition knowledge is associated with indicators of socio-economic status. Kruskal-Wallis and Mann Whitney U-tests were used to test the above mentioned hypothesis. The comparison was made between children’s nutrition knowledge collected at three points of time, baseline (t0), post-intervention (t1) and follow-up (t2) and the six levels of MOL and FOL and between the three levels of FAS with the above mentioned tests.

The results revealed that children’s nutrition knowledge is comparable between the father’s occupation level at baseline (p=0.51). However, it varies significantly at post-intervention (p=0.017) and follow-up (p=0.000).
Table 13: Nutrition knowledge at baseline, post-intervention and follow-up with respect to father’s occupational level

<table>
<thead>
<tr>
<th>Father’s occupational level</th>
<th>n</th>
<th>Correct answers baseline</th>
<th>Correct answers post-intervention</th>
<th>Correct answers follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean   SD  Min  Max</td>
<td>Mean   SD  Min  Max</td>
<td>Mean   SD  Min  Max</td>
</tr>
<tr>
<td>Economically inactive</td>
<td>28</td>
<td>9.00  2.99  3  15</td>
<td>11.96  4.05  5  19</td>
<td>11.18  2.51  6  15</td>
</tr>
<tr>
<td>Very Low</td>
<td>44</td>
<td>9.77  3.38  2  16</td>
<td>13.18  3.49  7  20</td>
<td>12.18  2.54  7  21</td>
</tr>
<tr>
<td>Low</td>
<td>55</td>
<td>10.09  2.93  4  16</td>
<td>13.27  3.61  6  21</td>
<td>12.75  2.93  7  22</td>
</tr>
<tr>
<td>Medium</td>
<td>96</td>
<td>10.20  2.92  3  17</td>
<td>14.15  3.09  5  21</td>
<td>13.67  3.21  6  20</td>
</tr>
<tr>
<td>High</td>
<td>70</td>
<td>10.29  2.92  2  17</td>
<td>14.56  3.24  6  21</td>
<td>13.73  3.61  4  20</td>
</tr>
<tr>
<td>Very High</td>
<td>10</td>
<td>10.80  3.01  8  16</td>
<td>14.80  3.58  10  21</td>
<td>14.40  3.65  8  20</td>
</tr>
</tbody>
</table>

Graph 4: Nutrition knowledge at baseline, post-intervention and follow-up with regard to level of father’s occupation.
The children’s nutrition knowledge significantly varies between mother’s occupation levels at baseline (p=0.032), post-intervention (p=0.008) and follow-up (p=0.002).

Table 14: Nutrition knowledge at baseline, post-intervention and follow-up with respect to mother’s occupational level

<table>
<thead>
<tr>
<th>Mother’s occupational level</th>
<th>n</th>
<th>Correct answers baseline</th>
<th></th>
<th>Correct answers post-intervention</th>
<th></th>
<th>Correct answers follow-up</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Economically inactive</td>
<td>63</td>
<td>9.51</td>
<td>2.63</td>
<td>3</td>
<td>16</td>
<td>12.83</td>
<td>3.30</td>
</tr>
<tr>
<td>Very Low</td>
<td>152</td>
<td>9.84</td>
<td>2.83</td>
<td>2</td>
<td>17</td>
<td>13.57</td>
<td>3.51</td>
</tr>
<tr>
<td>Low</td>
<td>26</td>
<td>10.15</td>
<td>3.63</td>
<td>2</td>
<td>15</td>
<td>14.00</td>
<td>3.69</td>
</tr>
<tr>
<td>Medium</td>
<td>51</td>
<td>10.86</td>
<td>3.09</td>
<td>3</td>
<td>16</td>
<td>14.96</td>
<td>3.17</td>
</tr>
<tr>
<td>High</td>
<td>6</td>
<td>11.17</td>
<td>4.00</td>
<td>3</td>
<td>16</td>
<td>15.67</td>
<td>2.42</td>
</tr>
<tr>
<td>Very High</td>
<td>5</td>
<td>12.80</td>
<td>4.20</td>
<td>6</td>
<td>17</td>
<td>15.80</td>
<td>2.16</td>
</tr>
</tbody>
</table>

Graph 5: Nutrition knowledge at baseline, post-intervention and follow-up with regard to level of mother’s occupation.
The results demonstrate that children’s nutrition knowledge varies significantly at baseline (p=0.022), post-intervention (p=0.001) and follow-up (p=0.000) between three levels of FAS.

Table 15: Nutrition knowledge at baseline, post-intervention and follow-up with respect to Family Affluence Scale

<table>
<thead>
<tr>
<th>FAS</th>
<th>n</th>
<th>Correct answers baseline</th>
<th>Correct answers post-intervention</th>
<th>Correct answers follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Min</td>
</tr>
<tr>
<td>Least wealthy</td>
<td>156</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.57</td>
<td>3.07</td>
<td>2</td>
</tr>
<tr>
<td>Average wealthy</td>
<td>112</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.44</td>
<td>2.84</td>
<td>3</td>
</tr>
<tr>
<td>Most wealthy</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.91</td>
<td>2.91</td>
<td>6</td>
</tr>
</tbody>
</table>

Graph 6: Nutrition knowledge at baseline, post-intervention and follow-up with regard to Family Affluence Scale.

These results support the study hypothesis that nutrition knowledge of children is associated with the indicators of socio-economic status. Children
Results

with lower socio-economic status had lower nutrition knowledge scores at baseline, post-intervention and follow-up.

Nutrition knowledge, at baseline, post-intervention and follow-up between intervention and comparison children with regard to different levels of mother’s and father’s occupation and Family Affluence Scale is comparable.

In part b of the third hypothesis, it was assumed that the indicators of children’s socio-economic status affect the gain in nutrition knowledge, measured as ‘short-term knowledge gain t0-t1’ ‘long-term knowledge gain t0-t2’ and ‘retention of knowledge gain t2-t1’. The results of the Kruskal-Wallis test revealed that the gain in nutrition knowledge as short-term, long-term knowledge gain and retention of knowledge were comparable between father’s and mother’s occupational level (Table 16 and Table 17, respectively) and between Family Affluence Scale (Table 18).

Table 16: Short-term and long-term knowledge gain and retention of knowledge at baseline, post-intervention and follow-up with regard to father’s occupational levels

<table>
<thead>
<tr>
<th>Father’s occupational level</th>
<th>n</th>
<th>Short-term knowledge gain (t1-t0)</th>
<th>Long-term knowledge gain (t2-t0)</th>
<th>Retention of knowledge gain (t2-t1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Min</td>
</tr>
<tr>
<td>Economically inactive</td>
<td>29</td>
<td>2.96</td>
<td>3.42</td>
<td>-4</td>
</tr>
<tr>
<td>Very Low</td>
<td>45</td>
<td>3.41</td>
<td>4.30</td>
<td>-9</td>
</tr>
<tr>
<td>Low</td>
<td>55</td>
<td>3.18</td>
<td>4.23</td>
<td>-6</td>
</tr>
<tr>
<td>Medium</td>
<td>94</td>
<td>3.95</td>
<td>3.26</td>
<td>-7</td>
</tr>
<tr>
<td>High</td>
<td>70</td>
<td>4.27</td>
<td>3.83</td>
<td>-6</td>
</tr>
<tr>
<td>Very High</td>
<td>10</td>
<td>4.00</td>
<td>4.13</td>
<td>-2</td>
</tr>
</tbody>
</table>
Table 17: Short-term and long-term knowledge gain and retention of knowledge at baseline, post-intervention and follow-up with regard to mother’s occupational levels

<table>
<thead>
<tr>
<th>Mother’s occupational level</th>
<th>n</th>
<th>Short-term knowledge gain (t1-t0)</th>
<th>Long-term knowledge gain (t2-t0)</th>
<th>Retention of knowledge gain (t2-t1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean    SD  Min  Max</td>
<td>Mean    SD  Min  Max</td>
<td>Mean    SD  Min  Max</td>
</tr>
<tr>
<td>Economically inactive</td>
<td>63</td>
<td>3.32    3.91  -9   13</td>
<td>2.63    3.60  -8   11</td>
<td>-0.68    3.88  -13  8</td>
</tr>
<tr>
<td>Very Low</td>
<td>152</td>
<td>3.72    3.69  -6   17</td>
<td>3.03    3.79  -7   12</td>
<td>-0.69    4.47  -13  10</td>
</tr>
<tr>
<td>Low</td>
<td>26</td>
<td>3.85    4.01  -4   11</td>
<td>3.27    4.78  -6   12</td>
<td>-0.58    4.82  -9   9</td>
</tr>
<tr>
<td>Medium</td>
<td>51</td>
<td>4.10    3.86  -7   12</td>
<td>3.45    4.53  -8   14</td>
<td>-0.65    4.22  -13  12</td>
</tr>
<tr>
<td>High</td>
<td>6</td>
<td>4.50    2.42  1    8</td>
<td>3.83    2.99  0     8</td>
<td>-0.67    2.58  -3   2</td>
</tr>
<tr>
<td>Very High</td>
<td>5</td>
<td>3.00    5.38  -2   12</td>
<td>2.40    4.93  -4   9</td>
<td>-0.60    2.88  -3   3</td>
</tr>
</tbody>
</table>

The gain in nutrition knowledge is comparable between children of higher and lower SES. Thus, the results do not support the hypothesis that gain in nutrition knowledge is associated with children’s socio-economic status.

Table 18: Short-term and long-term knowledge gain and retention of knowledge at baseline, post-intervention and follow-up with regard to Family Affluence Scale

<table>
<thead>
<tr>
<th>FAS</th>
<th>n</th>
<th>Short term knowledge gain (t1-t0)</th>
<th>Long term knowledge gain (t2-t0)</th>
<th>Retention of knowledge gain (t2-t1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean    SD  Min  Max</td>
<td>Mean    SD  Min  Max</td>
<td>Mean    SD  Min  Max</td>
</tr>
<tr>
<td>Least wealthy</td>
<td>156</td>
<td>3.46    4.12  -9   17</td>
<td>2.79    4.15  -8   14</td>
<td>-0.67    4.34  -13  12</td>
</tr>
<tr>
<td>Average wealthy</td>
<td>112</td>
<td>4.07    3.26  -6   11</td>
<td>3.35    3.81  -6   12</td>
<td>-0.72    4.17  -13  10</td>
</tr>
<tr>
<td>Most wealthy</td>
<td>35</td>
<td>3.71    3.74  -6   12</td>
<td>3.20    3.57  -4   11</td>
<td>-0.51    4.31  -11  8</td>
</tr>
</tbody>
</table>
Short-term knowledge gain is comparable between girls and boys. Long-term knowledge gain and retention of knowledge is significantly higher among girls as compared to boys (Mann Whitney-U test p=0.027, p=0.036 respectively).

