THE EFFECTIVENESS OF A FOOD BASED DIETARY GUIDELINE NUTRITION EDUCATION GAME AND EDUCATOR'S SUPPORT MATERIAL AS A SUPPLEMENT TO IMPROVE RETENTION OF KNOWLEDGE IN RURAL GRADE 5 LEARNERS, LIVING IN SWEETWATERS, KWAZULU-NATAL.

by

REBECCA ANNE ESTEVES

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Dietetics and Human Nutrition,
School of Agricultural, Earth and Environmental Science
College of Agriculture, Engineering and Science
University of KwaZulu-Natal
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(ii) This dissertation has not been submitted for any degree or examination at any other university.

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I, *Nicola Wiles*, chairperson of the Supervisory Committee and

I, *Annette van Onselen*, co-supervisor, approve the release of this dissertation for examination.

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ABSTRACT

Aim: To determine the effectiveness of a Food Based Dietary Guideline (FBDG) nutrition education game and educator's support material (ESM) as a supplement to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal.

Objectives: To determine: the baseline nutritional knowledge of Grade 5 learners; the effects of the ESM or a nutrition education game on the retention of FBDG knowledge, and the educators' opinions about using both the ESM and the nutrition education game.

Method: An intervention study involving 266 Grade 5 learners in four schools. A pre-test was followed by either an ESM intervention or a nutrition education game intervention. A post-test was conducted to determine the effects of both interventions on FBDG knowledge retention. A second questionnaire was administered to the educators of the learners who participated in the interventions.

Results: The sample was made up of 53.8% (n=141) male participants and 46.2% (n=121) females, all between the ages of 8 and 15 years. Results showed very little improvement in the retention of knowledge as a whole. However, questions that asked about familiar concepts showed an improvement compared to those that were completely new. More complicated questions showed an improvement when the game was used, as the pictorial representation helped the learners to remember the answer. For example the average percentage for knowledge of fortification before the game was 1% while post intervention it increased to 29.6%. This showed that simple concepts based on a good pictorial representation were retained better than information that was difficult to conceptualise. All educators found the game useful and beneficial for the learners. The ESM was not as well used as the game as it was perceived to be too time consuming.

Conclusion: Learners enjoyed the game and the educators gave positive feedback, however there was no significant retention of knowledge in this study. Further research needs to be done using a game as a tool for nutrition education over a longer period of time and with a greater amount of educator training.

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CHAPTER 1: INTRODUCTION, THE PROBLEM AND ITS SETTING

1.1 Background to the importance of the study

According to United Nations Children's Fund (UNICEF 2013) 25% of children under the age of five are stunted worldwide, 15% are underweight and 8% are wasted (UNICEF 2013). More than 814 million people of all ages are undernourished in developing countries and 204 million of these come from Sub-Saharan Africa (FAO 2004). Approximately 60% of child deaths around the world occur in developing countries due to under-nutrition (FAO 2012). UNICEF (2013) has stated that in developing countries, children living in rural areas are twice as likely to be underweight than those living in urban areas. Southern Africa has the highest percentage of stunting in the world (39%) and a wasting prevalence of 7%. According to UNICEF a wasting prevalence of 10% or over requires immediate feeding interventions. In Sub-Saharan Africa the poorest section of the population are almost 20% more likely to be underweight than those in the richest section of the population (UNICEF 2013).

In South African, the 1999 National Food Consumption Survey (NFCS) indicated a high prevalence of underweight and stunting among children aged 1-9 years. In rural areas 25% (1 in 4) of children were affected by stunting compared to 17% in urban areas (Labadarios, Steyn, Maunder, MacIntryre, Gericke, Swart, Huskisson, Dannhauser, Vorster, Nesmvuni & Nel 2005). Six years later the National Food Consumption Survey Fortification Baseline (NFCS-FB-1 2005) showed that these results had not decreased substantially (1 in 5 children were stunted) and stunting still remains the most common nutritional disorder in young children. The most recent South African National Health and Nutrition Examination Survey (SANHANES) (2013) found an improvement in children over 5 years old with regards to stunting, wasting and underweight. However, stunting in children aged 1 to 3 years has increased from 1 in 5 (20%) to 26.5%. Severe stunting, severe wasting and severe underweight have all increased since the 2005 NFCS – 9.5%, 1.1% and 1.1% respectively. In addition, the number of children at risk of hunger has increased from 23% in 1999 to 28.3% in 2012 (SANHANES-1 2013). Despite the improvements made in older children the government has recognised the remaining challenge of malnutrition in children under 5 years and has stated that many of the targets set by the United Nations Development Programme (UNDP) Millennium Development Goals (MDG) in relation to nutrition will not be met by 2015 (UNDP 2010).

In contrast 44 million children globally are estimated to be overweight (UNICEF 2013). The South African statistics are even higher and have increased from 10.6% to 18.2% since 2005 (SANHANES-1 2013). The highest prevalence of overweight and obesity is found among children age 2-5 years (18.9% and 4.9% respectively) with the prevalence of overweight in children 10 to 14 years old also increasing to 16.7% (SANHANES-1 2013).

This situation has created a "double burden" of disease which is exasperated by the increasing prevalence of HIV/AIDS. Overweight children who are stunted have poor physical and cognitive development, as well as an increased risk for developing non-communicable diseases such as diabetes, heart disease and stroke (Kimani-Murage, Kahn, Pettifor, Tollman, Dunger, Gómez-Olivé & Norris 2010).

This "double burden" crisis could be exacerbated by the poor eating habits observed in many families across the country. The consumption of a mainly carbohydrate-based diet that lacks variety and micronutrient density coupled with an increased consumption of high fat, high sugar foods due to the introduction of the Western diet, is aggravating the problem (Oldewage-Theron & Egal 2009). Healthy food choices based on nutrition knowledge provided by effective interventions is the key to solving many of the above mentioned problems (Oldewage-Theron & Egal 2009).

Traditionally in South Africa, feeding schemes at crèches, schools and clinics have been the main method of nutrition intervention. However, evaluation of these programmes has been disappointing. These types of programmes focus too heavily on malnutrition and fail to address the wider cause of under-nutrition (Chopra 2003). Thus a more effective short term strategy needs to be investigated. The most effective setting for a successful intervention is a school as learners are required to be there all day and are surrounded by an environment that promotes learning (Oosthuizen, Oldewage-Theron & Napier 2011a; Kandiah & Jones 2002). Educators also have the ability to positively influence the learners using the school curriculum and additional resources to make it interactive and inspiring (Perez-Rodrigo & Aranceta 2003; Perez-Rodrigo & Aranceta 2001). The ideal age for intervention is Grade 5 because they have the greatest ability to be influenced (Perez-Rodrigo & Aranceta 2003).

KwaZulu-Natal (KZN) is the most densely populated province in South Africa and was ranked as the second most affected province in the country with regards to stunting (NFCS 2005). The largest age group in KZN is the 0-19 year old age group and the government requires that rural schools teach English to this age group from Grade 5 regardless of the learner's home language.

In South Africa Food Based Dietary Guidelines (FBDG) were developed to promote healthy eating practices. The current nutrition education (NE) curriculum is based on these FBDG. Unfortunately there is a lack of knowledge in South Africa regarding the ability of isiZulu speaking black learners to retain this FBDG knowledge when learners are prescribed to be taught in English as the main language of instruction. Therefore, this lack of research raises the following questions:

1. Can nutrition education be successful in rural areas where English is not a home language?
2. Is a nutrition education game the best approach to teach nutrition and promote knowledge retention?
3. Would it be more effective to enhance lessons through educators support material that focuses on nutrition?

This study therefore provided an excellent opportunity to gain additional insight into the effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators' support material (ESM) on supplementing nutrition education to improve retention of knowledge in Grade 5 learners in rural schools in KZN. Sweetwaters in KZN was an ideal place to test an intervention as the demographics were very similar to the wider South African population. It was anticipated that the results of this study would provide a greater insight into the current over- and under-nutrition burden in KZN.

1.2 Statement of the problem

The purpose of this study was to determine the effectiveness of a Food Based Dietary Guideline NE game and educators' support material (ESM) as a supplement to improve retention of knowledge in rural Grade 5 learners particularly those from a lower socio-economic background.

1.3 Study objectives

1.3.1 To determine the baseline nutritional knowledge regarding the Food Based Dietary Guidelines of Grade 5 learners attending a rural school.

1.3.2 To determine whether ESM would improve the learners' retention of nutritional knowledge surrounding the Food Based Dietary Guidelines.

1.3.3 To determine whether a nutrition education game would improve the learners' retention of knowledge surrounding the Food Based Dietary Guidelines.

1.3.4 To determine the opinions of the educators on the effectiveness and ease of use of both the ESM and the nutrition education game.

1.4 Type of study

This study was classified as a quasi-experiment where a pre-test post-test design was used to test the retention of nutrition knowledge in Grade 5 learners living in Sweetwaters. This is the most effective method to use as it measures the relationship between two variables and clearly shows clearly the differences in actual effect verses the intended effect (Reichardt 2009, p47). Grade 5 learners were chosen as they are generally between the age of 8 and 12 years which has been found to be the most effective age to target when trying to inspire change (Oosthuizen *et al* 2011b).

The area of Sweetwaters was used as it is a good representation of KZN in terms of race, language, gender and age distribution. In Sweetwaters 99.7% of the population are black and 98% speak isiZulu as their first language (Stats SA 2011). Children in this area aged 5-19 years make up 29% of the population which is similar to KZN where 31.9% of the population falls into the age group of 5-14 years (Stats SA 2011).

The schools participating in the study were chosen based on the fact that they had at least two Grade 5 classes and were within Wards 1 and 2 of Sweetwaters. Only 4 of the 22 schools in the area were found to be suitable and thus used in this study.

1.5 Study constraints

This study only included learners in Grade 5 attending a school in Sweetwaters, who had obtained both consent and assent. The study took place over a six week period. Learners who did not write both the pre- and post-test, as well as those who did not fill in the questionnaire correctly were excluded from this study. Learners who were not able to read or write English proficiently were included however, those with learning disabilities were excluded for the purpose of this study.

1.6 Assumptions

It was assumed that:

- Learners would have an opportunity to play the game during school hours.
- Educators would put effort into using the ESM in their NE lessons.
- The pre-test would have covered what the learners had already been taught.
- The learners would understand and answer all questions without assistance from educators or other learners.
- The answers to the questions were a true reflection of the learners' current knowledge at the time of the study.
- All learners were familiar with and able to play the game "Beetle Drive".
- The educators would answer questions about the game and ESM honestly.

1.7 Definition of terms

For the purpose of this study the following are defined:

Educator:	The person who educates a group of learners in a school setting with the outcome of improving knowledge.
Educators' Support Material:	A guide for educators to incorporate the Food Based Dietary Guidelines by providing fun activities for the learners as part of the CAPS curriculum.

Learner:	A child who is taught by an educator in a school setting.
Malnutrition:	Includes either over- or under-nutrition. (Tanumihardjo, Anderson, Kaufer-Horwitz, Bode, Emenaker, Haqq, Satia, Silver & Stadler 2007).
Non-communicable diseases:	A chronic condition that is not transferred from person to person and is long in duration and slow in progression. It usually includes diseases such a cardiovascular disease and diabetes (WHO 2013).
Nutrition education:	Educating individuals on nutrition and healthy lifestyle choices.
Nutrition education game:	A revision game based on the Food Based Dietary Guidelines that could be played during school time to allow learners to revise what was taught.
Nutrition transition:	The major change in the diet composition of human populations resulting from a shift from a traditional diet to a Western one (Jinabhai, Taylor & Sullivan 2003).
Over-nutrition:	Excessive intake of energy and/or macronutrients (Faber & Wenhold 2007).
Pre-testing:	Testing an individual's abilities before performing any form of intervention to determine knowledge and understanding (Perez Rodrigo & Aranceta 2003).
Post-testing:	Testing the retention of knowledge of an individual after performing in an intervention (Perez Rodrigo & Aranceta 2003).

Stunting:	Linear growth faltering (low height-for-age) caused by chronic malnutrition which is indicated by a z-score of <-2 (Faber & Wenhold 2007; Chopra 2003).
Self-efficacy:	The ability to feel personally motivated enough to change certain behaviour (Contento 2008).
Under-nutrition:	The result of a poor or inadequate diet. This can be divided into protein-energy malnutrition and micronutrient deficiencies (Tanumihardjo *et al* 2007; Faber & Wenhold 2007)

1.8 Abbreviations

ADA:	American Dietetic Association
CAPS:	Curriculum and Assessment Policy Statement
DOE:	Department of Basic Education
DOH:	Department of Health
ESM:	Educators' Support Material
FAO:	Food and Agricultural Organisation
FBDG:	Food Based Dietary Guidelines
KZN:	KwaZulu-Natal
MDG:	Millennium Development Goals
NE:	Nutrition Education
NFCS:	National Food Consumption Survey
SA:	South Africa
SANHANES:	South African National Health and Nutrition Examination Survey
SD:	Standard Deviation
UNICEF:	United Nations Children's Fund
UK:	United Kingdom
USA:	United States of America
WHO:	World Health Organisation

1.9 Hypotheses

Hypothesis 1: The baseline nutrition knowledge of the learners would be on par with other studies conducted in South Africa using primary school learners.