![Graph 7: Long-term nutrition knowledge and retention of nutrition knowledge between boys and girls.](image)

**4.6 Effect Size**

The effect size for present study was calculated post hoc with the G*Power program. Means of correct answers received at post-intervention from intervention group (13.99) and comparison group (13.54), sample size of intervention (147) and control (156) groups, along with pooled standard deviation of 3.45 was given, which resulted in the effect size of $d=0.130$. According to Cohen’s (1988) interpretation of effect sizes, the effect size below 0.2 is reported as small, 0.5 as medium and 0.7 as large. As the effect size ($d=0.130$) of the present study is below 0.2 therefore, it can be interpreted as small. With an effect size of $d=1.30$ and alpha level of 0.05, the power of detecting the difference in nutrition knowledge between intervention and comparison groups in a two tailed test is very small ($1-B=0.203$). By using a power of 0.8, an alpha level of 0.05 and effect size of $d=0.130$ a total
Results

A sample of 1860 would be required to detect a difference in nutrition knowledge between intervention and comparison groups.

4.7 Replies received on Nutrition Knowledge Questionnaire Items

A comparison was made of the overall nutrition knowledge between intervention and comparison groups at baseline, post-intervention and follow-up in chapter 5 (page 62). In the following part, a comparison of the replies given to the individual items of nutrition knowledge questionnaire at baseline, post-intervention and follow-up were made between intervention and comparison groups. The given replies were coded as ‘correct’ and ‘wrong’. Two x two cross tables were computed. The level of significance was determined by the Fisher Exact test.

The following questions at baseline received significantly more correct answers from the intervention group than the comparison group: ‘Why is it important that you do not always eat the same foods?’ (0.006), ‘Which of the following sentences about calcium are correct?’ (0.048), ‘How many glasses of water should you drink per day?’ (0.018) and ‘Which of the following drinks should you drink if you are very thirsty?’ (0.00).

On the other hand, more correct answers were given in the comparison group to the following questions: ‘In which row are three foods that contain a lot of carbohydrates?’ (0.00) and ‘How many servings (times) of fruits and vegetables should you eat per day?’ (0.021).

At post-intervention, question ‘In which row are the three foods that contain a lot of calcium?’ (0.004) received significantly more correct answers in the intervention group. In the intervention group, the number of correct answers to the question ‘Which of the following drinks should you drink if you are very thirsty?’ remained significantly (0.024) higher than the control group. In the
control group, more correct answers were given to the questions, ‘Fish, cheese, yogurt and milk contain a lot of…..’ (0.005) and ‘The amount of foods your body needs depend on…..’ (0.00). The question ‘How many servings (times) of fruits and vegetables should you eat per day?’ again received significantly (0.032) more correct answers from the comparison group than the intervention group.

At follow-up, the questions, ‘Why is it important that you do not always eat the same foods?’ (0.003) and ‘Why does your body need carbohydrates?’ (0.005) received significantly more correct answers in the intervention group. In the comparison group the only question that received significantly (0.041) more correct answers was: ‘In which row are the three foods that are prepared with very little fat’.

The question ‘Why is it important that you eat breakfast?’ received the highest percent of correct answers from both intervention and comparison groups at baseline (84% and 79% respectively), post-intervention (89% and 85% respectively) and follow-up (94% and 85% respectively). In the intervention group at baseline, the question ‘In which row are three foods that contain a lot of carbohydrates?’ received the least percent of correct answers (18%). In the comparison group at baseline, the question ‘How many times per week do you need to get out of breath, in order to help your body stay in shape’ received the least (17%) percent of correct answers (Appendix 10: presents comparison of the percentage of correct replies that each item of nutrition knowledge questionnaire received from intervention and comparison groups).
4.8 Student teacher’s nutrition knowledge

The result of t-test indicates that overall nutrition knowledge (mean number of correct answers) of student teachers significantly (p=0.000) increased from a mean of 10.12 before two days’ training to 16.00 after two days’ training.

![Bar chart showing mean number of correct answers before and after two days' training](chart.png)

Figure 5: Student teacher nutrition knowledge as mean number of correct answers before and after two days’ training

4.9 Evaluation Questionnaire for student teacher of intervention group and focus group discussion

The evaluation questionnaire for student teacher of intervention group was filled out by all (n=8) student teachers. It revealed that student teachers liked the teaching tool i.e. Cool Food Planet Kidz provided on CD-ROM. They especially liked the graphics and animation.

The focus group discussion (n=3) further revealed that it was the first time they had used the computer as a teaching tool. At the same time, they were amazed by the immense interest and involvement of the children in computers. Teachers rated the children’s interests in the CD-ROM as very high. From the student teachers point of view, the program was very
appealing for the children and they enjoyed learning through computers. Some student teachers hinted that children regarded the computer as a thrilling and entertainment device instead of an educational tool. The high level of keenness demonstrated by the children indicates the effectiveness of computers as a teaching tool. Furthermore, student teachers reported that the children enjoyed learning nutrition concepts through computers.

Some of them mentioned that, in the first few lessons, they had not felt comfortable and confident in using computers as a teaching tool, because they were not used to working with computers themselves. Several student teachers, based on their intervention experience, realized the need of computers in classrooms and therefore, emphasized the use of computers as a teaching tool in other academic subjects. Most of the student teachers showed willingness to work with computer based tools in future. Some of them mentioned the lack of computer-related skills of the children as a critical factor, which hindered them from getting the maximum benefit from computers. However, they showed concerns about the potential hurdles in using computer based tools in classrooms. They regarded the frequent power breakdowns as a core hurdle in incorporation of computer based tools in teaching, as it reduced the amount of time allocated for the use of the computer. Furthermore, the potential lack of support from schools administration was highlighted regarding teaching children through computers. Most schools only use computers to teach children basic computer skills and do not use them as a teaching tool. A few student teachers also pointed out that the computer in their schools were not up to the standard.

All of them were agreed that nutrition education should be included in the school curricula. In this regard, many of them highlighted the time constraints for integrating nutrition education as a separate subject and suggested its incorporation in subjects being taught currently in schools.
To conclude, the present study reveals that children enjoyed learning nutrition concepts through the use of computers. Furthermore, it highlights the prospective problems facing computer-based education in Pakistan, including frequent power breakdowns, lack of computer-related skills of teacher’s and children’s, lack of support from school administration and lack of computer equipment. These factors need to be taken into account in order to successfully integrate computer-oriented education in Pakistani primary schools.

4.10 Evaluation Questionnaire for children of the intervention group and focus group discussion

A total of 195 questionnaires were received back from the intervention group. The coding scheme did not allow for direct comparison between nutrition knowledge and how the children evaluated the computer-based tool. This is also the reason for having more evaluation questionnaires than the nutrition knowledge questionnaires. According to the responses received, 61% of the children ranked the computer-based tool as very good, 23.2 % as good and only 2.3% as not good at all as depicted in the Figure 6.

![Figure 6: Rating of computer-based tool by intervention children](image)
Eighty-five percent of the children would like to continue using computers in the classroom, only 15% said no.

28.2% of the intervention children liked the cartoons, 25.1% liked the topic, 21.0% liked the pictures and 13.3% liked the colors, as depicted in the Figure 7.

Figure 7: The most liked features of computer-based tool by intervention children.

Thirty-three percent of the children judged their computer skills as good and only 5.6% as very good. On the other hand, 40.7 % judged them as not so good and 20.3 % as not good at all (Figure 8).
The focus groups (n=3) with the intervention children proved very constructive. The overall response of the children about the drill was very good and encouraging. Children revealed that use of the computer as a medium for learning was new to them. Therefore, initially, they faced difficulties in operating them. Despite difficulties, the children regarded learning through computers as interesting and entertaining. Some of them acknowledged that it was easier to comprehend nutrition concepts like food servings and nutrients through computers. Most of them liked the autonomy they exercised while exploring the CD-ROM. However, on the other hand, they also appreciated the role of teacher as a facilitator and helper. The children emphasized their lack of computer related skills as the major barrier in taking full advantage of the CD-ROM.

4.11 Evaluation Questionnaire for children of the comparison group and focus group discussion

182 questionnaires were received back from the comparison group. According to the responses received, 73.6% of the children ranked the worksheets as very good, 18.1% as good, 5.5% as not so good and only 2.7% as not good at all as depicted in the Figure 9.
Results

Figure 9: Rating of worksheets by the comparison children

30.8% of the comparison children liked the topics, 44.5% liked the pictures, and 19.2% liked the content of the worksheets as depicted in the Figure 10.

Figure 10: Most liked feature of worksheets by the comparison group

29.7% children enjoyed learning nutrition concepts through worksheets and 63.2% very much enjoyed. Only 7.1% found learning through the worksheets as boring (Figure 11).
67.6% children reported the text very easy and 26.9% as easy. Only 5.5% children reported the text as hard.

The focus group (n=2) with the comparison children was proved very helpful. The overall response of the children about the intervention was very positive. Children enjoyed working with nutrition worksheets and learning nutrition concepts through board and card games and found them very interesting. Some children highlighted that they learn more when their teachers employed creative and interesting methods in teaching them. However, children of certain comparison schools mentioned and complained about the infrequent use of worksheets in their regular classrooms. They suggested that worksheets and games should be used more frequently in teaching.

### 4.12 Observations of nutrition education lessons

For the purpose of observing the nutrition lessons, five schools: two from intervention and three from comparison schools, were randomly selected. The observations were based on the following points: topic of the day, classroom environment, lesson procedure and additional material used.
On the day of observation, the topic of the day was clearly mentioned in four out of the five schools. These included ‘The Nutrients’, ‘Healthy Habits’, ‘Snacks’ and ‘Breakfast’. In one school the topic was not clearly mentioned and written as ‘Nutrition’.

The classroom environment of all observed schools was heterogeneous. In one school, the visual aids related to the nutrition lesson were pasted on the blackboard. In the second school, the different healthy and unhealthy snack items were hung up in the class. In the third school, food pyramid guide made by the children was pasted on the walls of the classroom. In the fourth school, only the worksheet related to the day’s topic was hung up on the blackboard.

Variations in lesson procedures were also observed. In one comparison school, the student teacher made cards about different snacks. Children were asked to choose the snacks that were healthier. In another comparison school, during the two class periods, the student teacher delivered lesson on Nutrients. She informed them about different nutrients with the help of the food pyramid guide. Later, she provided the children with the food pyramid drawn on paper and pictures of different food items related to different food groups. They were asked to paste pictures in the relevant food group.

In the third comparison school, the student teacher delivered a lesson on ‘Breakfast’ in three consecutive class periods. She held a survey to find out how many children had breakfast and how many skipped having it. She used empty cartons of milk, yogurt, fruit juice, cereal and eggs as visual aids. She held a brainstorming session and asked children to describe different breakfast dishes that could be made from combining these food items. Later, she asked the children to draw pictures of how they felt about themselves when they had breakfast and when they did not. They also described the pictures in one sentence. In the end, they worked on the ‘Breakfast’ worksheet provided for the intervention.
In the two intervention schools, the lesson procedure in the beginning was similar. However, the way children were provided access to computers varied in both schools. Student teachers informed the children about the topic of the day. Later, in one school, the student teacher took the children in the computer laboratory. She allotted one computer to two children and asked them to work with the CD-ROM. In the second school, the student teacher gave the children the worksheets specifically developed to help children navigate through the CD-ROM. Afterwards; she divided the class into two groups. One group was taken to the computer laboratory and worked with the CD-ROM. Meanwhile, the other group played the card and board games and vice versa.