Hypothesis 2: More than half the learners would retain their nutrition knowledge after the interventions.

Hypothesis 3: A significant improvement would be seen in nutrition knowledge after the interventions.

Hypothesis 4: Educators would find the game and ESM effective and easy to use.

1.10 Summary

According to the SANHANES conducted in 2011 the highest amount of stunting occurs in the youngest age group (1 to 3 years) and has increased from 20% in 2005 (NFCS 2005) to 26.9% in 2011. The percentage of overweight children has also increased dramatically from 10.6% to 18.2% (NFCS 2005 to SANHANES 2013) and is now of great concern. The effects of this double burden are seen in the adult population in the form of non-communicable diseases such as diabetes, heart disease and stroke, with the greatest effect on rural areas. These statistics have improved but are still a concern when looking ahead to the Millennium Development Goals of eradicating poverty and hunger and combating HIV/AIDS and other diseases by 2015.

A nutrition education game and ESM were used in this study in a school setting among Grade 5 learners to assist the current curricula in promoting knowledge retention of nutritional information. The interventions were targeted at the portion of the population most affected by over- and under-nutrition in an attempt to determine whether NE tools are effective in increasing knowledge retention in order to improve healthy eating habits. The combination of the game and the ESM measured independently would be the first of its kind in KwaZulu-Natal as it was targeted at isiZulu speaking learners living in a rural and semi-rural area. If these interventions were successful it could provide learners with a better understanding of the South African FBDG and help them to retain this information into adulthood. It was

anticipated that the results of this study will provide a small insight into how NE can play a role in alleviating malnutrition, specifically in rural and semi-rural areas where isiZulu is spoken as the primary language.

1.11 Dissertation overview

This dissertation contains six chapters that provide an overview of the study. In this chapter (Chapter 1) the study objectives were provided as well as the importance of the study to South Africa's current "double burden" situation. Chapter 2 looked at the relevant literature surrounding under- and over-nutrition and provided insight into what tools have been used to teach nutrition to primary school learners and which have been the most effective in promoting knowledge retention. The next chapter (Chapter 3) presented the methodologies used in this study. This included the study design, development of the ESM, game and questionnaires, as well as the validation of these tools. Chapter 4 presented the results found in this study while Chapter 5 discussed these results in light of the current literature established in Chapter 2. Finally, relevant conclusions and recommendations were made in Chapter 6 based on the findings of this study.

CHAPTER 2: REVIEW OF THE RELATED LITERATURE

The following chapter will provide a review of the related literature by looking at the importance of NE is and how it is best implemented in a school setting. The methods of teaching NE to learners internationally will also be addressed, as well as what has been researched in South Africa. This will be followed by a conclusion.

2.1 Prevalence of over- and under-nutrition in South Africa

According to Crush, Frayne and McLachlan (2011) ten million children worldwide die from causes that could have been prevented and most of these children occur in developing countries (Crush, Frayne & McLachlan 2011). Of those deaths caused by infectious diseases, 53% are as a result of poor nutrition (Crush, *et al* 2011). Globally it has been estimated that more than 10% of children under the age of five have acute malnutrition as seen by wasting, and 30% have chronic malnutrition, which implies stunting (Ruel & Hoddinott 2008).

In South Africa there has been an improvement in the nutritional statistics when comparing the latest SANHANES (2013) with the most recent National Food Consumption Survey (NFCS-FB-1 2005). The latest results show a decrease in stunting, wasting and under-nutrition among children under 10 years old (SANHANES-1 2013). However, there is still a major concern regarding nutrition in South Africa as it is one of the few countries that has shown an increase in child mortality due to HIV/AIDS that is worsened by a poor nutritional status (UNDP 2010). The government's aim for this country is to reduce the number of deaths to less than 20 deaths per thousand live births in order to meet the universal MDG. The construction of the MDG's at the United Millennium Summit in 2000 included eight priorities in social and economic development which are to be achieved by 2015. By 2005 some progress had been made but many of the areas showed challenges that needed attention in order to meet the target in 2015. A 2010 Country Report was produced to clearly define the positives and negatives surrounding the eight MDG. Unfortunately, according to this report, the rate of childhood mortality was still at 104 deaths per thousand live births (UNDP 2010).

In addition to the under-nutrition still seen in South Africa there has been a rise in the number of overweight and obese children since 2005. The 2005 NFCS reported that the prevalence overweight and obesity at the national level was 10% and 4% respectively, which was as high

as the prevalence for underweight (NFCS-FB-1 2005). The SANHANES (2013) found that the prevalence of overweight and obesity in the 2-14 year old age group was significantly higher among girls (overweight – 16.5%, obesity – 7.1%) than boys (overweight – 11.5%, obesity – 4.7%), with an increase in the prevalence of overweight rising from 10.6% to 18.2% in less than a decade (SANHANES-1 2013).

Both over- and under-nutrition have created a "double burden" of disease which is worsened by the devastating effects of HIV/AIDS in developing countries like South Africa (Vorster 2012; UNDP 2010; Jinabhai, Taylor & Sullivan 2003). As a result there has been an increased interest in the field of nutrition and public awareness (SANHANES-1 2013; Contento 2008) and continued attention has been given to the area of nutrition as it falls under the MDG's (UNDP 2010). The eight MDG's are:

1. Eradicate extreme poverty and hunger.
2. Achieve universal primary education.
3. Promote gender equality and empower women.
4. Reduce child mortality.
5. Improve maternal health.
6. Combat HIV/AIDS, malaria and other diseases.
7. Ensure environmental sustainability.
8. Develop a global partnership for development.

The first MDG which requires eradication of poverty and hunger is slowly being achieved in South Africa by halving the number of people living below the poverty line. However, the MDG Country Report issued in 2010 suggested that despite the improvements this MDG will not be met by 2015 due to the large number of people living without education or resources (UNDP 2010). This links up to the second MDG which looks at providing primary education to everyone. The South African government feels that educating a population remains one of the most important areas of focus as it is a platform for achieving many of the other MDG's. Goal 3 has already been met yet education services require a practical aspect to learning where children can take what they have learnt and apply it at home. This can be done by developing new interventions and improving old ones. In an attempt to reduce these problems the government has developed guidelines to educate the public (UNDP 2010).

2.2 Development and use of guidelines and food guides

There are various tools through which nutrition information is disseminated in order to provide to all members of the public with information on healthy food choices. These tools have changed over time and also vary across countries (USDA 2011).

2.2.1 North America

The United States are the pioneers in NE and the United States Department of Agriculture (USDA) are recognized as having produced many of the components for the first food guide (USDA 2011). In 1916 the first USA food guide was developed using the 3 food groups which were the body-building foods, protection foods and fuel foods. This progressed in the 1980's to the food wheel which consisted on the 5 food groups of milk and meat; cereals; fruit and vegetables; fats and fat foods; sugars and sugary foods. By the end of 1992 a complete remodel of the American food guide was undertaken to produce a pyramid that focused on spreading fats and sugars throughout the food groups as well as promoting variety, moderation and portion sizes (USDA 2011). Based on consumer research this was then modified in 2005 to a simplified version called *MyPyramid*, and a few additions were made, such as the importance of exercise. The pyramid consisted of varying sized tiers each representing a different food group. The base tier was the largest and symbolised the food group to be consumed in the largest portion. The tiers above that each represented another food group to be consumed in increasingly smaller portion sizes as the pyramid came to a point at the top. This new pyramid still focused on variety, moderation and proportions but was designed with online information to give further details on healthy eating. The *MyPlate* was developed in 2011 when the *2010 Dietary Guideline for Americans* were updated to serve as an striking reminder of healthy eating for the consumer (USDA 2011).

Other countries have used similar tools to teach nutrition but have modified them based on the most commonly consumed foods by their population. Canada who used a rainbow to depict the different food groups, with the largest food group, grains, being on the outer band and the smallest consumed food items falling into the inner band (Painter, Rah & Lee 2002).

2.2.2 Europe and Asia

Since 1995 the United Kingdom (UK) has used the plate model which is divided into the 5 food groups in the same way as the USA (Painter *et al* 2002). China has a pagoda as their picture which focuses on sweet potato, legumes and soy, with oil and salt in the top tier representing the smallest portion size to be consumed. The French are currently using "stairs" as their NE tool with each step representing a different food group and the number of servings that should be consumed daily. They also include physical activity as well as a magnifying glass to emphasise small portions of salt, sweets and oils. Greece has a food pyramid that is modified to suit their Mediterranean diet thus wine and oils are added to the top of the pyramid. The Japanese have a spinning top which acts like an inverted pyramid with greater focus being placed on grains, vegetables and fish, and less on fruit and dairy. It also includes exercise and information about sugars and fats on the side. Spain has a food pyramid with 6 tiers where fish, chicken and beans are split from processed and red meats. They also include a block on the second tier for olive oil, which is synonymous with their culture, and highlighted physical activity and water consumption (Painter *et al* 2002).

2.2.3 South Africa

Previously in South Africa the food guide and food related guidelines were used based on those developed by other countries such as the USA. However in 1997 the Nutrition Society of South Africa (NSSA) decided to develop guidelines that would be appropriate for the South African population (Vorster, Love & Browne 2001). It was important that these guidelines included locally available foods, addressed the specific issues that faced South Africans, and were easy to understand, user friendly and written in a positive way (Vorster *et al* 2001). The guidelines needed to meet all South African ethnicities and cultures as well as ensure the prevention of under- and over-nutrition that had been seen across the population. In 1998 the guidelines were provisionally written and a focus group discussion was conducted in two of the nine provinces to determine the acceptability of these guidelines. These focus group discussions were incorporated into the guidelines developed in a meeting held in 2000, along with the results from the other focus groups that had been held in the other seven provinces. The result of much deliberation and hard work was a list of eleven Food Based Dietary Guidelines (FBDG) that could be applied directly to the South African

context, taking into consideration ethnicity, race and socio-economic standings (Vorster 2012; Vorster *et al* 2001).

However, with rapid urbanisation, economic development and the nutrition transition there was a need to revise the FBDG. In 2011 a national working group was formed to review the old guidelines and adapt them into something more suitable for the current South African population. Once a consensus was reached regarding the wording of the guidelines and those that should be included or removed, a new set of ten guidelines were produced and published (Vorster 2012). The ten guidelines included:

1. **Enjoy a variety of foods.**
   The aim of this first guideline was to promote dietary diversity in the foods that were eaten within a meal as well as across the week. It also included the method of cooking as different methods may affect the nutritional composition of a food item, for example boiling would leach nutrients and frying would add fat.
2. **Be active!**
   The guideline to "be active" intended to encourage physical activity in the form of sport, gym, or even smaller tasks such as gardening or cleaning the house. It was used as a means to begin reversing the effects of NCD as a result of poor eating habits and a lack of exercise.
3. **Make starchy foods part of most meals.**
   This guideline was edited from saying "the basis of most meals" to saying "part of most meals" taking into account the South African context. Most people, especially those living in rural areas, consume a large amount of starch and thus needed to be reminded to eat starchy foods in moderation as part of a meal and not as a meal on its own.
4. **Eat plenty of vegetables and fruit every day.**
   This fourth guideline was included to encourage the consumption of vegetables and fruit. The word "plenty" was used instead of the "5-a-day" concept used in many other countries because it was understood that many people would not be able to consume 5 fruits and vegetables every day and thus anything more than what was being consumed currently was acceptable. The word "vegetables" was written first to encourage vegetable consumption over fruit consumption as vegetables are easier to grow and are lower in sugar which accommodates people with diabetes.