4.13 Teaching protocol

From a total of 17 protocols, only 14 were given back. Seven out of the nine student teachers from the intervention schools returned their protocols. Out of the eight student teachers from the comparison schools, only seven returned their protocols.

Most student teachers incorporated intervention in five lessons (n=12). Only two student teachers used six lessons. A large variation between schools was found in respect of the number of days on which the lesson was carried out. Three student teachers in intervention schools carried out nutrition lesson on four days, two on three days and one on five days. Two student teachers in comparison schools carried out nutrition lessons on six days, two on five days and one on four, one on three and one on two days. None of the schools held the lesson on all three consecutive days.

A total of 12 worksheets were provided for the nutrition lessons. Only nine student teachers provided information in this regard. Rest of the student teachers left the question blank. Variation was also found in the number of worksheets used by the student teachers as depicted in Figure 12.
Four student teachers utilized all the games provided for the nutrition lessons. One student teacher only used the board game. Six student teachers used one card game and one board game. In addition to the material provided for the nutrition lessons, five student teachers used additional material.

Student teachers in intervention schools were also asked to provide information about how long the children worked with the computer and only five out of nine student teachers provided information in this regard. Three student teachers mentioned that children worked 30-45 minutes on the computer and two mentioned more than 45 minutes. Two out of seven student teachers left the question blank as whether every child got the chance to work with the computer. Two student teachers said yes and two said no.

Figure 12: Number of worksheets used by the student teachers
5 Discussion

In this chapter results will be discussed and compared with available literature in context with the study purpose. For the purpose of discussion, major findings related to the three hypothesis of the research are commented upon separately in the first three sections. The fourth and fifth sections deal with the effect of gender and age on nutrition knowledge respectively. In the sixth section, comparison of nutrition knowledge among the intervention, control and comparison groups is presented.

5.1 Hypothesis 1

Nutrition knowledge is expected to increase in all children irrespective of the teaching tool

The highly significant increase found in the mean number of correct answers from baseline to post-intervention and at follow-up in both study groups supports the first hypothesis of the present study and confirms that nutrition education intervention was successful in increasing the nutrition knowledge of children.

School-based nutrition education intervention provides an opportunity to inculcate healthy eating habits in children. Eating habits developed in early childhood continue to persist into adulthood (Kelder et al, 1994). Consequently, unhealthy eating habits acquired in childhood lead to chronic diseases in later life. Evidence supports that lack of nutrition knowledge is a key factor in different choices in diet; more healthy eating habits are associated with individuals with more nutrition knowledge (Oldewage-Theron and Egal, 2010).
The significant increase in nutrition knowledge, found in the present study, as a result of nutrition education intervention is in accord with other studies done regarding nutrition education intervention. Many such school-based interventions developed and assessed around the world, have demonstrated beneficial effects. (Lakshman et al, 2010; Tuuri et al, 2009; Amaro et al, 2006; Salgado et al, 2005). Lister-sharp et al (1999) reviewed 32 reviews of health promotion in schools and reported that knowledge gain was achieved in all such interventions.

The present study observed 3.70 mean increase in nutrition knowledge from baseline to post-intervention. This finding was consistent with the findings of Gupta and Kochar (2009) and Subba Rao et al (2006) who reported 7.51 and 4.74 mean increase in nutrition knowledge of the respondents respectively. The observed mean increase could be attributed to the fact that Pakistani primary schoolchildren had never been exposed to such a motivating and interesting learning methodology and environment before.

Adequate implementation period for the intervention is necessary to demonstrate significant changes in children’s knowledge regarding nutrition. The available literature suggests that 10-15 hours were needed to demonstrate noteworthy changes in knowledge gain (Bergen D, 1993). In the present study, the time allocated was five lessons comprising of 45 minutes each for duration of two weeks. Hence, by engaging children in as few as two hours and 25 minutes of the intervention, the study demonstrated a considerable increment in the nutrition knowledge of children. Contento et al (1995), in a review reported eight studies with nutrition education intervention. The intervention time in these studies ranged from eight lessons in as many weeks to 24 lessons in six months. All studies reported increase in nutrition knowledge. Although, the intervention time in all eight studies was greater than the present study yet it also demonstrates the same result.
5.2 Hypothesis 2

Nutrition knowledge is expected to be higher in the group using computer-based nutrition education tool in addition to non computer-based materials as compared to the group using only non computer-based materials at post-intervention and three months’ follow-up.

The study did not find significant difference in the nutrition knowledge from baseline to post-intervention between the intervention and comparison groups. This finding did not support the second hypothesis proposed in the study. Hence, suggesting that the computer-based tool did not support additional learning in children. Although nutrition knowledge in children of both groups (intervention and comparison) increased, however, children in the intervention group attained more scores.

This result is consistent with the results reported in literature (Munguba et al, 2008; Kreisel K, 2004). Munguba et al (2008), in a study in Brazil, recruited 200 children of 8-10 years of age. They compared the effects of two interactive games (video game and board game) based on the food pyramid and reported that the children in both groups demonstrated increase in learning of nutritional concepts. The study proposed the use of both videogame and board game in nutrition education. Kreisel K (2004) also reported no significant difference in mean number of correct answers between control (traditional methods) and intervention (computer-based) groups at post-intervention and follow-up. Instead, this study also reported significant increase in both groups.

On the contrary, in a study similar to the present study, Fančovičová et al, (2010) evaluated the effectiveness of computer-based health and nutrition education tool in increasing nutrition knowledge of primary school children. A total of 138 students participated in the intervention. During the two-week intervention, control group was provided nutrition information through
traditional education materials including books and worksheets. The experimental group used a website, provided on CD-ROM. The nutrition knowledge questionnaire was administered at baseline, after intervention and after three months. The study found increase in both groups. However, it reported that the control group attained more scores as compared to the experimental group. In Fančovičová et al study, students in the experimental group only used CD-ROM and attained fewer score as compared to the control group, where as the intervention children in the present study worked both with CD-ROM and worksheets and attained more scores as compared to the comparison group. In line with this comparison, it can be rightly inferred that using computers in combination with traditional teaching methods is a more productive strategy than using only computers. Computer-based tools should be used to enhance the effectiveness of traditional methods rather than replacing them.

Similarly, Raghunatha et al (2007) also found the traditional method more effective in increasing the nutrition knowledge of students as compared to the computer-based method. The study further reported that the attention of the respondents was considerably high during the intervention 1 (traditional method) as compared to the intervention 2 (CD-ROM) and regarded it a contributing factor of low increment of nutrition knowledge in intervention 2. However, the low attention of children in intervention 2 could be attributed to the fact that the same respondents participated in intervention 1 and intervention 2. Due to the repetition of the information over the limited time period they lost interest. Therefore, they did not find the information provided in the intervention 2 very informative and challenging, irrespective of the different teaching tool. It further strengthens the abovementioned proposition that an amalgam of computer-based tools and other creative methods brings more fruitful results than using these methods in isolation.
On the contrary, there are other studies that reported beneficial effects of computer-based tools on learning regarding nutrition and healthy eating habits as compared to traditional methods (Kim and Hyun, 2006; Serrano and Anderson, 2004; Valadez A, 2004; Turnin et al, 2001).

The mixed results found in literature about the effectiveness of computer-based tools regarding increase in nutrition knowledge may be ascribed to the variations in the study designs. The studies that reported significant increase in nutrition knowledge of the computer-based group, either evaluated it vis-à-vis teacher-led strategy or vis-à-vis the group which did not receive nutrition education (Kim and Hyun, 2006; Serrano and Anderson, 2004; Valadez A, 2004; Turnin et al, 2001). On the other hand, the studies that compared the computer-based group with the one that received nutrition education through specifically developed worksheets, cards, boards and video games, reported no significant differences between the nutrition knowledge of the computer-based group and the control group (Moore et al, 2009; Munguba et al, 2008; Kreisel K, 2004). This shows that other creative mediums also confer equal positive influence on nutrition learning. Other factors such as animation, colour and sound effects of the computer-based tools, and time allocated to explore the computer-based tools also influence the variations.

Supporting the said argument, Vernadakis et al (2008) argued that the research is ambivalent in establishing the comparative effectiveness of computer-based tools alone over traditional methods. However, it suggests that more in-depth research is required to explain the prevailing discrepancies in the literature.

In short, the increase in nutrition knowledge achieved by non computer-based materials (worksheets, board and card games) in the present study found similar to the computer-based tool, suggests that computer-based tools do not support additional learning regarding nutritional concepts in children. It is
suggested that by employing interactive and innovative strategies in teaching nutrition to the children, when they are involved in learning at their own pace, similar advantages can be attained.

5.3 Hypothesis 3

Nutrition knowledge and Indicators of socio-economic status

The literature proposed several ways to measure the socio-economic status of children. In general, parental education, parental occupation and the parent’s income are considered the three main determinants of socio-economic status (Vlismas et al, 2009). Given that socio-economic status is a multidimensional concept, it has been suggested to incorporate different socio-economic measures to fully comprehend its influence on health (Vlismas et al, 2009). Therefore, in the present study, two indicators of socio-economic status were used. One based on occupational level of father and mother, and the other, non-occupational i.e. Family Affluence Scale (FAS) developed by Currie et al (1997).

The present study found a significant difference in children’s nutrition knowledge (mean number of correct answers) with regard to mother’s occupational level. Children’s nutrition knowledge with regard to father’s occupational level did not differ at baseline however differed significantly at post-intervention and follow-up. The nutrition knowledge differed significantly between scores of FAS at baseline, post- intervention and follow-up.

Nutrition knowledge differed significantly between scores of FAS at baseline, post-intervention and follow-up. This result is consistent with the findings of Hakeem et al (2004). In a study conducted in Karachi, Pakistan, she reported a similar trend. She found significant low nutrition knowledge scores in individuals belonging to low income group in comparison to middle and higher income groups.
A strong association between the socio-economic status and healthy eating habits has been documented in literature. Many studies reveal that individuals from the higher and middle socio-economic status demonstrate higher nutrition knowledge, habits and healthy lifestyles as compared to individuals from lower socio-economic status (Wardle and Steptoe, 2003).

The present study found a significant difference in children’s nutrition knowledge (mean number of correct answers) with regard to mother’s occupational level. It was found that children whose mothers’ occupational level was ‘very high’, ‘high’ and ‘medium’ had more nutrition knowledge as compared to children whose mothers’ occupational level is ‘very low’, ‘low’ and ‘non-categorizable’.