5. **Eat dry beans, split peas, lentils and soya regularly.**
   Consuming these foods provided a source of protein to those who could not afford expensive protein sources and acted as a good source of fibre and low fat protein for those with NCD's. "Regularly" implied that these foods should be eaten often during a week.
6. **Have milk, maas or yoghurt every day.**
   Originally this guideline fell under the guideline about meat and eggs but was changed to a guideline on its own as it is also a cheap source of high biological protein and thus should be eaten every day. Maas was included as it is culturally appropriate for South Africans.
7. **Fish, chicken, lean meat or eggs can be eaten daily.**
   These food products are encouraged as they are a good source of protein and can be eaten everyday if affordable, but due to the expense are not required to be consumed every day. Fish and chicken were written first to promote a greater consumption of these foods as they are lower in fat.
8. **Drink lots of clean, safe water.**
   Water is advised rather than sugar sweetened drinks, and should be clean and safe to avoid illness from contaminated water.
9. **Use fats sparingly. Choose vegetable oils, rather than hard fats.**
   Fat can be used however only in small amounts. The new guideline was changed to include the kind of fats that should be chosen to help reduce problems of obesity and heart disease.
10. **Use sugar and foods and drinks high in sugar sparingly.**
    Sugar was originally combined with the fat guideline but was later divided as a high sugar intake is a large problem in this country and needed to be addressed individually. These food items are also recommended with caution to avoid an increase in diabetes, obesity and tooth decay.
    (Vorster 2012; Love 2002; Vorster *et al* 2001)

Despite these new, improved FBDG, they were considered incomplete without a formal food guide that could be used as a pictorial representation when teaching nutrition (Vorster 2012). Thus a food guide (Figure 2.1) was developed that linked directly to the FBDG and was unique to South Africa (DOH 2012; Vorster 2012).

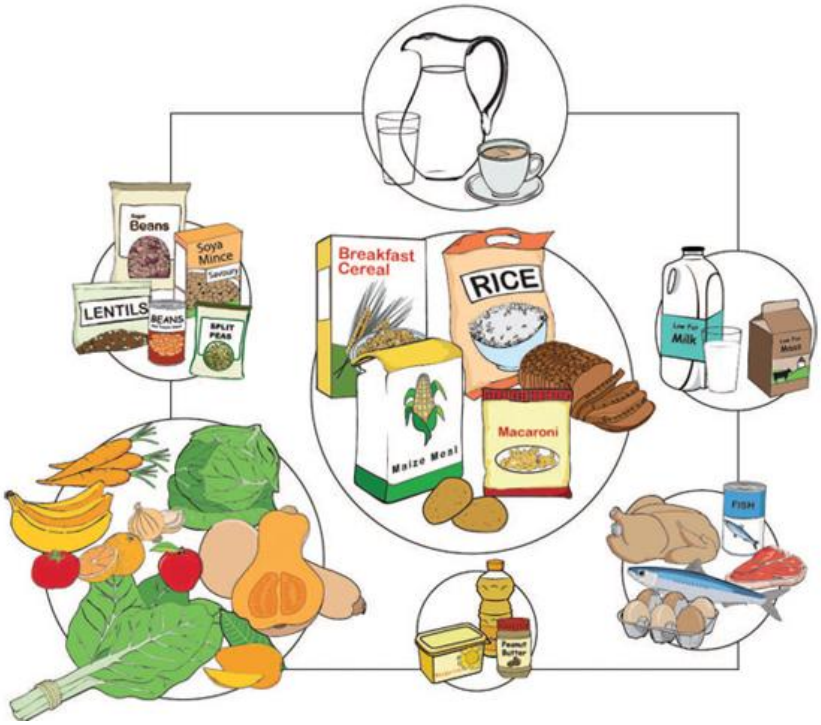

Figure 2.1: The South African food guide

The purpose of the FBDG and the new food guide[1] was to help the general public make healthier choices. However, despite the availability of these tools the rising prevalence of over- and under-nutrition indicates that these dietary guidelines were either unknown or poorly understood and as a result have had no impact on the eating patterns of consumers. This in turn had a negative effect on the choices that both adults and children were making which affected their nutritional status. (Oldewage-Theron & Napier 2011; Oldewage-Theron & Egal 2009).

2.3 Benefits of healthy food choices for children

A healthy diet gives a child a better start in life as it reduces the occurrence of long term problems, including impaired cognitive development, poorer educational achievement and a greater risk for obesity (Kimani-Murage *et al* 2010). Lytle, Eldridge, Kotz, Piper, Williams & Kalina (1997) suggested that the food choices of children will be positively affected if nutritional messages were adapted to target the appropriate age and if these messages give specific instructions on what behaviours should be followed (Lytle *et al* 1997). Research has

[1] It should be noted that the food guide has not been incorporated into the current South African nutrition education curriculum.

found that when options are made available, children as young as six years old can make their own food choices (Oosthuizen *et al* 2011b). At this age the prevalence of overweight in the USA has been seen to increase and retention of nutrition knowledge that is then put into practice could help improve this (Powers, Struempler, Guarino & Parmer 2005). Mothers are primarily responsible for the food in a household and thus children are limited in their food choices, yet prolonged contact with nutrition information has shown to improve nutritional knowledge (Oosthuizen *et al* 2011b). Good eating habits need to be developed in the early stages of life. Studies show that if healthy eating continues during adolescence there is a high possibility that these will remain into adulthood (Oosthuizen *et al* 2011b; Oldewage-Theron & Egal 2009; Perez-Rodrigo & Aranceta 2003).

In an ideal world families would make wise decisions about what they eat and parents would create a loving, supportive environment where children felt comfortable and were encouraged to try new foods and continue to eat those that are beneficial for health. These children would then be able to understand and learn more effectively at school and grow up to make their own healthy choices which would in turn have a positive influence on their children. Unfortunately in South Africa, due to broken homes, poverty and the high prevalence of food insecure households, the ideal world of healthy food choices and healthy lifestyles requires more follow through than simply producing the guidelines and hoping people will change (Crush *et al* 2011; UNDP 2010). Methods need to be developed to help take the information available in the FBDG and make it applicable to the population (SANHANES-1 2012). This may encourage a healthier generation that are able to make better food choices from a young age. NE is a means by which this can be done.

2.4 Nutrition education as a means to promote healthy food choices

NE as defined by Contento (2011, p14) is "any combination of educational strategies, accompanied by environmental support, designed to facilitate the voluntary adoption of food choices and other food and nutrition-related behaviours conducive to health and well-being". NE is increasingly being recognised as a solution to the problem of diseases of lifestyle that are occurring concurrently with underweight and stunting. Contento (2008) discusses three essential components needed for effective NE. These include:

1) Motivation component

This component allows the person to identify the benefits of taking action and helps them to see these benefits as important. Part of NE is to demonstrate the problems that may arise if action is not taken, to recognise possible reasons for these problems and then to help find ways in which these problems can be overcome. It has been found that when people feel a sense of control their self-efficacy is increased.

2) Action component

Many people will set goals to adopt healthy eating but will find acting on these intentions very difficult. Activities in this phase help to bridge the gap between intentions and actions so that changes are actually made and maintained over time. This is often referred to as goal-setting and needs to be very specific. In addition to setting goals, people need to obtain the relevant nutrition knowledge in order for their motivations to take action.

3) Environmental component

An important step in the process to facilitate easy action, this component looks at the environment in which a person is living, for example home, school and community, and aims to alter that in order to promote knowledge intake and retention. Policies often need to be written to reinforce these changes and ensure proper implementation. This is usually carried out by nutrition educators and policymakers (Contento 2008).

These three steps all centre on obtaining information and retaining it in order to make changes, thus information acquisition and retention are important components of any NE intervention. International studies have shown that NE is an accessible and effective tool in the development of healthy eating practices (Perez-Rodrigo & Aranceta 2001) and is centred on two main theories that affect how people learn. These theories need to be understood before any form of NE programme can be developed.

2.4.1 Two theories regarding how knowledge is retained

In the last 10 years, NE programmes have been divided into two different approaches (Contento, Balch, Bronner, Paige, Gross, Bisignani *et al* 1995). The first approach (knowledge-based) teaches knowledge and skills to learners in such a way that a clear understanding of nutrition concepts results in a change in their knowledge, attitudes, and thus dietary intake. The second approach (behaviour-based) is aimed at changing the choices people make in order to reduce their risks of developing non-communicable diseases such as

obesity, diabetes and heart disease. The expected outcome of this approach is to either change a specific behaviour, such as choosing to eat low fat foods rather than those high in fat, or to produce the skills needed to eventually reach a desired goal, for example, exercise more and eat a lower kilojoule diet in order to lose weight (Contento *et al* 1995).

Both the knowledge-based and behaviour-based approach have positive and negative aspects. Knowledge-based NE is useful in a school setting because it follows the same structure as the learner's other subjects and provides a broad base from which learners can use their improved knowledge to make healthier food choices. This is often not the case if only a few specific behaviours are selected and taught as in the behaviour-based approach. This can be seen by the Finish study "*From Puijo to the World with Healthy Lunches"* conducted in 2012 as part of the European Network of Health Promoting Schools (ENHPS) project. Here the researchers tested and evaluated the NE and eating habits of Grade 7 learners. Educators integrated home economics, computer science and student counselling with NE in each experimental school. Results showed that pupils in the experimental school had an increase in nutrition knowledge, as well as an improvement in their eating habits and a more regular consumption of school lunches during the intervention (Räiha, Tossavainen, Turunen, Enkenberg & Kiviniemi, 2012). Integrating nutrition into other school subjects allows for a broader scope of nutrition to be taught. This broad knowledge base helps to produces a better understanding of nutrition thereby ensuring that the behaviours being taught are relevant to the learner (Panunzio, Antoniciello, Pisano & Dalton, 2007).

Although the knowledge-based approach has its advantages further research has shown the need to include the behaviour-approach in order for greater success to be seen over the long term (Contento 2008; Powers *et al* 2005; Hoelscher, Evans, Parcel, Kelder 2002; Kandiah & Jones 2001; Sahota, Rudolf, Dixey, Hill, Barth & Cade 2001; Contento *et al* 1995; Lytle & Achtenberg 1995). Nutrition knowledge provides the understanding required to make changes in food choices; however knowledge is not always enough to promote change. For this reason behaviour-based theory places emphasis on teaching the "how" rather than the "why" to encourage behaviour change. This empowers people to move from knowing why they should make a change to actually making the change (Contento *et al* 1995). Similarly, Sapp & Jensen (1997) agreed that a person might have an excellent knowledge of "nutrition basics," but be unable to translate this knowledge into action.

A study carried out in Venezuela by García-Casal, Landaeta-Jiménez, Puche, Leets, Carvajal, Patiño & Ibarra (2011) aimed to evaluate the changes in iron, folate and retinol deficiencies after a NE intervention. Each of the 17 schools involved in the intervention wrote a pre-test, followed by six workshops, two participative talks, five game activities, one cooking course and a recipe contest. Educators were trained and then taught the learners using active involvement. The learners wrote a post-test at the end of 14 months. The prevalence of iron deficiency amongst the learners who took part showed a significant decrease (from 25% to 14%) due to a change in diet, with a slight improvement in overall nutritional status (García-*Casal et al* 2011). This shows that changes in behaviour can be seen if programmes are focused on the "how" rather than only the "why".

Another successful study was conducted by Sahota *et al* (2001) in Leeds in the UK. The specific focus was on empowering schools to implement a school action plan that they felt met the needs seen in their school. The intention of the study was not to only improve nutrition knowledge but to influence dietary patterns and physical activity behaviours as well. Questionnaires were given to parents, educators and catering staff regarding whose responsibility it was to educate on nutrition and physical activity and what they thought could be changed or implemented in the school. These were then used by each school to develop a unique action plan for their school. Results showed that 89% of action plans were achieved. Both parents and staff were actively involved and 64% of parents reported seeing positive changes in their school. As a result learners produced higher scores for knowledge and attitudes related to nutrition and physical activity, and could remember topics learnt at school and how they linked in practice (Sahota *et al* 2001).

A good understanding of nutrition concepts enables a person to convert basic knowledge into the ability to take action (Sapp & Jensen 1997). Ideally, a balance of the two theories is needed so that NE programmes are behaviourally focussed and theory driven (Contento *et al*, 1995). Therefore, having an accurate nutrition knowledge tool that focuses on the numerous factors that influence eating behaviours may be essential for helping people to convert nutrition messages into healthy eating behaviours (Contento 2008; Perez-Rodrigo & Aranceta 2003; Perez-Rodrigo, Klepp, Yngve, Sjöström, Stockley & Aranceta 2001, Perez-Rodrigo & Aranceta 2001; Sapp & Jensen 1997).

2.5 Factors influencing the development of an effective nutrition education programme

Effective NE programmes should be inventive, interactive and inexpensive to use and reproduce (Perez-Rodrigo & Aranceta 2003). The American Dietetic Association (1996) suggested that an NE programme should look at the diet as a whole rather than focusing on the specific foods a person is eating. When developing the South African FBDG Vorster *et al* (2001) also agreed that a positive approach to food should be emphasised, where food enjoyment is encouraged and statements made about food are affirmative. For example "eat lots of fruit and vegetables" is a more positive statement than "do not eat sweets" (Vorster *et al* 2001; ADA 1996). Another point raised by the ADA (1996) and supported by Vorster *et al* (2001) was that there are no "bad" foods only "bad" diets, and that the key to eating healthy is eating a variety of foods in moderation (Vorster *et al* 2001; ADA 1996).