A study in Korea analyzed the effect of parents’ occupational and educational level on nutrition knowledge and dietary behaviour of their children. In contrast to the present study result, it demonstrated that mothers’ employment status had no significant effect on children’s nutrition knowledge, dietary behaviour and nutrition attitude. However, it reported better nutrition knowledge and dietary behaviour as mothers’ education level increased (Choi, et al, 2008).

Considering that parental education is evidence of parental occupation (Richter et al, 2009), that both measures are interconnected (Galobardes et al, 2001; Gnawi et al, 2000), and that parental education is a strong determinant of parenting knowledge (de Castro Ribas and Bornstein, 2005), a possible explanation of no significant effect of mother’s employment on children’s nutrition knowledge in Korea may be the high female literacy rate i.e. 94% (Harp et al, 2000). The educated mother, whether she works outside or stays at home, in both circumstances is able to provide her children better information related to hygiene, nutrition and health (Block SA, 2007). In Pakistan, female literacy rate is 45%. Illiterate or less educated mothers not
Discussion

only work in low status jobs but also possess little knowledge about nutrition and healthy eating (DeWalt and Hink, 2009; Hakeem et al, 2002). Consequently, they are not as effective in teaching their children about healthy foods and healthy behaviours compared to women with higher education level, who enjoy higher occupational jobs and are more informed about healthful diets (Hakeem et al, 2004). These women are able to transfer this knowledge to their children more successfully. This finding corroborates the ideas of Gnavi et al (2000) who also made a similar proposition. In his study, he found no difference in the rate of obesity with regard to parental occupation while he was able to find differences in the rate of obesity with regard to the education level of the parents. He regarded occupational status as disposable income and education as a cultural resource i.e. being able to determine lifestyles behaviour.

The study found that at baseline, nutrition knowledge of children did not differ with regard to occupational level of fathers while it varied significantly with regard to the occupational level of mothers. A possible explanation of this variation is that mothers, particularly in Pakistan, are predominantly more engaged in selection, preparation and serving of food and in determining the nutrition-related behaviours of their children as compared to fathers (Madden and Chamberlain, 2010; Hakeem et al, 2004). Furthermore, as a large number of mothers are homemakers and children spend more time with their mothers, therefore, it is more likely that the mother’s beliefs, values and model behaviour regarding nutrition may influence children’s nutrition knowledge more likely. Thus, explaining the variation in nutrition knowledge with regard to the occupational level of the mother and the father. Although, significant variation was found in nutrition knowledge of children within the occupational levels of mothers, it could be conceivably deduced that even less educated Pakistani mothers are quite ingenious regarding issues about nutrition and are more capable of transmitting this knowledge to their children.
as compared to the fathers, who are more educated but are naive in this aspect (Nayga RM, 1997).

However, these findings must be interpreted cautiously keeping in view that the children were the proxy informants about the occupational level of their parents and there was no other option to confirm the accuracy of the responses provided by children. Many studies consider taking information from children about parental occupation as complicated (Currie et al, 2008). Furthermore, the results of the present study indicated a small number of children whose parents belonged to very high occupational level. It is recommended for future studies to include measure of parental education for identifying a more robust nexus between parental occupation and nutrition knowledge of children.

To summarize, the results of the present study affirms the hypothesis that both indicators of socio-economic status i.e. FAS and mothers’ and fathers’ occupational level are concordant with the nutrition knowledge of the children. While, on the other hand the results did not support the second part of the third hypothesis that gain in nutrition knowledge of children is associated with indicators of socio-economic status. This suggests that gain in nutrition knowledge is tantamount to the various level of socio-economic status. Furthermore, no difference was detected in nutrition knowledge with regard to different levels of mother and father occupation and FAS between intervention and comparison groups. This suggests that computer-based tool did not support additional learning in children.

5.4 Gender and nutrition knowledge

The result revealed that girls had higher long-term knowledge gain and retention of knowledge as compared to boys. The result is consistent with the study result of Salgado et al (2005). In this study, they investigated the impact of nutrition education program on food and nutrition knowledge of 283
elementary school students. The study design comprised of four stages including pre-test, post-test, re-test 1 and re-test 2. No difference was detected between nutrition knowledge of girls and boys at pre-test and post-test. However, significant difference was found at three months’ re-test.

A possible explanation for this significant difference in retention of nutrition knowledge between girls and boys could be associated to the fact that in Pakistani society the male and female domains and roles are clearly distinct. The woman’s role is primarily defined within the home. Therefore, girls found nutrition knowledge more relevant to their future prospective role as homemaker and caretakers. Hence, they showed high retention as compared to boys who did not find nutrition knowledge of much relevance to their future adult life pattern. Furthermore, the result is in affirmation with the universal trend of women having better nutrition knowledge than men (Grønhøj and Ölander, 2007; Parmenter et al, 2000). Lynn et al (2005) in a study, investigated sex differences in general knowledge and reported that women’s gained higher scores in nutrition knowledge in comparison to men’s who gained higher score in sport, finance and science. He also suggested women’s higher interest in nurturing as a possible explanation for the observed variation.

5.5 Age and nutrition knowledge

The result showed that younger children (8-9 years) remember more at three months’ follow-up as compared to older children (10-11 years), indicating that the intervention material may have been more suitable for the younger children. Furthermore, it indicates that the nutrition intervention is more advantageous when started at an early age (Perez-Rodrigo and Aranceta, 2001; Koivisto-Hursti UK, 1999). The younger children’s retention of nutrition knowledge could be associated to their better comprehension of the intervention material and/or student-teachers of this age group incorporated the intervention more advantageously.
5.6 Nutrition knowledge comparison among intervention, comparison and control groups

The results of the control group show an increase in mean number of correct answers from baseline to post-intervention and at three months’ follow-up. However, the increase is not statistically significant. The repetition of the same questionnaire at post-intervention and follow-up without any intervention may be a possible factor responsible for the increase in the nutrition knowledge (Benjamin et al, 2008; Hewitt et al, 2001)

The children may have discussed the questionnaire content with their peers and families, which may have resulted in their increased in nutrition knowledge. Murimi et al (2008) also reported a similar finding and described that children who discussed the nutrition topics with their parents had achieved significantly higher scores as compared to those who did not. In another study in Tehran Abdollahi et al (2008) reported parents and media as two important sources of acquisition of nutrition knowledge for children aged 6-11 years.
6 Comparative analysis of the Lahore study and the Vienna Study

The purpose of the study was to compare the present study results with the Vienna study results in order to understand whether the computer-based nutrition education program i.e. Cool Food Planet Kidz and materials designed for children in developed countries could be effectively implemented and whether they would be appropriate for children in developing countries. Therefore, in line with this background the adapted model of the Vienna study was implemented in the selected primary schools of Lahore and the present study investigated the same associations in a comparable sample in Lahore, Pakistan. Taking up this framework, the following main directions are considered to commence the comparison: (a) to explore similarities (b) to determine line of fraction and (c) to propose suggestions.

In the first part the similarities and in the second part the differences found between the children of the Lahore study and the Vienna study with regard to the computer-based nutrition education are discussed. Suggestions based on the comparison were incorporated in the recommendation chapter.

6.1 Similarities

The Vienna study reported a significant increase in nutrition knowledge from baseline to post-intervention and at follow-up. The Lahore study also found similar results, confirming that intervention was also effective in increasing the nutrition knowledge related to healthy eating habits in children of Lahore. The results of GLM repeated measures show that the mean number of correct answers at post-intervention and follow-up is comparable in both studies (P=0.29). Table 19 and Graph 8 show nutrition knowledge as the mean number of correct answers of Vienna children and Lahore children at baseline, post-intervention and follow-up.
Table 19: Comparison of nutrition knowledge (mean number of correct answers) at baseline, post-intervention and follow-up between Lahore study and Vienna study

<table>
<thead>
<tr>
<th></th>
<th>Studies</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answers</td>
<td>Lahore Study</td>
<td>303</td>
<td>10.05</td>
<td>3.00</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>baseline</td>
<td>Vienna study</td>
<td>271</td>
<td>11.29</td>
<td>3.25</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Correct answers</td>
<td>Lahore Study</td>
<td>303</td>
<td>13.76</td>
<td>3.46</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>post-intervention</td>
<td>Vienna study</td>
<td>271</td>
<td>13.86</td>
<td>3.43</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>Correct answers</td>
<td>Lahore Study</td>
<td>303</td>
<td>13.09</td>
<td>3.22</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>at Follow-up</td>
<td>Vienna study</td>
<td>271</td>
<td>13.55</td>
<td>3.31</td>
<td>2</td>
<td>21</td>
</tr>
</tbody>
</table>

Graph 8: Comparison of nutrition knowledge (mean number of correct answers) at baseline, post-intervention and follow-up between the Lahore study and the Vienna study
This strengthens the view that nutrition education improves knowledge about diet and develops awareness about healthy eating habits that considered being first step towards modification of behaviour irrespective of the cultural variations.

Related to the second hypothesis, the Vienna study reported that using the computer-based tool combined with non computer-based materials did not prove effective in increasing the nutrition knowledge. The Lahore study also found no additional beneficial effects of the computer-based tool. Both groups demonstrated significant increase in nutrition knowledge. Mean number of correct answers of intervention groups in both studies was higher as compared to the comparison groups. However, the increase was not statistically significant. Table 20 and Graph 9 show the nutrition knowledge (mean number of correct answers) at baseline, post-intervention and follow-up between intervention and comparison groups of the Lahore study and intervention and comparison groups of the Vienna study.

The Vienna study did not report significant difference in mean number of correct answers between intervention and comparison groups at the three months’ follow-up, hence supporting the view that the computer-based tool did not prove helpful in retaining the gain in nutrition knowledge. Similarly, in the Lahore study, no significant difference was found in mean number of correct answers between intervention and comparison groups at the three months’ follow-up. Both in the Vienna study and Lahore study, mean number of correct answers of intervention group was higher as compared to comparison group at follow-up. However, the difference was not large enough to be considered as statistically significant.

This is in accordance with other studies. In order to assess the retention effects Pisapia et al (1993) in a review of five studies with follow-up intervals of 2 to 6 months, reported that in four of them retention effects of computer-
Comparative Analysis

based as compared to control groups were not large enough to be considered statistically significant. This result supports the findings that knowledge imparted through innovative and creative mediums, irrespective of the mode of delivery, has longer effects on retention which is the foremost and fundamental aim of teaching.