Lytle and Achterberg (1995) identified several key elements that are important to consider when developing an effective NE programme. These include:

1. Adequate time and intensity required for the intervention to promote change;
2. Family involvement when working with younger learners;
3. Involvement of the community to enhance the school NE programme;
4. Incorporation of self-evaluation and feedback for older learners;
5. Modification of the school environment to reinforce the NE programme.

(Perez-Rodrigo & Aranceta 2003; Hoelscher *et al* 2002; Perez-Rodrigo *et al* 2001; Perez-Rodrigo & Aranceta 2001).

It is important to understand these different elements in order to be able to use them effectively. A number of studies worldwide using an NE programme of some kind have found these elements to be relevant in producing successful results (Räiha *et al* 2012; Kandiah & Jones 2010; Jackson, Mullis & Hughes 2009; Panunzio *et al* 2007; Powers *et al* 2005; Hoelscher *et al* 2002; Sahota *et al* 2001; Auld, Romaniello, Heimendinge, Hambidge & Hambidge 1998; Contento *et al* 1995). Thus the five key elements mentioned above will be further discussed in light of the international studies in order to determine practically what can be implemented in a South African setting.

2.5.1 Adequate time and intensity for change

Knowledge retention and behavioural change have been found to correlate positively with the amount of hours of teaching received (CDC 1996), thus programmes that are conducted for a longer time period with more hours of contact with the curriculum or NE tool show more positive results than those that have a shorter contact time period (Contento *et al* 1995). A minimum of 50 hours of NE per school year is the estimated amount of time required to have an impact on behaviour, yet most American schools are only spending an average of 13 hours a year on this (ADA 2003). When trying to positively influence the food choices of a learner, an NE programme should focus less on the broad facts about nutrition, and should look more at how specific eating behaviours can be changed. This requires devoting adequate time and intensity to activities that develop the skills needed to promote a change in eating behaviours (Räiha *et al* 2012; Auld *et al* 1998; Vandongen, Jenner, Thompson, Taggart, Spickett, Burke, Beilin, Mulligan & Dunbar 1995).

It is also important to provide sufficient training for educators on the topic of NE (ADA, 2003). In 2007, Italian researchers Panunzio, Antoniciello, Pisano and Dalton questioned whether a NE taught by educators would increase the intake of fruit and vegetable more successfully when compared to the same intervention done by a group of nutritionists. This study involved 521 Grade 4 learners who formed part of a 36 week programme. Educators attended a 12-week training course followed by 12 weeks of teaching the nutrition programme, while the nutritionist group did the same. Both groups produced positive results but interestingly the educator-based intervention proved more successful in promoting fruit, vegetable and legume consumption as well as decreasing the intake of chips and sugar-sweetened drinks with their learners. It was proposed that extensive, well run training for the educators resulted in the incorporation of nutrition into other lessons outside of the nutrition lesson. Educators were able to increase the intensity of the education resulting in a more profound impact on the learners' behaviour (Panunzio *et al*, 2007). Similarly, studies conducted by Kandiah & Jones (2010) in the US and Auld *et al* (1998) in the UK showed that providing adequate time and intensity to a programme produces better results. Auld *et al* (1998) was particularly successful because they incorporated the learner's family into the study.

2.5.2 Family involvement

Adding a family component has proven very helpful in conducting effective NE, specifically when dealing with younger learners (Auld *et al* 1998). These researchers implemented their intervention over four years in order to encourage behavioural change. In the fourth year a parent and community component was added to the programme as the researchers realised the importance of this in a successful intervention (Auld *et al* 1998). A literature review by Engle, Bentley & Pelto (2000) showed the importance of proper involvement from the caregiver in the feeding practices of children. The nutritional status of a child should be considered from the perspective of the family and not purely from an external place of influence (Engle *et al* 2000). In western Uganda Kabahenda, Mullis, Erhardt, Northrop-Clewes & Nickols (2011) looked at educating the caregivers of young children in order to try and reduce anaemia and improve vitamin A status in those children. Results showed a significant improvement in the children's food-selection and food variety when the caregiver was involved (Kabahenda *et al* 2011). Similarly, community involvement has been shown to have an effect on learning and behavioural change.

2.5.3 Community involvement

Some interventions that are run as part of a larger community are able to enhance NE at a school level (Perez-Rodrigo & Aranceta 2001). Often in low-income areas there is a greater sense of community among the residents and thus a community based project works well in promoting significant behavioural change. Studies conducted by Jackson *et al* (2009) and Dollahite, Hosig, Adeletti White, Rodibaugh & Holmes (1998) both found that the element of community involvement played a role in helping to encourage healthy lifestyle choices. Dollahite *et al* (1998) looked specifically at the impact of a school-based community intervention programme on nutrition knowledge and food choices in Grade 4 and 5 learners. A group from the community was formed to facilitate three different interventions among Grade R-5 learners in a local school. Post-test results showed a significant increase in knowledge and behaviour. Interestingly, the parents of the learners who took part in the intervention also showed a slight improvement in their food choice behaviour. In the study conducted by Jackson *et al* (2009) the focus was a theatre-based intervention that aimed at promoting lifestyle changes by conveying nutrition and physical activity messages in an active learning environment. The researchers found that involvement of the community

resulted in positive changes among the adolescents with regards to eating habits and nutrition knowledge. This intervention also proved successful as a result of the constant self-evaluation that was required from the adolescents during the programme (Jackson *et al*, 2009).

2.5.4 Self-evaluation

Self-assessment forms part of a Social Cognitive Theory framework and is viewed as a behavioural change technique (Contento *et al*, 1995). It is a method usually used in older learners as they have a greater ability to reason and convert abstract ideas into practical applications (Hoelscher *et al* 2002; Auld *et al*, 1998). The teenagers in the Jackson *et al* (2009) study were able to learn through performance because they were required to discuss ideas on nutrition and physical activity before each lesson and then evaluate their theatre scripts at the end (Jackson *et al* 2009). Evaluation of an intervention as a whole is important for future growth, and can help to determine ways in which the school environment can be altered to improve knowledge retention and change (Perez-Rodrigo & Aranceta 2001).

2.5.5 Modifying the school environment

Several NE interventions that have taken place in schools have included a school lunch programme as part of the overall intervention (Wall, Least, Gromis & Lohse 2012; Dollahite *et al* 1998; Powell, Walker, Chang & Grantham-McGregor 1998). A number of supplementation programmes have been run by the American government in order to help underprivileged learners get the required nutrition (ADA 2010). In the study conducted by Dollahite *et al* (1998) the researchers found that the NE programme along with a number of supplementation programmes helped to modify the canteen menu to include more healthy options which consecutively had positive effects on the learners (Dollahite *et al*, 1998). Focus also needs to be placed not only on changing the food provided by the canteen but also on changing the items sold at the tuck shop and the overall focus of the school in order to reinforce the positive health messages being taught in the classroom.

Once these elements have been considered attention needs to be given to the development of the actual tool that will be used to educate the learners and inspire behavioural change.

2.6 Developing a nutrition education tool

An NE tool is vital for effective NE as it is the driving force behind what the learners are able to learn and how much is retained (Hoelscher *et al* 2002). In both theory and practice researchers have suggested and found that including methods where learners are required to solve a practical problem has the potential to improve the long term effects of NE on knowledge retention. Examples of these problem-solving activities are word searches, cross word puzzles, matching games and role play (Oldewage-Theron & Egal 2009; Kandiah & Jones 2002). An educational strategy should be relevant to the goals set for that programme and should use culturally appropriate teaching materials that take into account current knowledge and skills of the learners (ADA 2003; Perez-Rodrigo & Aranceta 2003).

The Food and Agricultural Organization (FAO) has a framework that can assist in developing an NE tool that is scientifically based. The four areas that need to be focused on when looking to develop an NE tool are:

1) the preparation phase, where a needs assessment can be done to identify the concerns of the target population and then find out what may be causing them;
2) the formulation phase, where the outcomes of the project are developed and the methods needed to achieve these outcomes are decided on;
3) the implementation phase, where the necessary tools are developed, key participants are trained and the programme is implemented;
4) the evaluation phase, where the NE tool is examined and critiqued (Oldewage-Theron & Napier 2011; Oldewage-Theron & Egal 2009).

The development of a great tool is useless without the correct setting in which to implement it. The school environment is very effective for teaching children.

2.7 The school as a setting for nutrition education

In order to improve the numerous health issues found in adults they need to be taught healthy principles as children (Pérez-Rodrigo & Aranceta 2001), and schools provide the ideal location to create opportunities where children can be positively influenced (Powers *et al* 2005; Kandiah & Jones 2002). In the early stages of life a child is heavily dependent on the family when developing eating habits and preferences, however as they reach school age children become more independent and begin to make their own decisions about food and

eating habits. As the child moves into adolescence the area of primary influence shifts from family onto friends and social models (Powers *et al* 2005; Perez-Rodrigo & Aranceta 2003). Implementing an NE programme into a school environment ensures that NE is well received as learners must remain at school for most of the day and mandatory attendance is required of all classes. The many hours spent in this type of environment encourages focus and promotes learning (Oosthuizen *et al* 2011b). NE programmes are most effective when incorporated into the school curriculum from a young age and continued through into high school. However, this is not always possible as programmes often have unclear objectives and put further burden on educators who already have insufficient time to complete what is required of them (Park, Kim, Shin, Shin, Bae & Lee 2006; Perez-Rodrigo & Aranceta 2003). The structure and physical environment of a school, along with the educators and teaching material have enormous potential to influence a child's eating behaviours (Pérez-Rodrigo & Aranceta 2003; Pérez-Rodrigo & Aranceta 2001). Much research has been conducted using Grade 5 learners (Oosthuizen *et al* 2011a; 2011b; Baytak & Land 2010; Kandiah & Jones 2010; Lakshman, Sharp, Ong & Forouhi 2010; Powers *et al* 2005; Sahota *et al* 2001).

2.7.1 Teaching Grade 5 learners

Children in Grade 5 fall between the ages of 9 and 12 years old. At this age children are no longer fully reliant on their parents for advice, guidance and counsel, but are also not yet independent of all adult help (Perez-Rodrigo & Aranceta 2003). Thus they need to be mentored and led to self-reflect (Educational Testing Service 2008). According to The Praxis Series complied by the Educational Testing Service (ETS) in the USA, it is important to remember that Grade 5 learners come from diverse backgrounds, they all learn in different ways and they are motivated by a variety of different factors (EST 2008). These factors need to be considered by the educator in order to determine how best to help each learner to develop within the classroom environment (Powers *et al* 2005). Grade 5 learners require structure, diversity and interesting activities that stretch their thinking and encourage creativity. They need to be taught in a variety of different ways and need to incorporate all areas of learning in a single lesson (EST 2008; Powers *et al* 2005). Thus a variety of different tools have been developed both internationally and locally to ensure effective knowledge retention and behavioural change.

2.8 Nutrition education programmes used internationally

In developed countries such as Australia, the USA, Italy and Finland fitness programmes as well as teaching nutrition in a classroom setting are common, as seen by Wall *et al* (2012); García-*Casal et al* (2011); Shariff, Bukhari, Othman, Hasim, Ismail, Jamil, Kasim, Piam, Samah & Hussein (2008); Auld *et al* (1998) and Vandongen *et al* (1995). More recently, there has been a rising trend to use alternative methods as a NE tool, such as theatre performances and computers.

2.8.1 Alternative forms of nutrition education

Computer gaming among children and adolescents has become more prevalent in recent years and has increased interest in the potential of using computers as a form of nutrition education (Baytak & Land 2010). In the USA researchers Baytak and Land (2010) conducted a case study on Grade 5 learners who were tasked with developing a computer game to teach Grade 1 learners about nutrition. The process of game development was watched and was used as a measure of their understanding of nutrition. It was found that many learners became actively involved in problem solving and engaged with others by sharing ideas and helping one another. This process allows learners to take ownership of their learning by empowering them to choose what they learn and how to learn it. This in turn enables knowledge to be retained more accurately and for an extended period of time (Baytak & Land 2010).

Another recent approach with adolescents and children is the use of theatre as a means to encourage visualisation. Both Cheadle, Cahill, Schwartz, Edmiston, Johnson, Davis & Robbins (2012) and Jackson *et al* (2009) tried theatre as a way to improve knowledge on healthy eating and exercise. In the study by Jackson *et al* (2007) a drama was performed by teenagers whereas Cheadle *et al* (2012) had a show performed by professionals while the learners watched and were tested afterwards and 3 weeks later to determine if their knowledge had increased. Both studies found a much greater acceptance of healthful eating and exercise based on their increased knowledge of nutrition (Cheadle *et al* 2012; Jackson *et al* 2007).

Younger learners may battle a bit more with using theatre as a way to acquire and retain knowledge but a game or activity worksheets for this age group have shown promising results in producing change.

2.8.2 Nutrition education as a game or activity

As mentioned previously, obesity is becoming more of an issue among learners thus the focus of NE has shifted onto finding new and innovative ways to educate learners on healthy eating and exercising. In many studies the goals that are set for knowledge retention are focused on an increase in the consumption of fruit, vegetables and whole grain products, and a decrease in the intake of foods high in sugar, fat and salt (Lakshman *et al* 2010; Fahlman, Dake, McCaughtry & Martin 2008; Panunzio *et al* 2007; Auld *et al* 1998; Vandongen *et al* 1995) as well as increasing activity levels (Cheadle *et al* 2012; Wall *et al* 2012; Shariff *et al* 2008; Vandongen *et al* 1995). Kandiah & Jones (2002) conducted a study on middle-income Grade 5 learners with the focus on six general topics about nutrition. The experimental group received 45 minutes of NE, four days a week for three weeks using a variety of interactive educational tools to do so, including games and puzzles. A pre- and post-test questionnaire consisting of 25 questions was used to determine the nutrition knowledge received, and a three day food diary was kept to determine whether food choices were healthy or not. Results showed that both nutrition knowledge and compliance in meeting the Dietary Guidelines improved for the intervention group, showing a 59% increase in knowledge scores and an increase in carbohydrates and protein intake with a decrease in the intake of fat and total kilojoules.

In the United Kingdom, Lakshman *et al* (2010) conducted a study that looked specifically at using a game to improve nutrition knowledge in children. A card game called “Top Grub” was developed by Cambridgeshire Personal, Social, Health Education (PSHE) service and Health Enterprise East (HEE) using a popular children’s card game called “Top Trump”. The game focused on the nutritional content of commonly known foods and was used in combination with a “healthy eating” curriculum that incorporated cards. The intervention was carried out during nine weeks of a term and educators could choose to play the game in which ever way they wanted, without input from the researchers. During the intervention period educators were encouraged to incorporate the cards and curriculum into the school day as they felt necessary and were asked to give the cards to each child to take home for at least

one weekend. The primary outcome of improved nutrition knowledge was met as there was an improvement in the intervention groups in all categories; however, there was also an increase in the control. Some schools in the study were considered “deprived” and may have had limited resources so the researchers recommended that an intervention should be developed that did not require regular assistance from health professionals and also fitted into the school curriculum (Lakshman *et al* 2010).

An American pilot study was conducted using a bilingual Mexican-American population. The focus of the study was to determine the effectiveness of a bilingual nutrition game in increasing the number of servings of vegetables, fruit, and water consumed, and decreasing the intake in servings of sugary beverage given to learners. The game was also developed using a popular game among this community, and included local and cultural foods. The cards were written in both English and Spanish to help improve reading, and the game could be played in a few different ways and could be adjusted for time. The game was played at school at least twice a week. Food frequencies obtained from parents at home, at the beginning and end of the year allowed researchers to calculate any improvement in food intake. Results showed that there was a statistical significance in the increase in vegetables eaten by the learners. Although no other statistical significance was found, focus groups with educators confirmed that the game helped to improve food recognition in the learners (Piziak 2012). Insufficient research has been conducted on the impact of NE programmes and NE tools in South Africa, and even less recently with the implementation of the new school curriculum and FBDG (Oldewage-Theron & Napier 2011). However, those that have been done have proven successful.

2.9 Nutrition education programmes in South Africa

The presence of a good school curriculum is important to ensure that the school as a means for NE dissemination is used effectively. In South Africa the Department of Basic Education (DOE) has recently revised the school curriculum (DOE 2012).

2.9.1 The current state of the South African curriculum

In 1997 the Department of Basic Education introduced outcomes-based education as a platform for educational equality after apartheid (DOE 2011). However, a review took place in 2000 which resulted in the development of the Revised National Curriculum Statement for Grades R-9 and the National Curriculum Statement for Grades 10-12 (2002). Numerous challenges arose when executing this curriculum and so it was reviewed again in 2009 to produce the National Curriculum Statement for Grades R-12 (DOE 2011). A single comprehensive Curriculum and Assessment Policy Statement (CAPS) document was developed for each subject to replace Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines in Grades R-12. The purpose of this was to ensure that learners could obtain knowledge that could be developed into the skills that are needed for practical living (DOE 2011). The NE section of the curriculum is based on a variety of national and international teaching tools and is thus not focused on the South African FBDG. However, researchers in South Africa have developed NE programmes that include the FBDG and are aimed at lower socio-economic populations.

2.9.2 Local programmes and tools

A number of studies have been conducted in South Africa that are focused on learners using a game as a form of NE. Table 2.1 shows a breakdown of these studies and what they have found regarding NE through the use of a game. The purpose of the study conducted by Oldewage-Theron and Napier (2011) was to explain the development of an NE tool in 2007 which would later form part of an NE programme in low income Grade 1-3 learners. An activity book was developed to supplement a text book which contained information on the five food groups, the FBDG and personal hygiene. The information provided in the text book was reinforced by a number of activities in the activity book aimed at younger learners, such as word-searches, crossword puzzles, colouring in and matching words with pictures. In addition to these work books, a card game and board game was developed to further support the nutrition information. The card game contained 24 cards with a picture and message on the one side and a matching letter of the alphabet on the other side. The board game was a modified version of “Snakes and Ladders” but was called “Slides and Ladders”. In this game a ‘good for you’ message took the player up the ladder while a ‘not so good for you’ message sent a player down a slide. A food plate puzzle was also developed to teach the learners about

food groups and portion sizes, and included different types of foods to teach learners how to exchange different food items (Oldewage-Theron and Napier 2011).

Oosthuizen *et al* (2011a); Oosthuizen *et al* (2011b); Oosthuizen (2010); and Oldewage-Theron and Egal (2009) all used this game to determine its effectiveness in combination with the activity book, on learners in different areas around Gauteng. Soon after the NE tool was developed in 2007 a study was conducted by Oldewage-Theron and Egal (2009) in 88 pre-school learners. This study focused on their nutritional knowledge and also used the activity book, card game, board game and puzzle as part of the intervention. Educators were trained and learners spent four hours a week using the games and activities. Results showed a statistically significant improvement in most of the areas taught which included the importance of breakfast ($p=0.000$), the classification and function of food groups ($p=0.000$), and personal hygiene practices ($p=0.000$). Some areas showed an increase that was not significant and one question (the function of vegetable in protection against infection) showed a decrease after the intervention. However, the overall result was very good and long term follow up was recommended to determine if this increase in nutrition knowledge would remain high.

Oosthuizen *et al* (2011a) then aimed to look at the long term effects of this intervention in 9 to 13 year old learners in an informal settlement 70km south of Johannesburg. Using the NE tool designed by Oldewage-Theron and Napier in 2007, the researchers implemented a programme that ran for nine weeks of the school term once a week for 30-45 minutes. The text and activity book were used to teach from and included colouring in, word searches and crossword puzzles, while the card game, board game and puzzle were played after the lesson for a total of two hours divided up during the intervention. Short term results indicated a significant improvement in the total mean nutrition knowledge score (13.4%), however a decline was seen in the nutrition knowledge of the learners after three months. Questions related to variety, serving sizes and fat intake showed a decrease of between 0.5% and 13.7%. Overall these results were positive and indicated the ability of a well developed NE tool to improve understanding and nutrition knowledge of primary school learners (Oosthuizen, Oldewage-Theron and Napier 2011a).

Oosthuizen *et al* (2011b) also used the NE tool developed but focused on the dietary patterns of the learners rather than their knowledge alone. The study was based on an NE programme

which included the text and activity book, the card game, board game and food puzzle. It was conducted directly after school to avoid disruption of class time. The sample size included 81 learners in the experimental group and 91 learners in the control group. A total of seven hours were collectively spent teaching the nutrition information from the text book and two hours playing the games. A pre- and post-test were conducted to determine the nutrition knowledge of the learners before and after the intervention, and a 24-hour recall was used to assess the food choices of the learners. Results showed a link between the learners' knowledge of foods and their intake, for example vitamin C intake correlated to knowledge about fruit and vegetables. Altered food choices in the first seven weeks resulted in a significant improvement in protein and carbohydrate intake and a decrease in fat intake. However, nine months later many of the learners had reverted back to their old eating habits of refined sugars and fats. The researchers found that although the South African FBDG were developed to improve dietary behaviours this study did not find this positive outcome amongst children (Oosthuizen *et al* 2011b).

In 2010 Oosthuizen conducted a very similar study (n = 173) also looking at the nutritional status and nutrition knowledge of learners in a two phase intervention. A pre-test, along with a 24-hour recall and food frequency questionnaire (FFQ) were carried out in order to determine the food choices of the learners, as well as their knowledge on nutrition topics. This revealed a community consuming a diet high in carbohydrates and low in fruit and vegetables. Thus an NE programme was implemented to try and improve these results. The NE programme was conducted in the same way as the study by Oosthuizen *et al* (2011a; 2011b) and found similar results. Knowledge on serving sizes of starchy foods, dairy products and fruit and vegetables improved and an increase in fruit and carbohydrate intake was seen by the 24-hour recall and FFQ. Long term results showed improvement in some areas of knowledge such as protein but more focus needed to be given to knowledge about variety, sources of nutrients and food groups (Oosthuizen 2010).

These positive results indicate the effectiveness of a game as a tool for disseminating information and producing behavioural change in South Africa. Although implemented in a number of studies, many of these have a small sample size due to high dropout rates and thus improvements appear greater. A study with a large sample size using a game has not been tested. In addition, the use of a game tested independently of an additional curriculum or support material has also not been researched. This was a limitation of the study by

Oldewage-Theron and Egal (2009). In addition, this has not been investigated among isiZulu speaking learners (8-15 years) who make up the largest language and age group in South Africa. Thus there is a gap in knowledge.

According to the literature, there is a need for an NE tool that can be easily used in low income areas without great expense or resources on the part of the educators (Oosthuizen *et al* 2011b). Something that is culturally relevant, language and age appropriate, and is current with the South African FBDG is also required. In order to bridge this knowledge gap it is proposed that a game for Grade 5 learners can be adapted to teach rural, isiZulu speaking Grade 5 learners about nutrition in order to aim for knowledge retention and long term behavioural change.

Table 2.1: Studies conducted in South Africa using a game as a form of nutrition education for learners

Authors	Title	Objectives	Methods	Results	Conclusion
Oldewage-Theron, Napier (2011)	NE tools for primary school learners in the Vaal region.	To determine the effect of a NE tool in combination with a NE programme on Grade 1-3 learners living in a low-income areas in the Vaal region	The FAO framework for developing a NE programme was used to design and produce a NE tool suitable for primary school learners. This tool was developed to form part of an community-based NE programme and included the five food groups, the FBDG and personal hygiene	An activity book containing matching pairs and word search activities was developed, as well as a card game that has a picture and message on the one side, and a board game similar to "Slides and Ladders" with nutritional messages as the slides or the ladders.	One of the first NE tools to be developed that meets the needs of the educators and learners in a low-income area in its simplicity and cost-effectiveness. These tools should be validated by a test first before use.
Oosthuizen, Oldewage-Theron, Napier (2011a)	Impact of a NE programme on the nutrition knowledge of primary school learners.	To determine the effects of a NE programme on the nutrition knowledge of primary school learners in an informal settlement in Gauteng.	The NE programme was implemented in nine 30-45 minutes sessions and included information taught from an activity book as well as completion of related activities and games. Nutrition knowledge was collected pre- and post-intervention.	An improvement in nutrition knowledge was seen in the experimental group immediately after intervention (45.4% to 58.8%), however this did not last over the long term. Knowledge about physical activity and hygiene also improved.	Nutrition knowledge improved directly after the NE programme but long-term results indicated poor retention of knowledge. A look at dietary practices in relation to nutrition knowledge was proposed.
Oosthuizen, Oldewage-Theron, Napier (2011b)	The impact of a nutrition programme on the dietary intake patterns of primary school learners.	To determine whether a NE tool including a textbook, activity book, card and board game, and a food puzzle could be used to improve the eating habits and food choices of 9-13 year old learners in a semi-urban area.	The intervention was conducted in 2 schools for 9 weeks with 30-45 minutes lessons once a week. Nutrition knowledge and 24-hour recall were both tested pre- and post-intervention, and long term follow up was done only in the experimental group. Questions were analysed using FoodFinder3.	Although improvements were seen in the learners recognition of foods and their function there remained a poor intake of these fruit and vegetables and a high intake of high fat and high sugar foods even among the experimental group due to a large influence of mothers on food choices, and economic status.	The aim of the study was not met as the intake patterns of the learners did not change. A low intake of fruit and vegetables were still seen after intervention as well as limited variety of food items chosen on a daily basis.
Oosthuizen (2010)	Impact of a NE programme on nutrition knowledge and dietary practices of primary school learners in Biopatong.	To determine nutritional status and baseline knowledge of primary school learners, followed by the impact of an NE programme on short and long term nutrition knowledge and dietary practices.	Phase 1: conducted a 24hr-recall FFQ to establish nutrition status, and a questionnaire for knowledge. Phase 2: implemented a NE programme over 9 weeks and assessed further knowledge and nutritional status using a pre- and post-test and 24hr-recall.	Results showed a significant improvement of 13% between pre- and post-test when using the NE programme. Variety, sources of nutrients and food groups required more focus to produce long term results.	Long term knowledge retention was present in topics about milk, fat, and serving sizes of some food groups but was not always good.
Oldewage-Theron, Egal (2009)	The evaluation of a NE programme on the nutrition knowledge of learners aged six and seven years.	To evaluate the effects of an NE programme and specifically developed NE tool on the nutrition knowledge of pre-school learners in the Vaal region	Two pre-schools were trained how to use the NE tool which included a card game, a board game and a puzzle and activity book. Educators spent one hour a week on teaching and then each child played the 3 games for 1 hour each. A pre- and post-test was conducted to determine nutrition knowledge retained.	Learner's knowledge about breakfast as the most important meal of the day, the food groups and their function, and hygiene practices before eating significantly improved. Results showed an overall improvement of 18.2% of correctly answered questions by participants.	A control needed to be included and knowledge retention over a longer period should be tested in the future. Involving the caregivers in the process as a means to aid learning from home was also recommended.