Table 20: Comparison of nutrition knowledge (mean number of correct answers) at baseline, post-intervention and follow-up between intervention and comparison groups of the Lahore study and intervention and comparison groups of the Vienna study

<table>
<thead>
<tr>
<th></th>
<th>Studies</th>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answers baseline</td>
<td>Lahore Study</td>
<td>Intervention</td>
<td>147</td>
<td>10.01</td>
<td>3.01</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Comparison</td>
<td>156</td>
<td>10.08</td>
<td>3.01</td>
<td>2</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vienna Study</td>
<td>Intervention</td>
<td>145</td>
<td>11.50</td>
<td>3.25</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Comparison</td>
<td>126</td>
<td>11.04</td>
<td>3.25</td>
<td>1</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Correct answers post-intervention</td>
<td>Lahore Study</td>
<td>Intervention</td>
<td>147</td>
<td>13.99</td>
<td>3.48</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Comparison</td>
<td>156</td>
<td>13.54</td>
<td>3.42</td>
<td>5</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vienna Study</td>
<td>Intervention</td>
<td>145</td>
<td>14.07</td>
<td>3.41</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Comparison</td>
<td>126</td>
<td>13.61</td>
<td>3.44</td>
<td>4</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Correct answers follow-up</td>
<td>Lahore Study</td>
<td>Intervention</td>
<td>147</td>
<td>13.47</td>
<td>3.22</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Comparison</td>
<td>156</td>
<td>12.74</td>
<td>3.19</td>
<td>4</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vienna Study</td>
<td>Intervention</td>
<td>145</td>
<td>13.59</td>
<td>3.44</td>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Comparison</td>
<td>126</td>
<td>13.51</td>
<td>3.17</td>
<td>3</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>
Graph 9: Comparison of the nutrition knowledge (mean number of correct answers) at baseline, post-intervention and follow-up between intervention and comparison groups of the Lahore study and intervention and comparison groups of the Vienna study.

With regard to the socio-economic status and nutrition knowledge of children, both studies found that children belonging to lower socio-economic status demonstrate less nutrition knowledge as compared to the children of higher socio-economic status. Mother’s occupational level was also found significantly associated with children’s nutrition knowledge in both studies. However, Vienna study reported significant variation in nutrition knowledge of children with regard to father’s occupational level at baseline, post-intervention and follow-up. Whereas, Lahore study only found significant variation at post-intervention and follow-up.

### 6.1.1 Effect Size

The Vienna study reported an effect size of $d=0.134$ (there was no statistically significant difference between the groups). The present study yielded an effect size $d=0.130$ (there was no statistically significant difference
between the groups), which is highly compatible in magnitude to the Vienna study. According to Cohen (1988), interpretation of effect sizes, the effect size below 0.2 is reported as small, 0.5 as medium and 0.7 as large. An effect size in both studies was small (d<0.2). The small effect size of 0.130 replicated in the present study indicated that the computer-based tool also had a very small effect on Lahore children’s learning of nutrition knowledge.

6.2 Differences

The results of GLM repeated measures indicates that at baseline nutrition knowledge significantly (p=0.00) varies between two studies. The children of Vienna study had more nutrition knowledge at baseline as compared to the children of Lahore study, indicating that Pakistani children are short of knowledge about food and nutrition. Prior to the present study, there is no data available about the nutrition knowledge level of Pakistani children, especially in comparison with children of developed countries. However, the poor level of nutrition knowledge found in this study is consistent to the prevalent trend of low level of nutrition knowledge in south Asian region. In studies from India Subha Rao et al (2006) and Bamji and Murthy (2006) also reported nutrition knowledge of Indian children as poor. The low nutritional knowledge of children of the Lahore study indicates that the parents, school and media are unable to deliver sufficient and effective nutrition-related messages and develop healthy eating habits in the children.

This finding is in line with the other studies, which documented that the knowledge level of Pakistani children in many academic subjects is low (Andrabi et al 2007; Saeed et al, 2005). However, the low level of learning achievement is not only a Pakistan specific problem. In fact these trends are prevalent throughout the south Asian region (Das et al, 2006).

The Lahore study observed 3.70 mean increase in nutrition knowledge from baseline to post-intervention. Where as, the Vienna study observed 2.57
mean increase in nutrition knowledge from baseline to post-intervention. The 3.70 mean increase in nutrition knowledge of the children of Lahore study was consistent with the finding of Gupta and Kochar (2009) and Subha Rao et al (2006) who reported 7.51 and 4.74 mean increase in nutrition knowledge of the respondents respectively. The observed mean increase of 3.70 in the Lahore study as compared to mean increase of 2.57 in the Vienna study could be attributed to the fact that Pakistani primary school children had never been exposed to such a motivating and interesting learning environment designed to accelerate their learning.

The mean nutrition knowledge scores at follow-up between the two studies are comparable. However, children in the Vienna study notably retained more nutrition knowledge as compared to the Lahore children. A possible reason for retaining more nutrition knowledge of the Vienna children at three months follow-up as compared to the Lahore children could be of more opportunities to get nutrition-related information from their environment. These include media, teachers and parents thus strengthening the nutrition knowledge the children had already acquired.

On the contrary, the children of the Lahore study did not have this additional advantage to support in retaining their already learned nutrition knowledge concepts. This signifies the importance of delivering health and nutrition-related messages through the help of parents, media and schools (Hakeem et al, 2004).

To conclude, although the education systems differ between the Vienna, Austria and the Lahore, Pakistan, the effect of computer-based nutrition education was similar. Comparative analysis revealed important differences between the samples of both studies. It clearly highlighted that nutrition knowledge of Lahore children is very low, which demands urgent inclusion of nutrition education in their school curriculum. Children of the Lahore study
attain more nutrition knowledge scores as compared to Vienna children at post-intervention. However, at three months’ follow-up the Vienna children retain more nutrition knowledge scores. It indicates that they were unable to retain the learned knowledge due to lack of support and feedback from the environment.
7 Conclusion

The present study was distinctive in two aspects. For the first time, computer-based nutrition education intervention was implemented and evaluated in the Pakistan primary school setting and the acceptability of such a program in a Pakistan context was explored. Secondly, the comparative analysis of the present study data with data of Vienna study was carried out.

In the case of the first aspect, the study successfully demonstrated that the children could learn nutrition concepts and healthy eating habits in a lively and interesting environment. The study found that the children and teachers were both positive and receptive to the computer-based nutrition education intervention. However, significant barriers were identified that negatively affect the acceptability of computer-based education, thus eventually, affecting its applicability in the Pakistani primary schools.

As regards the second aspect, the comparative analysis helped to interpret further the present study results in the broader global context. Although the education systems differ between the Austria and the Pakistan, the effect of computer-based nutrition education was similar. Comparative analysis also revealed important differences between the samples of both studies.

Since, in the present study the nutrition knowledge increased in both groups, this implies that use of computer based nutrition education did not confer any additional advantage in the learning of nutrition concepts. Children do not like being passive learners. Rather, they learn through active involvement in the learning process. The intervention presented the nutrition concepts in concrete forms and through motivating and challenging activities (board and card games), which ensured the children’s active involvement. In the light of this result, it can be rightly inferred that irrespective of the delivery mode,
creative, motivating and age appropriate nutrition education programmes can facilitate the learning of lifelong nutrition concepts and healthy eating habits. Such learning has more potential to be effectively translated into practice.

As nutrition concepts are abstract and children at the concrete operational stage find them hard to comprehend, establishing innovative and creative methods to teach children about healthy eating habits are crucial. Matheson and Spangler (2001) in a review of 30 nutrition academic curricula suggest that half of the programs incorporated the element of curiosity and challenge to convey the nutrition content. The result of present study supports the view that use of creative methods increase children’s ability to learn and grasp nutrition concepts effectively and easily.

Low nutrition status of Pakistani children is amply documented in literature. However, it is devoid of any mention about the nutrition knowledge of these children. The present study fills this gap by providing data about the existing level of nutrition knowledge of children in Pakistan. It provides evidence that nutrition knowledge of Pakistani children is very low. Furthermore, it demonstrates that this area can be successfully targeted and change can be achieved with relatively few additional resources.

Besides the fact that the present study was unable in establishing any additional learning advantage of computer-based nutrition education, it demonstrated that children were very receptive towards using the computers as a learning device. They regarded learning of nutrition concepts through computers as interesting and entertaining. Generally, in Pakistan, ‘learning to operate computers’ is considered the main purpose of integrating computers in schools. A valuable outcome of the present study is therefore doing away with the existing notion and replacing it with the idea ‘learning through computers’ instead.
In this respect, the use of computer as a medium of learning was new to the children. As observed and discussed during the focus group discussions, they faced some difficulties using computers on their own. The success of computer-based education is not dependant upon the quality or quantity of the technology but rather upon the learner’s attitude and readiness to use it. The present world is the world of technology and there is need to develop children’s competence in computer related technology.

As discussed in focus group, although student teachers had some basic computer skills, they were not very comfortable using computers as a teaching tool. This indicated their lack of computer efficacy. However, during the intervention, they realized the potential of computers as a teaching tool and showed willingness to use computers in their teaching. Considering, their lack of computer efficiency implies that in order to integrate computers successfully in the Pakistani education system, teachers must recognize the importance of operating computers. Furthermore, they should familiarize themselves with computers as a teaching tool. The successful integration of computer-based education is largely dependant on teacher’s attitudes towards computers and their readiness to use them in teaching.

There are obviously more chances of today’s students teachers working with computers in classrooms of the future. Therefore, there is need to develop an awareness for incorporating computer-based teaching methods since the beginning. Computer-literate and computer-comfortable teachers are crucial for the effective integration of computers in education. This can be achieved by building up their confidence and improving their computer self-efficacy through providing them exposure to computers during their training. Such exposure will be helpful in developing the willingness to use computers in classrooms.
The study highlighted the problems facing computer-based education, including lack of computer related skills in teachers and children, frequent power breakdowns, lack of support from school administrations and lack of computer equipment and related infrastructure. This brings to light the fact that integration of computers in Pakistani education system requires comprehensive planning regarding physical infrastructure and teacher’s training as well as ongoing evaluation and feedback.

Given an account of the socio-economic status and nutrition Knowledge, the research also adds to the existing body of knowledge. Much of such literature has focused on developed countries. However, the present research was managed to establish in the Pakistani context that children belonging to lower socio-economic status had significantly lower nutrition knowledge as compared to those who belong to high socio-economic status. Low socio-economic status along with low nutrition related knowledge and poor life style habits contributes to the poor nutrition of the individuals.

An additional finding, worthy of raising in the context of the conclusion, is substantial increase in children’s nutrition knowledge and retention at post-intervention and follow-up without being cognizant of the repetition of the nutrition knowledge questionnaire. In Pakistan, teachers and students both focus on grade-oriented learning rather than conceptual learning. Therefore, a strong emphasis is placed on examination results. This phenomenon makes children concentrate and learn only those parts of the syllabus that they consider relevant to the exams. However, the present study reveals a different aspect from the prevailing situation, which implies that children can learn and retain knowledge without memorization and learning by rote.