2.10 Conclusion

The reviewed literature in this chapter shows that NE is very important in creating an awareness that allows people to make better food choices in order to prevent under- and over-nutrition. NE in children is becoming essential because it allows them to build a foundation based on the knowledge that they have gained at school and also enables them to become motivated to develop habits that promote a healthy dietary lifestyle. In order to do this effectively the NE programme needs to be targeted towards children between 8 and 12 years of age as this is the most successful age for promoting learning and change.

The school environment has been shown to be an extremely useful setting for implementing an NE programme. However, there is currently a lack of knowledge regarding the effectiveness of implementing an NE programmes among isiZulu-speaking people living in a rural area, and using an NE tool that focuses on the new FBGD to improve knowledge retention. This study will therefore contribute to the current lack of knowledge and this chapter has provided the basis for the next chapter which will describe the most appropriate methodology to achieve the objectives of this study.

CHAPTER 3: STUDY METHODOLOGY

In this chapter the following will be discussed: the study design; the techniques used to obtain the primary data; how the intervention tools were developed, as well as their reliability and validity. The pilot study and data analysis of the study objectives will also be addressed.

3.1 Study design

In this study a quasi-experiment was conducted to determine the effectiveness of an NE game and ESM on the retention of knowledge among rural Grade 5 learners in Sweetwaters, KZN. This method is further divided into a pre-test post-test design which is most commonly used amongst researchers in education settings. It is one of the most effective methods of determining the existence of a relationship between two established variables. It also shows clearly the intended effects verses the actual effects and allows a more accurate evaluation to take place (Reichardt 2009, p47). Although this method has its many strengths and weaknesses it can be used when ethical or practical constraints restrict randomisation required by other methods. It is the simplest experiment where results can be easily obtained and understood (Reichardt 2009, p47).

A possible disadvantage of this choice of design was that any improvement seen between the pre- and post-test may be as a result of external factors other than the intervention provided. This affects the internal validity and renders the effect bias. These threats include:

- Maturation: time would improve the sample regardless of the intervention. As Reichardt (2009, p49), a shorter time between pre- and post-test can reduce the opportunity for this threat to play a role. Therefore this study was only run for 6 weeks to reduce the chance of learners only improving as a result of the CAPS curriculum taught and not due to the use of the game or ESM.
- History: an external event could produce the same result, for example an innovative teacher or a different game or ESM. This was overcome by encouraging educators to use only the standard curriculum and the intervention during this study. It was proposed that most learners would obtain their nutrition knowledge from school and this would reduce the possibility of receiving nutrition information from outside the classroom during this time.

- Testing: The pre-test itself may affect the results. This test was validated by an expert panel to prevent any leading or cue questions which may have encouraged bias in the post-test results.
- Instrumentation: If different tests are used pre- and post-intervention then this may affect the internal validity, however in this study the same test was use for both the pre- and post-test.
- Experimental mortality: This refers to the participants that may write the pre-test and not the post-test or vice versa which may inflate the effect an intervention had on the study population. In this study all learners who did not complete both tests were excluded from the results in order to ensure accuracy (Reichardt 2009, pp48-49).

In light of school interventions another key challenge of this design is that it is impossible to isolate every learner completely making interaction with one another inevitable which could potentially taint the results (Reichardt 2009, p49). Based on the suggestions of McCarthy (2008) this challenge was overcome by placing learners in a strict testing environment where all learners were to remain silent throughout the testing process and monitored by the researcher and fieldworker to ensure no copying took place.

The pre-test post-test design is the most useful method when resources are limited and the intervention programme is fairly new or controversial (McCarthy 2008). It is effective in determining the outcome of an intervention programme and allows results to be evaluated to find possible correlations. The internal validity of this design is strong because many of the threats had been overcome. Furthermore, the pre-test was coded so learners were compared to themselves which ensured that results were not inflated (McCarthy 2008). For example if a learner who answered the pre-test poorly was then compared to another learner who answered the post-test well the improvement would appear greater, thus the necessary precautions were taken to avoid this bias.

A questionnaire was used in this study instead of an interview as they are cheaper and less time consuming. Questionnaires can reach a larger number of people and are effective if simple concepts are being questioned (Birley & Moreland 1999, p45). Another reason for using a questionnaire is that participants can remain anonymous and thus will respond more honestly (Leedy & Ormrod 2001, p197). Open and closed questions can both be used in a

questionnaire and each have different functions. An open question allows the participant to express their views freely without being limited by the answers provided, however this may result in a long, cumbersome answer which could prove irrelevant to the study (Brace 2004, p37). Closed questions are not ideal for opening up a conversation but are appropriate for written questionnaires as the answers are known beforehand and can thus be appropriately coded. These questions are quicker for the participant to answer and often preferred by respondents as they are less time consuming. Closed questions are easy to administer and cheap to process and analyse (Brace 2004, p38). Open questions are more effective when measuring attitudes whereas closed questions aim to measure behaviour (Brace 2004, p38), thus closed questions were used in developing this questionnaire.

Closed questions are further divided into multiple choice questions and Likert scales. These often make up the body of the questionnaire in order to measure attitudes. In this study the educators' attitudes towards to ESM or game were measured used a five point Likert scale of "strongly agree", "agree", "neutral", "disagree" and "strongly disagree". This is a verbal scale as it describes in words what the participant may be feeling. There are an equal number of positive and negative statements to choose from therefore a balance is maintained (Kothari 2004, p86). In this study the answers were conflated in the reuslts to represent "agree", "neutral" and "disagree" only. A limitation of this method is that it does not give a detailed idea of the respondents' opinions. This was overcome by providing space at the end of certain questions to explain any further thoughts, and educators were encouraged to share any other comments with the researcher. The advantages of this type of questioning are that it is easy to construct and more controlled as opinions are standardised by the scale. It can also be used to measure the responses to people as well as stimuli which provide a broader understanding of educators' opinions about the game as well as the learners using it (Kothari 2004, p86).

The game used in this study was original, however the study as a whole was inspired by Lakshman *et al* (2010) and Oldewage-Theron and Egal (2009) who both looked at the impact of a nutrition education game and support material on nutrition knowledge in primary school learners. UK researchers Lakshman *et al* (2010) developed a game for their study that was similar to one played by other learners. This game was tested on Grade 5 learners along with support material that aimed to supplement learning. Oldewage-Theron and Egal (2009) conducted their study in South Africa using a number of different tools, two of which

included a card game and a board game in their studies. These were used in combination with nutrition support material which was then tested in a number of primary school ages across Gauteng. Although both interventions were successful to some degree a limitation in the study by Oldewage-Theron and Egal (2009) was that the NE tools of a game and support material were used in combination and tested as one intervention thus the impact of each of the tools individually could not be measured. This study aimed to measure these tools independently to determine the more specific effect each one had on nutrition knowledge retention.

3.2 Study population and sample selection

3.2.1 Study population

The study population included all Grade 5 learners, between the ages of 9 and 12 years old, living in Sweetwaters and attending a school in this area. Grade 5 was selected as previous researchers have found it to be the age most receptive to change, where the child is no longer fully reliant on parents for advice, but is not quite yet independent of all adult help (Oosthuizen *et al* 2011b). Kandiah & Jones (2002) showed that behavioural patterns become more resistant to change after Grade 6 and thus interventions should be implemented between the ages of 8 and 12 years.

Sweetwaters was chosen as the sample area because it is a good representation of the province in terms of race and age distribution, gender, language and education levels (Stats SA 2011). In Ward 1 and 2, where all of the intervention schools in this study originated, there is a total population of 37203 people of which 37075 (99.7%) are black. The primary language is isiZulu with 98% of the population speaking this language. The age distribution in Sweetwaters has the majority of the population also falling between the ages of 5 and 19 years (n=10831, 29%). The 5-9 year old group and the 10-14 year old group make up 9.1% and 9.2% respectively. The gender distribution is about 52.1% females and 47.9% males, which also correlates very closely with the KZN figures of 53.4% females and 43.6% males (Stats SA 2011).

3.2.2 Sample Selection

The area of Sweetwaters consisted of 2 wards (Ward 1 and Ward 2) in which there were 22 schools in total with an average of 500 to 1000 learners. Nine of these were secondary schools and thus did not qualify. A few others only had classes up to Grade 4 or were situated on the outskirts of Sweetwaters and were thus not included. This left seven schools that were suitable. For the purpose of this study schools were required to have two Grade 5 classes in order for an intervention to take place. This left four schools that met the requirements and were willing to participate.

3.2.2.1 Method of sampling

The subsequent steps were followed in order to conduct the research and obtain results.

1. Suitable schools were selected from the two wards.
2. The Principals of each school were approached to obtain permission to use their school as part of the study.
3. Classes were randomly assigned as a control, ESM or game intervention as seen in Figure 3.1.
4. Consent and assent from educators, parents and learners was obtained.
5. The nutrition knowledge pre-test was conducted.
6. The ESM was given to the educators and they were trained on how to use it.
7. The game was given to the schools. Learners and educators, with the assistance a translator, were taught how to play it.
8. Six weeks later a nutrition knowledge post-test was conducted along with the educator questionnaire.

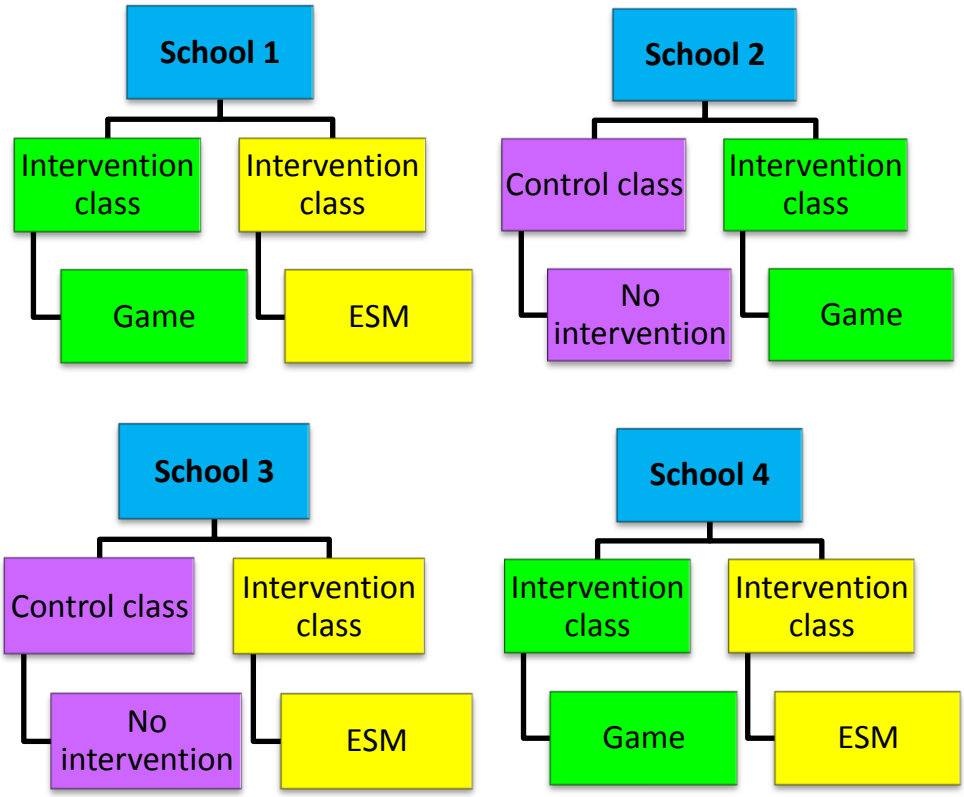

Figure 3.1: Allocation of classes into intervention and control groups

All children were encouraged to participate, provided consent and assent was obtained from them and their parent/guardian. The number of learners in each class ranged from 25 to 45 depending on the size of the school.

3.3 Survey methods and materials

3.3.1 Questionnaire development

Two different questionnaires were developed[2] in order to gain a clear understanding of the effectiveness of the game and ESM on knowledge retention surrounding nutrition. The first questionnaire was given to the learners as a pre-test to measure their baseline knowledge and again as a post-test after the intervention to determine if any knowledge had been retained because of the intervention. The second questionnaire was provided for the educators to express their opinions on the intervention they used. They were asked to evaluate the game or

[2] For the purpose of this study the first questionnaire will be referred to as the learner questionnaire; while the second will be referred to as the educator questionnaire.

ESM in terms of ease of use, effectiveness in promoting knowledge retention as well as potential use in the future. The development of each of these will now be discussed.

3.3.1.1 Learner questionnaire

For the purpose of measuring nutrition knowledge retention this questionnaire had five parts (Appendix A, p108). The overall questions in this study were developed based on the Food Based Dietary Guidelines for South Africa, and other information that the children should have learned with the new CAPS curriculum (DOE 2011). The questionnaire narrowed down the broad topic of "nutrition" into the poor eating habits that were observed in Sweetwaters and found in other rural areas. These poor eating habits include a high intake of starchy and fatty foods and a low intake a lean protein, fruit and vegetables along with limited exercise (Oosthuizen *et al* 2011b). The questionnaire was then divided into two sections with section A containing: demographic information and the learners source of prior nutrition knowledge, and section B including questions regarding nutrition knowledge. Section B was further sub-divided into four sections; FBDG knowledge, food groups, nutrient content of foods, and nutritional benefits and deficiencies. A code was assigned to the questionnaire for test-retest purposes to ensure the same learners answers could be compared. Each section was developed as follows:

Section A:
Demographic information and sources of prior nutrition knowledge – this section included questions determining the age, gender and race of the learners, as well as the source of nutrition knowledge received by learners prior to this study.

Section B:
Questions regarding nutrition knowledge – these questions made up the bulk of the questionnaire however were limited to 23 questions. This was done in order to retain the attention of the Grade 5 learners, taking into account that English was their second language. Although the learners could read, many of them read very slowly and may have required more time to understand/interpret what was being asked from them. This section was subdivided into 4 parts.

Part 1: *FBDG knowledge* – This section consisted of four questions which focused on the South African Food Based Dietary Guidelines (FBDG) that were not related to food. The

purpose of this was to determine if the learners understood that health as a whole is not only related to eating or avoiding certain foods, but involves exercise and personal hygiene as well.

Part 2: *Food groups* – This section consisted of nine questions that highlighted the different food groups contained within the FBDG. Oldewage-Theron and Napier (2011) found it necessary to include the food groups when developing their game as it made the content easier for learners to understand and remember. Consequently a similar structure was used when developing this questionnaire. The questions focused on the negative eating habits seen in children across the country in rural and semi-rural areas. These include a high intake of starchy foods and sugary foods, with a low intake of fruit, as well as a limited intake of protein rich foods (Oosthuizen *et al* 2011b; Oldewage-Theron & Egal 2009). The questions were designed to make the information "practical" by showing that the learners had not only obtained the knowledge but were also able to apply this knowledge to action. For example, instead of asking "how many fruit they should eat a day" the question asked "how they could increase their fruit intake if they had been instructed to". This forced them to think about how they could apply what they had learned if they were required to. The options given in the multiple choice answers are foods that were known and consumed regularly in their local community.

Part 3: *Nutrient content* – These questions determined which foods contained various macro- and micro-nutrients. This was included to determine if the learners could identify what nutrient specific foods contained in addition to how often these foods should be eaten and what they could do to increase or decrease the intake thereof.

Part 4: *Nutritional benefits and deficiencies* – A basic needs assessment prior to the study indicated that children and adolescents in the area where less likely to eat certain foods because they were unaware of the benefits of that food. As a result they ate the food because they were told to and stopped eating it as they got older if they did not like it. Therefore it was hypothesised that helping to provide a basic understanding of the benefits of some of the foods could produce an awareness that would encourage the consumption of less desirable foods because it would be health promoting. Thus five questions that focussed on the benefits of certain nutrients and some of the negative consequences of not consuming enough of specific nutrients were included. The micro-nutrients that were emphasised were those that

have been a focal point in South Africa for a number of years due to the previously high rate of deficiencies. These include vitamin A and iron, along with calcium as anecdotal evidence showed a large number of children having rotten teeth in this community (SANHANES-1 2013).

3.3.1.2 Educator Questionnaire

A questionnaire was developed for the educators to provide an opportunity for feedback on the ESM (Appendix B, p114) or game (Appendix C, p120) given to each educator. The questionnaire was divided into four sections: clarity of explanation, ease of use, effectiveness and a general evaluation. The first three sections were made up of a number of multiple choice questions, while the last section consisted of five questions using a Likert scale of "strongly agree to strongly disagree". The responses helped the researcher to obtain perspective on the educators' opinions of the game or ESM.

3.3.2 Development of the game

The game used in this study was developed based on a simple, popular childhood game called "Beetle Drive". In this study the game was modified and called "CAP-IT". Many children in the Sweetwaters area have played the game before and were assumed to be familiar with the concept. It was expected that the game would be played in small groups of about six to eight players in between lessons, during break, or once learners had finished their work in class. This would further reinforce what had been taught in class regarding nutrition. The game consisted of six boards to press on along with a pad of paper that contained an outline of a little Zulu boy named Jabulani (Figure 3.2). The boy was given a name to bring life and relevance to the game as he is the one who explained how to play the game in the rules that were provided (Appendix D, p126). Also included in the game was a pack of nutrition questions on cards, a dice, a pack of crayons, some clips to hold the paper onto the board (if playing outside) (Figure 3.3), and a few coloured, laminated caps (Figure 3.4) The aim of the game was to colour in Jabulani after answering a question correctly and then ultimately put a cap on his head (Figure 3.5) and shout "Cap-it!" Detailed rules are referred to in Appendix D, p126.

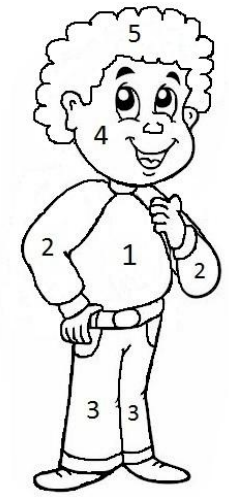

Figure 3.2: Jabulani boy

Figure 3.3: Photos of the game

Figure 3.4: Jabulani's cap

Figure 3.5: Completed Jabulani

The questions on the cards were developed using the Curriculum and Assessment Policy Statement (CAPS) and a pictorial representation was added to the back to act as a clue for a learner who did not understand the question or was unsure of the answer (Figure 3.6). This was added after the pilot study as it was found that many learners did not understand the question and the educators on the academic panel felt that adding pictures would help solve this challenge.

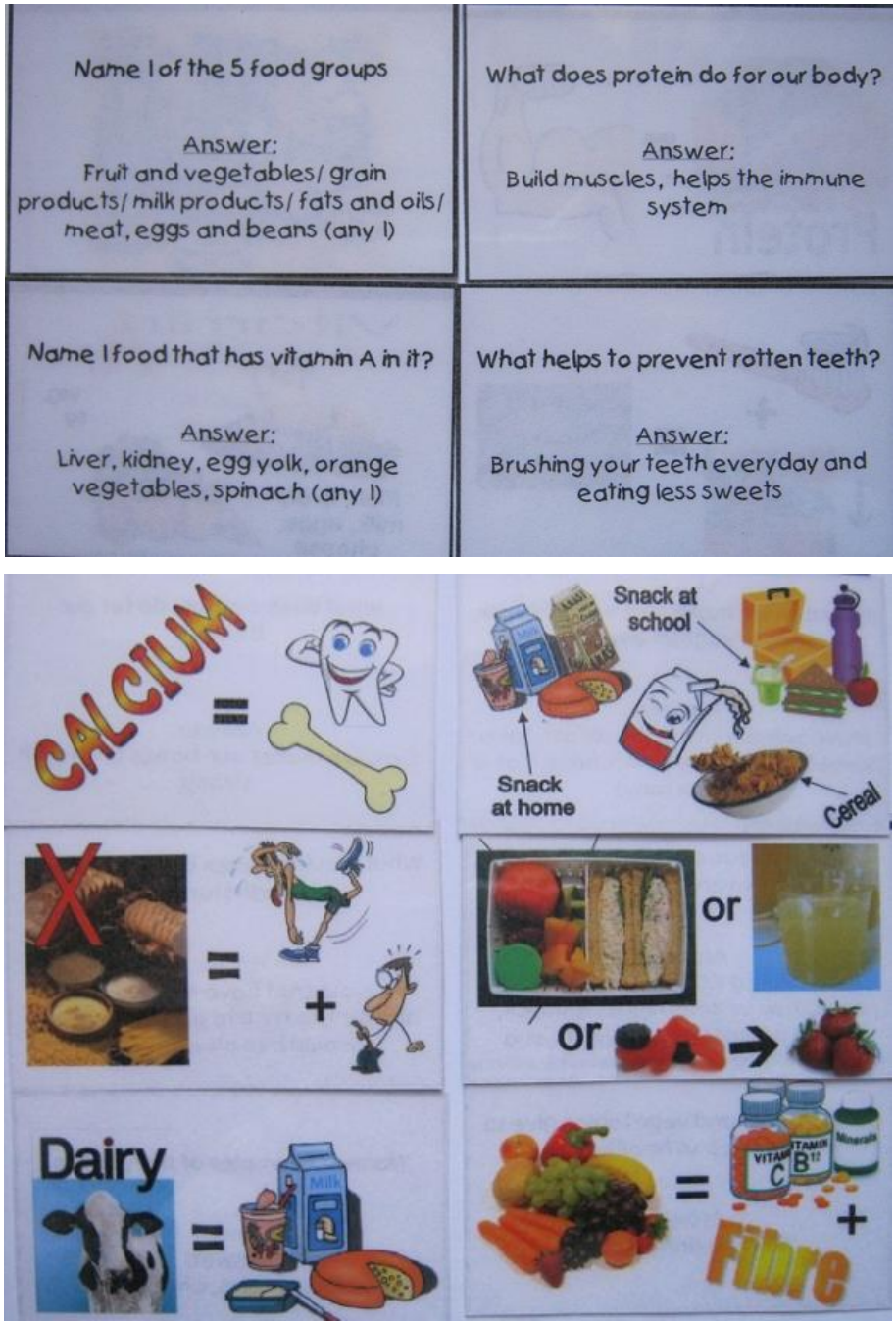

Figure 3.6: Questions and answer cards with pictorial clues on the back

3.3.3 Development of the ESM

The ESM was put together using material developed by Unilever and written by Carol Browne a consultant dietician who specialises in public health. Both Unilever and Mrs Browne gave permission for the material to be used in this study and was developed independentaly of the learner questionnaire. An information booklet was written to provide facts on health, hygiene and nutriton for educators to use when preparing lessons. The

information was based on research of the FBDG, effective ways to teach nutrition and the current South African curriculum. An activity book was also provided with tasks that were related to the information booklet. These were given to the learners to complete either in class or at home with the intention of encouraging learners to be active in the learning process in order to retain knowledge more effectively. Activities in the activity book included things such as interviewing family members about what they eat and analysing it, or performing a specific task at the shops. Both the information booklet and the activity book were explained to the educators and use of these two books was encouraged throughout the intervention.

3.3.4 Fieldworker training

A fieldworker was recruited to translate the consent letters for the parents as most parents in this area were not proficient in English and rather spoke isiZulu as their first language. The fieldworker was also required to be present, along with the researcher, when the learners did the pre- and post-tests to assist with any questions regarding the questionnaire such as a misunderstanding with the wording or sentence structure. Although learners in South Africa are currently being taught in English from Grade 5, it was their second language and certain learners in this study may have found some words or concepts difficult to interpret. The fieldworker was a third year Dietetics student at the University of KwaZulu-Natal and it was assumed that he would have had a good understanding of nutrition concepts, as well as experience in working with communities and NE. The fieldworker was trained on the basics of translating as well as the importance of translating accurately, without adding any extra information based on his personal opinion.