The comparison of the present study results with the Vienna study results revealed two very important aspects. Firstly, in terms of nutrition knowledge at baseline, the study identified that nutrition knowledge of Pakistani children
is very low as compared to the children in Vienna study. It signifies the inadequacy of Pakistani school curricula in particular and society in general in providing knowledge related to nutrition and healthy eating to children. In addition, it draws attention to develop efficacious strategies to incorporate nutrition education in the primary school curriculum. It is an established fact that the nutrition concepts learnt early in life are more beneficial in later life. Knowledge is the first step towards the realization of healthy eating habits.

Secondly, in literature, the Pakistani children learning achievement are reported as low as compared to the international standards (Andrabi et al, 2007). Interestingly, the comparison of post-intervention nutrition knowledge results between Lahore study and Vienna study presented a different picture. Children in the present study attained more nutrition knowledge scores as compared to the children of Vienna study. Hence, suggesting that the observed patterns of low achievement of Pakistani children could not be solely attributed to their low intellectual competency. Indubitably, when innovative and interesting strategies are employed to teach children, they can produce equal learning results.

The study results have provided a strong foundation for incorporating nutrition education intervention in primary schools. Computer-based tools were found helpful in disseminating nutrition education. However, they were not the panacea. Other creative mediums were almost equally effective in disseminating nutrition knowledge. Even though, the study was unable to confirm additional advantage of computer-based nutrition education in the learning of nutrition concepts, it would not undermine the potential of computers in the context of the Pakistan school setting.
8 Recommendations

The present study successfully demonstrated that children’s nutrition knowledge can be increased with the use of both computer-based tools and other innovative and motivating strategies. Considering the successful implementation and the comparative analysis of the both studies, the following recommendation for incorporation of nutrition education and computer-based education in Pakistan should be considered.

8.1 Recommendations for practice

The finding that nutrition knowledge of Pakistani children is low justifies urgent inclusion of nutrition education in the primary school curriculum, in order to develop self-efficacy and inculcate skills of healthy food selection and preparation in children. Therefore, nutrition education should not only provide the children information about healthy foods but also focus on transforming this knowledge into practice. Considering this, the higher authorities need to acknowledge the importance of nutrition education and must integrate nutrition education in primary schools curricula. Successful Integration of computer-based tools in Pakistani education system needs more rigorous research. Policies related to integration of computer-based tools in education must be based on research findings and empirical evidence.

The considerably low level of nutrition knowledge in student teachers also calls for attention. It is strongly recommended that teachers training curriculum should be revised. Nutrition education should be included in the teachers training curriculum. Incorporation of nutrition education in teachers training will prove beneficial in developing awareness in the community through children. Furthermore, it should incorporate comprehensive training regarding the use of computers as a teaching tool.
In developing and implementing nutrition education programs, more attention should be given to the children of low socio-economic status. Mass media (both electronic and print) needs to realize its potential in developing awareness about the importance of healthy eating and balanced diet in public and should act accordingly.

8.2 Recommendations for future research

As the present study was the only study of its kind in the Pakistan context, there is need for further research to substantiate these findings. This is advised in order to ascertain whether similar findings will be found using other computer-based nutrition education programs. Due to the time and resource constraints, the study did not attempt to explore the effects of nutrition knowledge on change in dietary behavior. Future studies are highly recommended in order to explore this aspect.

The future studies to determine the effectiveness of computer-based nutrition education should include varied time spans for the intervention. Further research needs to be conducted, which addresses the effectiveness of computer-based nutrition education among other age groups (adolescent, elderly) and children in different settings (public schools). Follow-up after one or two year’s duration should be conducted to determine the effect of computer-based education on knowledge gain. Future studies need to explore the nexus between nutrition knowledge, attitudes and dietary behavior specifically in the Pakistani population. There is also need to explore the relationship between parental nutrition knowledge and children nutrition knowledge and dietary habits.
9 Summary

The purpose of the present study was twofold. It aimed to implement and evaluate a computer-based nutrition education intervention in the primary schools of Pakistan and to explore the acceptability of such a program in the Pakistani context. Secondly, the study attempted to compare results of the present study with the study results of ‘Cool Food Planet Kidz’ (Kreisel K, 2004). A total of 11 schools (344 children) including 4 intervention (147 children), 5 comparison (156 children) and 2 control (41 children) schools completed the study. Schoolchildren of 8-10 years of age participated in the study.

The study was carried out during the two-week practical experience of student teachers in Lahore, Pakistan. The comparison group received nutritional education through worksheets, board and card games. The intervention group used the computer-based tool (Cool Food Planet Kidz) along with worksheets, board and card games. The control group received no nutrition education. The nutrition knowledge was measured at baseline (t0), post-intervention (t1) and three-months’ follow-up (t2) with the help of the validated Nutrition Knowledge Questionnaire. In addition to the Nutrition Knowledge Questionnaire, focus group discussions, observation of the nutrition lessons and evaluation questionnaires were also employed to gather data.

The nutrition knowledge increased significantly from baseline to post-intervention in both intervention and comparison groups (p<0.001). No tangible difference was observed at post-intervention and follow-up between the two groups indicating that the computer-based tool did not support additional learning in children. The intervention effect was significantly maintained at three months’ follow-up, indicating the retention of nutrition knowledge gained. Younger children (8-9 years old) significantly (p=0.045)
retained more nutrition knowledge at three months follow-up as compared to the older children (10-11 years old) implying that nutrition intervention is more advantageous when started at an early age. Long-term knowledge gain and retention of knowledge is significantly higher among girls as compared to boys (Mann Whitney-U test \( p=0.025 \), \( p=0.024 \) respectively). Higher retention of nutrition knowledge in girls as compared to boys could be associated to the fact that girls found nutrition knowledge more relevant to their future prospective role as homemaker and caretakers.

Nutrition knowledge in all children was strongly associated with the indicators of socio-economic status i.e. occupational level of the father and the mother and Family Affluence Scale. No difference was detected in nutrition knowledge with regard to different levels of mother and father occupation and Family Affluence Scale between intervention and comparison groups. This suggests that computer-based tool did not prove beneficial concerning the socio-economic status.

Children and teachers both enjoyed learning and teaching nutrition concepts through computers. Nevertheless, Student teachers highlighted many important factors that need to be taken into account in order to integrate computer-assisted education in Pakistani primary schools successfully.

The comparison with the Vienna study revealed that at baseline, nutrition knowledge (mean number of correct answers) of Vienna children was higher as compared to the Lahore children, indicating that nutrition knowledge of Pakistani children is very low as compared to the children in Vienna study. It signifies the inadequacy of Pakistani school curricula in particular and society in general in providing knowledge related to nutrition and healthy eating to children. At three months’ follow-up children in the Vienna study notably retained more nutrition knowledge as compared to the Lahore children.
suggesting that children in Vienna have more opportunities to get nutrition-related information from their environment.

The study results have provided a strong foundation for incorporating nutrition education intervention in primary schools. Computer-based tools were found helpful in disseminating nutrition education. However, they were not the panacea. Other creative mediums were almost equally effective in disseminating nutrition knowledge. The low level of nutrition knowledge urgently demands incorporation of nutrition education in the school curriculum.
10 Zusammenfassung


Sowohl in der Interventions- als auch in der Vergleichsgruppe stieg das Ernährungswissen nach Intervention signifikant an (p<0,001). Allerdings konnten zwischen den beiden Gruppen keine relevanten Unterschiede sowohl nach Intervention als auch beim Follow-Up festgestellt werden. Das computergestützte Programm führte somit zu keinem zusätzlichen Lerneffekt bei den Schülern. Beim Follow-Up wurden der Interventionseffekt und somit


Der Vergleich der Baselineergebnisse mit den Resultaten der „Cool Food Planet Kidz“-Studie zeigte, dass das Ernährungswissen (durchschnittlich Anzahl an korrekten Antworten) bei den Kindern aus Wien wesentlich besser war als bei den Kindern aus Lahore. Dies hebt die Unzulänglichkeit in der pakistanischen Gesellschaft im Allgemeinen und insbesondere die Unzulänglichkeit der Bildungsinhalte an pakistanischen Schulen hervor,
Zusammenfassung

Kindern Wissen über gesunde Ernährung zu vermitteln. Beim Follow-Up nach drei Monaten zeigte sich, dass die Kinder der Wiener Studie deutlich mehr Ernährungswissen behalten konnten als die Kinder aus Lahore, was darauf zurückführen sein könnte, dass Kinder in Wien mehr Möglichkeiten haben, in ihrem Umfeld zu ernährungsbezogenen Informationsquellen zu gelangen.

11 References


References


Europe: a systematic review within the HOPE project. Obesity Reviews, DOI: 10.1111/j.1467-789X.2009.00711.x


References


12 Appendices (1-11)
12.1 Appendix 1: Lahore Map
12.2 Appendix 2: Questionnaire for school principals

1) Name of primary school: ________________________________________________

2) Principal’s name: _____________________________________________________

3) Class teachers’ name:

   4a: ___________________ 4b: ___________________ 4c: _______________

   5a: ___________________ 5b: ___________________ 5c: _______________

4) Number of children per class:

   4a: __________   4b: __________   4c: __________ __

   5a: __________    5b: __________   5c: ______________ 

5) Number of Girls:

   4a: __________   4b: __________   4c: __________ __

   5a: __________    5b: __________   5c: ______________ 

6) Number of Boys

   4a: __________   4b: __________   4c: __________ __

   5a: __________    5b: __________   5c: ______________ 

7) Do you have computers for children’s use?
   ☐ Yes
   ☐ How many___________________________?
   ☐ No

8) In your opinion, how would you judge the computer literacy of the schoolchildren?
   ☐ Good (children are competent in using the computer)
   ☐ Not that good (children are not competent in using the computer)
   ☐ I do not know. It is difficult for me to judge the computer literacy of the children.

9) Do classrooms in your school have internet access?
   ☐ Yes
   ☐ No
   ☐ Some

10) In your opinion, what is the “socio-economic status” (SES) of your schoolchildren?
    ☐ Higher SES (children in my school are from richer families)
    ☐ Lower SES (children in my school are from poor families)

11) What is the school fee for the fourth and fifth class?
    Fourth Class __________
    Fifth class __________

12) Would you allow the student teachers to implement their two week teaching practice in your school?
    ☐ Yes
    ☐ No

13) Do you use worksheets and games in your teaching?
    ☐ Yes
    ☐ No

Thank you for taken out the time to fill the questionnaire!
12.3 Appendix 3: Nutrition Knowledge Questionnaire

Salam!

On the next pages you will find questions about nutrition!

Every question has four answers! Only one out of four is correct! Please read the questions carefully and choose the answer which you think is correct! Choose only one answer.

EXAMPLE:

In which row are three foods that are all from animals?

- Chicken - Eggs - Fish
- Keema - Milk - Potatoes
- Meat - Cheese - Bananas
- I do not know

If you do not know the correct answer, please DO NOT GUESS! If you do not know the correct answers please tick the box: “I do not know”!

It is very important that you answer the questions by yourself! Do not look at your neighbors’ answers!

Thank you for filling out the questionnaire!

□□□□□□□□□□
1) Why is it important that you eat breakfast?
   - So that my teeth can start moving early in the morning
   - My body’s energy stores are empty in the morning and they have to be filled up.
   - Because it is tradition to eat breakfast
   - I do not know

2) In which row are three foods that are healthy for breakfast?
   - Nan - chai (tea) - egg
   - Bread - butter - jam
   - Roti - yogurt - fruits
   - I do not know

3) Why is it important for you do not always eat the same foods?
   - So that my taste buds do not get bored
   - Because different foods have different vitamins and minerals
   - Because there are so many different things to buy in the supermarket
   - I do not know

4) In which row are three foods that contain a lot of carbohydrates?
   - Potatoes - eggs - kebabs
   - Bread - Noodles - bananas
   - Rice - Cheese - Meat
   - I do not know

5) How many servings (times) of fruits and vegetables should you eat per day? (One serving is for example one piece of fruit or a side dish of vegetables at lunch or dinner).
   - 1-2 servings per day
   - 2-3 servings per day
   - 5 or more servings per day
   - I do not know

6) Why does your body need carbohydrates?
   - Carbohydrates give my body energy to play run and learn
   - Carbohydrates give my body important vitamins
   - Carbohydrates make me stay full longer
   - I do not know

7) In which row are three foods that contain a lot of fat?
   - Banana - Butter - Lassi (butter milk)
   - Butter - Chocolate - Nuts
   - Milk - Yogurt - Cheese
   - I do not know

8) Which of the following sentences about calcium are correct?
   - My body needs calcium, so that I have enough energy to play
   - My body needs calcium, so that I have strong bones
   - My body needs calcium, so that I have strong muscles
   - I do not know
9) Fish, cheese, yogurt and milk contain a lot of:
   - Vitamin C
   - Carbohydrates
   - Proteins
   - I do not know

10) Some foods contain “hidden fats”. In which row are three foods that contain a lot of those hidden fats?
   - Butter - Kebab - Desi ghee
   - Cake - Chips - Chocolates
   - Oil - Cheese - Milk
   - I do not know

11) In which row are the three foods that contain a lot of calcium?
   - Milk - bread - meat
   - Noodles - Bananas - Yogurt
   - Yogurt - cheese - Milk
   - I do not know

12) How many glasses of water should you drink per day?
   - 2-3 glass
   - At least five glass
   - 1 glass is enough
   - I do not know

13) If you get hungry between meals, you should eat a little snack. In which row are three foods, which are especially good choices for snack?
   - Apples - Cakes - Chips
   - Cakes - Yogurt - Chocolate
   - Bananas - cheese - Yogurt
   - I do not know

14) Which of the following drinks should you drink if you are very thirsty?
   - Milk
   - Tap water or mineral water
   - Sakanjbeen (Lemonade)
   - I do not know

15) The amount of foods your body needs depend on
   - the season of the year
   - the amount of fat my body has
   - the amount of exercise I do
   - I do not know

16) Haseeb is playing outside the entire afternoon. Haris is sitting at home and watching TV. Which of the following statement is true?
   - Haseeb needs more calories than Haris.
   - Haris needs more calories than Haseeb.
   - Both need same amount of calories.
   - I do not know
17) In which row are the three foods that are prepared with very little fat:
- Chips - chargha (fried chicken) - fried fish
- Paratha - koftas (meat balls) - noodles
- Boiled egg - potatoes - poached fish
- I do not know

18) It is very important to eat fruits and vegetables daily:
- so that I get more muscles
- because they contain lots of proteins
- because they contain lots of vitamins
- I do not know

19) To stay healthy, your body needs exercise. How many times per week do you need to “get out of breath” when you exercise, in order to help your body stay in shape?
- Once a week
- On three days per week
- On seven days per week
- I do not know

20) Which of the following sentences about sugar is correct?
- Sugar contains important vitamins
- Sugar mainly contain calories
- Sugar promotes growth in children
- I do not know

21) Why is it important that you eat protein?
- Proteins protect you from disease
- Proteins help you to grow
- Proteins are good for your digestion
- I do not know

22) Which nutrient should you eat the most during the day?
- Proteins
- Fats
- Carbohydrates
- I do not know
Fill out the following questions about yourself!

1) □ I am a girl
   □ I am a boy

2) How old are you:____________________ years.

3) In which country were you born______________?

4) In which country was your mother born______________?

5) In which country was your father born______________?

6) How many people other than yourself live together with you_________?

7) Whom do you live with?
   □ Mother
   □ Father
   □ Brothers: With how many brothers do you live together:_______________
   □ Sisters: With how many brothers do you live together:_______________
   □ Step mother step father
   □ Aunts: With how many aunts do you live together:_______________
   □ Uncle: With how many uncles do you live together:_______________
   □ Grand father / Grand mother
   □ Other Persons________________________

8) Do you have a computer at home?
   □ No
   □ Yes

9) How often did you travel on holidays with your family last year?
   □ We did not go on holidays last year
   □ Once
   □ Two times
   □ More than two times
   Where did you travel to?______________________________________________

10) Does your family have a car?
    □ No
    □ Yes, we have a car
    □ Yes, we have two cars

11) Do you have room for yourself at home?
    □ No
    □ Yes

12) Does your mother work?
    □ No
    □ Yes what does she work?___________________________________________
    (Examples: nurse, sales persons; factory worker, doctor, psychiatric, teacher, etc)

13) Does your father work?
    □ No
    □ Yes what does he work?___________________________________________
    (Examples: taxi driver, cook, worker, doctor, psychiatric, teacher, mechanic, electrician, truck driver etc)
12.4 Appendix 4: Study Protocol and Variable coding

Demographic data

**Age**  
Data from baseline (1= 8-9 years of age, 2= 10-11 years of age, 0= missing variable)

**Gender**  
Data from baseline (1= girl, 2= boy, 0= missing variable)

**Mother's Occupation**  
Data from baseline, post-intervention and follow-up was compared. Job description provided by the children about their mother occupation is categorized on the basis of Pakistan Standard classification of Occupations (1994) and is coded into 6 major levels.  
1 = economically inactive (house person, unemployed)  
2 = very low (unskilled manual workers including construction workers, factory workers, house workers etc)  
3 = low (skilled manual workers including mechanics, drivers, tailors, electrician, cook, hair cutters, carpenter etc)  
4 = medium (clerks, skilled non-manual workers including nurses, teachers etc)  
5 = high (Professors, doctors, engineers etc)  
6 = very high (businessmen, manufacturers, executives, managers etc)

**Father's Occupation** (as mother’s occupation)

**Car Ownership**  
Data from baseline, post-intervention and follow-up was compared. In case of variation median of all three answers was used. (0= no, 1= yes, We have one car, 2= yes we have two or more cars, blank=missing variable).

**Own Bedroom**  
Data from baseline, post-intervention and follow-up was compared. Bedroom In case of variation median of all three answers was used. (0= no, 1= yes, blank= missing variable).
Vacation Data from baseline, post-intervention and follow-up was compared. In case of variation median of all three answers was used. (0= no, 1= yes, once in the last year, 2= yes, twice in the last year, 3= yes more than twice in the last year.

Computer Data from baseline, post-intervention and follow-up was compared. In case of variation median of all three answers was used. (0= no, 1= yes)

Computation of Family Affluence Scale

Family Affluence Scale consists of 4 items; car, own bedroom, vacation and computer. In order to compute family affluence scale as three levels these variables are recoded as follows

Compute FAS score= car + bedroom + vacation + computer
Recode FAS score= (0, 1, 2=1) (3, 4=2) (5, 6=3)
(1= least wealthy, 2= average wealthy, 3= most wealthy)

Nutrition Knowledge

1) Nutrition Knowledge= correct answers

All answers are individually coded into correct=1, wrong=2 and do not know=3. All correct answers are summed up.

2) Nutrition Knowledge gain

Short-term knowledge gain: difference between the nutrition knowledge at post-intervention and baseline (t1- t0)

Long-term knowledge gain: difference between the nutrition knowledge at follow-up and baseline (t2 – t0)

Retention of knowledge: difference between the nutrition knowledge at Post-intervention and follow-up (t2- t1)
12.5 Appendix 5: Evaluation Questionnaire for the children of comparison group

Salam!
I would like to have your opinion!
On the next page I will ask you questions about the worksheets you used during the nutrition lessons- I want to know:

❖ How would you like the worksheets and
❖ Did you enjoy working with the worksheets during class!

Please be very honest when you answer the questions!

1) **What did you especially like about the worksheets (You can check more than one answer)**
   - [ ] The topics (10 cool Food Tips, Brain fit, Building healthy habits, etc)
   - [ ] Pictures
   - [ ] Content
   - Other things for example:-

2) **Did you enjoy learning about nutrition with the worksheets?**
   - [ ] Yes, I enjoyed very much!
   - [ ] Yes, I enjoyed it!
   - [ ] No, it was boring!
   - [ ] No, it was very boring

3) **Was it easy to understand the text?**
   - [ ] Yes, the text was very easy to understand!
   - [ ] Yes the text was easy to understand!
   - [ ] No, the text was hard to understand!
   - [ ] No, the text was very hard to understand!

4) **What grade would you give to the worksheets?**
   - [ ] Very good
   - [ ] Good
   - [ ] Not so good
   - [ ] Not good at all

5) **Is there something you would like to improve in the worksheets?**

We hope that you enjoyed the nutrition project and also wish you ‘Good Health’ in the future!
12.6 Appendix 6: Evaluation Questionnaire for the children of intervention group

Salam!

I would like to have your opinion!

On the next two pages I will ask you questions about the CD-ROM you used during the nutrition lessons - I want to know:

❖ How would you like the CD-ROM and
❖ Did you enjoy working with the computer during class!

Please be very honest when you answer the questions!

1) **What did you especially like about the CD-ROM? (You can check more than one answers)***
   - The topics (10 cool Food Tips, Brain fit, Building healthy habits, etc)
   - The colors
   - The pictures the music
   - The moving cartoons
   - Other things for example: ____________________________________________________________
   ___________________________________________________________

2) **Did you enjoy learning about nutrition with the computer?***
   - Yes, I enjoyed very much!
   - Yes, I enjoyed it!
   - No, it was boring!
   - No, it was very boring

3) **Was it easy to understand the text?***
   - Yes, the text was very easy to understand!
   - Yes the text was easy to understand!
   - No, the text was hard to understand!
   - No, the text was very hard to understand!

4) **Was it easy to find your way around on the CD-ROM?***
   - Yes, it was very easy to find my way around!
   - Yes, it was easy to find my way around!
   - No, it was difficult to find my way around!
   - No, it was very difficult to find my way around!

5) **Is there something you would improve on the CD-ROM?***

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
6) Will you look website of Cool Food Planet: www.coolfoodplanet.org?
☐ Yes
☐ No. why not: __________________________________________________________

7) What grade would you give the CD-ROM
☐ Very good
☐ Good
☐ Not so good
☐ Not good at all

8) Would you like to work with the computer again during class?
☐ Yes
☐ No, because__________________________________________________________

9) Would you like to work with the internet during class
☐ Yes
☐ No, because__________________________________________________________

10) Have you already worked with the computer during the class?
☐ Yes
  ☐ No,
    ☐ Because, we do not have computers in our school
    ☐ Because, I do not know enough about computers
    ☐ Other reasons: ________________________________________________

12) Have you already worked with the internet during the class?
☐ Yes
☐ No,....
  ☐ Because, we do not have internet access in our school
  ☐ Because, I do not know enough about internet
  ☐ Other reasons: ________________________________________________

13) How would you judge your computer skills?
☐ Very good
☐ Good
☐ Not so good
☐ Not good at all

I hope that you enjoyed the nutrition project and also wish you ‘Good Health’ in the future!
12.7 Appendix 7: Evaluation questionnaire for student teachers of the Intervention group

Salam!

Dear students of the Ali Educational Institute!
I would like to have your opinion!
On the next two pages I will ask you questions about the CD-ROM and about whether you liked teaching with the “new medium”.

❖ How would you enjoyed the CD-ROM and
❖ How you liked using the CD-ROM as a teaching tool during class!

1) In which Primary school did you go for the teaching practice?

________________________________________________________

2) Have you ever worked with the computer during class before this project?

☐ Yes
No, because________________________________________________________

☐ I have not had the possibility (eg. I have not had a practical experience: I have not had the chance to develop the teaching lesson on my own, etc)

☐ I am not interested in computer-based teaching. I prefer non computer-based teaching materials.

☐ other reasons, fro example________________________________________________________

3) What did you especially enjoy about the CD-ROM? (You can tick more than one option)

☐ Variety of topics ☐ Content
☐ Graphics ☐ Formulation of sentence
☐ Animation/sound ☐ Purpose (teach nutrition via new medium)
Other:

________________________________________________________

________________________________________________________
4) **How would you judge the clarity of the CD-ROM?**
- Very good
- Good
- Poor
- Very poor

5) **How would you judge the preciseness of the CD-ROM?**
- Very good
- Good
- Poor
- Very poor

6) **Do you think the CD-ROM is helpful during class?**
- Yes
- No, because___________________________________________
- ______________________________________________________

7) **How would you judge the quality of the text in regards to its target group (children of aged 8-11 years)?**
- Very good
- Good
- Poor
- Very poor

8) **In your opinion, how would you judge the computer literacy of the schoolchildren?**
- Good (children are competent in using the computer)
- Not that good (children are not competent in using the computer)
- I do not know, it is difficult for me to judge the computer literacy of the children.

9) **Would you like to use CD-ROM again as a nutrition education tool?**
- Yes
- No, because___________________________________________
- ______________________________________________________

10) **In which areas could the CD-ROM be improved?**
- ______________________________________________________
- ______________________________________________________
- ______________________________________________________
12.8 Appendix 8: Teaching protocol form for intervention and comparison student teachers

Description of the lessons:
1) Name of your primary school: _____________________

2) How many children were in your class: ______________

I had a  ☐ Comparison class
☐ Intervention class

3) How many lessons you used for cool food ______________

4) Please write the total number of lessons ______________

5) Please give the details of the days when you use Cool Food in class and also informed about the number of hours on the respective days.

<table>
<thead>
<tr>
<th>Weekday</th>
<th>Amount of lessons</th>
<th>Weekday</th>
<th>Amount of lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Monday, 06-10</td>
<td></td>
<td>☐ Monday, 13-10</td>
<td></td>
</tr>
<tr>
<td>☐ Tuesday, 07-10</td>
<td></td>
<td>☐ Tuesday, 14-10</td>
<td></td>
</tr>
<tr>
<td>☐ Wednesday, 08-10</td>
<td></td>
<td>☐ Wednesday, 15-10</td>
<td></td>
</tr>
<tr>
<td>☐ Thursday, 09-10</td>
<td></td>
<td>☐ Thursday, 16-10</td>
<td></td>
</tr>
<tr>
<td>☐ Friday, 10-10</td>
<td></td>
<td>☐ Friday, 17-10</td>
<td></td>
</tr>
</tbody>
</table>

6) Which worksheets you used for delivering lessons?
☐ WS1  ☐ WS4  ☐ WS7  ☐ WS10
☐ WS2  ☐ WS5  ☐ WS8  ☐ WS11
☐ WS3  ☐ WS6  ☐ WS9  ☐ WS12

7) For intervention (computer) group
☐ WS1  ☐ WS2  ☐ WS3  ☐ WS4  ☐ WS5

8) Which games you used?
☐ Memory
☐ Snack and climbing
☐ Race

9) Which ideas you implemented:
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

Thank you for your help!!!
12.9 Appendix 9: Inclusion criteria for schools and children into data analysis

Inclusion of individual questionnaire was based on the following criteria:

1. A child must completed all three questionnaires i.e. baseline t0, post-intervention t1 and follow-up t2.

2. Coding on the questionnaires must allow ascribing the questionnaire to the respective child.

3. A questionnaire, which was returned blank by children or in which more than one answers were given was considered as invalid.

Inclusion of participating schools were based on the following criteria

1. Children in the intervention group must have the opportunity to use computer for at least 30 minutes.

2. Children of both intervention and comparison schools must have taken the five nutrition lessons.

3. Schools must allow student teachers to conduct their two-week practical experience.
### 12.10 Appendix 10: Comparison of replies given to the individual items of Nutrition Knowledge Questionnaire by intervention and comparison groups

<table>
<thead>
<tr>
<th>Item</th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t0  t1  t2</td>
<td>t0  t1  t2</td>
</tr>
<tr>
<td>1). Why is it important that you eat <strong>breakfast</strong>?</td>
<td>84 89 94</td>
<td>79 85 85</td>
</tr>
<tr>
<td>2). In which row, is three foods that are healthy for <strong>breakfast</strong>?</td>
<td>42 61 65</td>
<td>53 65 59</td>
</tr>
<tr>
<td>3). Why is it important that you do not always eat the same foods</td>
<td>72 83 89</td>
<td>56 78 76</td>
</tr>
<tr>
<td>4). In which row are three foods that contain a lot of <strong>carbohydrates</strong>?</td>
<td>18 50 42</td>
<td>36 58 47</td>
</tr>
<tr>
<td>5). How many servings (times) of fruits and vegetables should you eat per day?</td>
<td>26 57 53</td>
<td>39 69 54</td>
</tr>
<tr>
<td>6). Why does your body need <strong>carbohydrates</strong>?</td>
<td>49 74 76</td>
<td>53 70 61</td>
</tr>
<tr>
<td>7). In which row are three foods that contain a lot of <strong>fat</strong>?</td>
<td>33 49 54</td>
<td>38 58 45</td>
</tr>
<tr>
<td>8). Which of the following sentences about calcium are correct:</td>
<td>74 78 82</td>
<td>64 72 74</td>
</tr>
<tr>
<td>9). Fish, cheese, yogurt and milk contain a lot of:</td>
<td>42 51 48</td>
<td>22 67 47</td>
</tr>
<tr>
<td>10). In which row are three foods that contain a lot of those hidden fats.</td>
<td>41 59 62</td>
<td>44 74 53</td>
</tr>
<tr>
<td>11). In which row are the three foods that contain a lot of <strong>calcium</strong></td>
<td>36 62 64</td>
<td>28 45 45</td>
</tr>
<tr>
<td>12). How many glass of water should you drink per day.</td>
<td>76 87 89</td>
<td>63 85 78</td>
</tr>
<tr>
<td>13). In which row are three foods that are especially good choices for snacks?</td>
<td>35 49 56</td>
<td>22 45 57</td>
</tr>
<tr>
<td>14). Which of the following drinks should you drink if you are very thirsty</td>
<td>69 76 83</td>
<td>48 64 85</td>
</tr>
<tr>
<td>15). The <strong>amount of foods</strong> your body needs depend on</td>
<td>31 28 47</td>
<td>26 56 54</td>
</tr>
<tr>
<td>16). Haseeb is playing outside the entire afternoon. Haris is sitting at home and watching TV.</td>
<td>30 44 69</td>
<td>51 58 70</td>
</tr>
<tr>
<td>17). In which row are the three <strong>foods</strong> that are <strong>prepared with very little fat</strong>:</td>
<td>43 54 66</td>
<td>45 51 77</td>
</tr>
<tr>
<td>18). It is very important to eat fruits and vegetables daily</td>
<td>49 60 73</td>
<td>47 67 63</td>
</tr>
<tr>
<td>19). How many times per week do you need to “get out of breath” when you exercise, in order to help your body stay in shape?</td>
<td>24 52 65</td>
<td>17 50 60</td>
</tr>
<tr>
<td>20). Which of the following sentences about sugar is correct?</td>
<td>52 65 78</td>
<td>49 59 60</td>
</tr>
<tr>
<td>21). Why is it important that you eat <strong>protein</strong>?</td>
<td>50 63 71</td>
<td>56 63 65</td>
</tr>
<tr>
<td>22). Which nutrient should you eat the most during the day?</td>
<td>30 63 67</td>
<td>40 67 63</td>
</tr>
</tbody>
</table>
12.11 Appendix 11: Curriculum Vitae

Aisha Siddique

Education

2007 - Present
Doctoral student in Department of Nutritional Sciences, University of Vienna, Vienna, Austria

Research Topic
• Comparative analysis of computer-based nutrition education in primary schools of Lahore and Vienna

1996 - 1998
M.Sc. in Home Economics (Child Development)
College of Home Economics, Lahore, Pakistan

Research Topic
• Perception of Home-Economics under-graduate students about their curriculum

1991 - 1995
B.Sc. Home Economics
College of Home Economics, Lahore, Pakistan

Work Experience

1999 – 2007
Lecturer in Department of Rural Home Economics, University of Agriculture, Faisalabad, Pakistan

(On study leave From 2007 - Present)

• Delivered lectures on various aspects of Home Economics i.e. child development & family relations psychology of childhood and adolescence, home-management & home economics education
• Developed B.Sc. Honours Home Economics scheme of study.
• Developed M.Sc. Child Development and Family Relations scheme of study

Short Trainings

2003
Certificate of Instruction in effective teaching

1998
Certificate of internship on special education

• Conducted surveys on institutes, working on social and education aspects in Lahore
• Developed and implemented in-reach and Out-reach programs for special children
• Motivated the families to send their children for education

1998
Certificate of intensive training course on working with mentally retarded children
Research Publications


2009 Elamdfa I and Siddique A. Assessment of computer-based nutrition education model in primary schools of Lahore. Poster presented in 19th international Congress of Nutrition, 4-9, October, 2009 Bangkok, Thailand


Skills

Computer Skills Microsoft Word, Excel, Power Point & SPSS.
Language Skills Fluent in English, Urdu & Punjabi

Interests & Activities

Reading, Travelling, Badminton & Chess