3.4 Data quality

3.4.1 Reliability

According to Sapp & Jensen (1997) reliability is “the extent to which a test yields the same results with repeated trials.” There are a number of things that need to be considered when constructing a reliable questionnaire. One of the challenges regarding reliability with multiple choice questions is that of “double barrel” questions, where a single question may require more than one answer, making it confusing and unreliable (Sapp & Jensen 1997). Care must also be taken to avoid establishing “cue” questions, where a question prompts the respondent

to a particular answer which can make the question biased. Both these potential issues were eliminated by the researcher and further validated by other academic staff who had expertise in questionnaire design. The researcher ensured reliability of the content as questions all fall under the same broad category of the FBDG and thus provided a good platform to test the leaner's general understanding of the FBDG. The same fieldworker was used to translate in each class.

3.4.2 Validity

A panel of experts was used in this study to assess the validity of the questionnaire. These panellists included both experts in the nutrition and education field, thus allowing for a high standard in the area of nutrition and experience in the field of teaching. Many had worked with NE for years, while others had worked specifically with Grade 5 learners and were thus able to provide a good base for assessing the quality of the questionnaire and to ensure it was suitable for a Grade 5 level.

"Validity is the extent to which a test measures what it is intended to measure" (Sapp & Jensen 1997) and this can be ensured using different methods. The group of panellists were provided with the study objectives, as well as a basic outline of the study and the study design. All panellists found that the questionnaire met the objective of testing nutrition knowledge before and after the intervention. The educator's questionnaire was also approved to provide insight into the final objective about the educators' options when using the game or the ESM. Some of the questions were phrased differently because the panel felt it was technically incorrect, while other questions were restructured or removed to ensure better clarity and understanding amongst the learners.

3.5 Pilot Study

A pilot study was conducted by the researcher and the fieldworker in order to determine if there were any problems that may have occurred while conducting the study. This took place using a similar school to those participating in the main study. The pilot study was useful to further validate the opinions of the expert panel in establishing whether the questionnaire was appropriate for that age group, and to ensure that the learners understood the purpose of the questionnaire and the questions that were asked. It also helped to refine the game as a number

of challenges were found when playing with the learners. For example, when observing the pilot study, it was found that the groups of learners participating were too big and some learners read the questions very slowly. Reducing the groups to between six to eight learners increased participation and progression of the game. Allowing those children who could read well to ask most of the questions also improved the flow and it could be seen that the learners were enjoying themselves. This pilot study resulted in many positive changes made and thus an overall improvement in the outcome of the questionnaire and game.

In terms of the learner questionnaire, it became clear in the pilot study that although these learners were being taught in English they did not have a vast understanding of the language and thus unfamiliar terms left them unsure of what the question was asking and how to answer. As a result some questions where either re-phrased in a simpler way, replaced with other questions, or removed altogether. Fear of being ridiculed may also have caused many learners to copy rather than ask for help. As a result careful attention was paid while the learners completed the learner questionnaire to ensure that there was no copying and it was made very clear that learners could ask for help at any time if they were unsure.

3.6 Data analysis

Data was analysed using the statistical software SPSS® version 21 (SPSS® Inc, Chicago, USA) with a significance value of p=0.05. All data was entered twice and checked for errors. Table 3.1 shows each objective, the methodology used to test it as well as how the data was analysed.

Table 3.1: Data analysis of objectives

Objectives	Methodology	Variables	Method of analysis
1. To determine the baseline nutrition knowledge regarding the FBDG of Grade 5 learners.	Learner questionnaire (pre-test)	• Learners' race, gender, age • Source of prior nutrition knowledge • Initial understanding of food groups and macro- and micro-nutrient content	Descriptive statistics Paired sample t-test
2. To determine whether the ESM would improve the learners' retention of nutrition knowledge surrounding FBDG.	Learner questionnaire (post-test)	• Compare nutrition knowledge before and after intervention • Determine if any knowledge has been retained surrounding nutrition.	Descriptive statistics Paired sample t-test Spearman's correlation ANOVA
3. To determine whether a nutrition education game would improve the learners' retention of nutrition knowledge surrounding FBDG.	Learner questionnaire (post-test)	• Compare nutrition knowledge before and after intervention • Determine if any retention of nutrition knowledge was seen • Evaluate the effectiveness of the game as a revision tool.	Descriptive statistics Paired sample t-test Spearman's correlation ANOVA
4. To determine the opinions of the educators on the effectiveness and ease of use of both the ESM and the nutrition education game.	Educator questionnaire	• Determine the educators' opinions about the material with regards to the ease of use • Determine the educators' opinions about the material with regards the effectiveness in promoting knowledge retention and learning.	Descriptive statistics

3.7 Ethical considerations

Written consent was obtained from the School Principal, the Grade 5 educators, the parent/guardian of the learner and the written assent from learners themselves. Only learners with both assent and consent were allowed to participate in the study. A copy of the letter of permission, consent and assent forms can be found in Appendix E, p127. An isiZulu version of the parent's consent is included in this appendix. Ethical clearance was obtained from the Human Social Sciences Ethics Committee of the University of KwaZulu-Natal and permission to use the schools was obtained from the Department of Basic Education. A copy of the ethical clearance approval letter for this study from the UKZN (reference number HSS/0747/012M) and permission letter from the DOE (reference number 2/4/8/453) can be found in Appendix F, p137 and Appendix G, p138.

3.8 Summary

This study was designed to determine the knowledge retention of Grade 5 learners in a rural to semi-rural area by using a quasi-experiment. Grade 5 classes were either given a game, ESM or remained as a control and learners completed a nutrition knowledge pre- and post-test. The educators were also asked to complete a questionnaire evaluating the use of the game in terms of its ease of use, effectiveness and usefulness. The data was collated and analysed using SPSS with descriptive statistics, a paired sample t-test, Pearson's correlations and ANOVA. All questionnaires were validated. The results of the learner questionnaire and the educator questionnaire will be presented in the following chapter.

CHAPTER 4: RESULTS

This chapter will focus on presenting the characteristics of the sample and the results from the data analysis of the pre- and post-tests; as well as the outcome of the ESM. The data will focus on the ESM group, the game group and the control group individually and then look at each in combination to determine if there were any similarities or correlations. The educators' opinions surrounding the questionnaire will also be discussed as part of the analysis of the game and ESM.

4.1 Sample characteristics

4.1.1 Demographics

Three hundred learners were approached and all of them returned their consent and assent forms signed. Of these, nine learners either left the school or were absent for both tests and were thus excluded from the study. Another 25 learners were absent on either one of the test days and therefore their answers were removed from the data set leaving the total number of participants as 266. The learners were then divided into an intervention group or control group. The game group consisted of 89 learners, the ESM group included 97 while 80 learners made up the control group. All learners came from the same area and attended similar schools. The participants all belonged to the Black (African) race group. The study population included 53.8% males (n=141) and 46.2% females (n=121). The mean age was 10.70 years old with a standard deviation (SD) of ±1.054. Most of the learners were either 10 or 11 years old (38.8% and 29.7% respectively), while the 9 and 12 year old learners made up another 27.2% combined. Interestingly, a small number of learners (4.3%) were over 12 years old which is unexpected for Grade 5. The minimum and maximum ages were 8 and 15 years respectively.

4.1.2 Learners previous exposure to nutrition information

Learners were asked to indicate where they had previously been exposed to nutrition information. Most of the learners responded that school was their only source of nutrition information (57.7%, n=153), while 15.8% (n=42) had heard a talk at a clinic and a very small

percent (7.2%, n=19) had read a pamphlet on nutrition. Interestingly, 19.2% (n=51) of the learners said that they had never learned about nutrition before.

4.2 Results of the statistical analysis of the variables

A pre- and post-test was done to determine the nutrition knowledge of the learners before and after either the game or ESM intervention. If the overall score or the score for an individual question remained the same it was assumed that there was retention of knowledge, whereas if the scores between pre- and post-test increased an improvement in knowledge was assumed. If a learner's score decreased then it was assumed that deterioration in knowledge had occurred[3].

4.2.1 The baseline nutrition knowledge of Grade 5 learners regarding the FBDG

The pre-test (Appendix A, p108) was done to determine the baseline nutrition knowledge levels of the learners before any intervention was implemented. The learners were required to answer 23 questions, which were then subdivided into four different sections; FBDG knowledge, food groups, nutrient content and nutritional benefits and deficiencies. Each section held a different number of questions and focused on a range of topics within the FBDG. The mean, as well as the minimum, maximum and standard deviation for each group in the pre-test is presented in Table 4.1. It can be seen that the overall mean score was 7.16 out of 23 (31.1%), with a SD of ±2.130. The minimum and maximum scores out of 23 were 2 (8.7%) and 17 (73.9%) respectively.

The overall mean score for "FBDG knowledge" was 2.56 ±1.08 out of 4 (64%), while the overall mean score for the "food groups" section was 2.41 ±1.12 out of 9 (26.8%). The overall mean score of the "nutrient content" section was 25.2% (1.26 ±0.92 out of 5), and the "nutritional benefits and deficiencies" section had an overall mean score of 18.6% (0.93 ±0.769 out of 5).

[3] It will be assumed that an increase in knowledge implies that learners retained and improved their knowledge

Table 4.1: Baseline nutrition knowledge scores obtained by all learners for the pre-test (n=266)

	Number of learners	Number of questions	Minimum score		Maximum score		Mean		Std deviation
			N	%	n	%	n	%	
Total score	266	23	2	8.7	17	73.9	7.16	31.1	2.130
FBDG knowledge	266	4	0	0.0	4	100	2.56	64.0	1.084
Food groups	266	9	0	0.0	6	66.7	2.41	26.8	1.120
Nutrient content	266	5	0	0.0	4	80.0	1.26	25.2	0.921
Nutritional benefits and deficiencies	266	5	0	0.0	3	60.0	0.93	18.6	0.769

The baseline scores for the pre-test are broken down even further into individual questions and are shown in Table 4.2. In the first few questions more than 50% of the learners answered correctly however as the questions became more difficult the number of correct responses decreased. Some questions have very few correct answers such as “What does this logo stand for?” where only 11 learners answered correctly (4.1%) out of a possible 266. Other questions that very few learners answered correctly included: “How can you eat more fruit and vegetables everyday if you need to?”, “What are examples of sugary foods?” and “What are some examples of foods that have a lot of fat in them?” where only 12 (4.5%), 15 (5.6%) and 14 (5.3%) learners respectively, from the whole group answered correctly.

Table 4.2: Individual questions showing the number of learners who answered correctly versus incorrectly (n=266)

		Correct		Incorrect	
		(n)	(%)	(n)	(%)
FBDG Knowledge (Multiple Choice)					
Q1	What does "eat a variety of foods mean"?	**172**	64.7	94	35.3
Q2	How much water do learners need to drink every day?	**147**	55.3	119	44.7
Q3	Do you think it is important to exercise?	**174**	65.4	92	34.6
Q4	What are good examples of exercise?	**188**	70.7	78	29.3
	Average for the FBDG knowledge questions	170	64.0	96	36.0
Food Groups Knowledge (Multiple Choice)					
Q5	Which foods are high in starch?	**163**	61.3	103	38.7
Q6	How often should we eat starchy foods every day?	126	47.4	140	52.6
Q7	What does this logo stand for?	11	4.1	255	95.9
Q8	How could you include more plant proteins into your diet?	48	18.0	218	82.0
Q9	Do you have to eat fish, chicken, lean meat or eggs every day?	**164**	61.7	102	38.3
Q10	How can you eat more fruit and vegetables every day?	12	4.5	254	95.5
Q11	What are examples of sugary foods?	15	5.6	251	94.4
Q12	What are examples of foods that have a lot of fat in them?	14	5.3	252	94.7
Q13	How often should we have milk, maas or yoghurt?	89	33.5	177	66.5
	Average score for the food groups questions	71	26.8	195	73.2
Nutrient Content Knowledge (Multiple Choice)					
Q14	Which foods contain vitamin A?	**145**	54.5	121	45.5
Q15	What is the main food source of calcium?	37	13.9	229	86.1
Q16	Which group of foods contain the most iron?	64	24.1	202	75.9
Q17	In which group of foods do we find the most protein?	60	22.6	206	77.4
Q18	What can we do to reduce our saturated fat intake?	28	10.5	238	89.5
	Average score for the nutrient content questions	67	25.1	199	74.9
Nutritional Benefits and Deficiencies Knowledge (Multiple Choice)					
Q19	What is the function of vitamin A in the body?	55	20.7	211	79.3
Q20	What does protein do for our body?	89	33.5	177	66.5
Q21	What would happen if we did not eat enough starches?	17	6.4	249	93.6
Q22	What vitamin/mineral helps to prevent weak bones & teeth?	46	17.3	220	82.7
Q23	What do you get from fruit and vegetables?	41	15.4	225	84.6
	Average score for nutrient benefits and deficiencies questions	50	18.7	216	81.3

Items in bold indicate questions with the greatest number of correct answers

Overall it can be seen that the learners' nutrition knowledge at baseline was not very good. The best answered question was question 4, "What are good examples of exercise?" where 70.8% (n=189) learners answered correctly.

4.2.2 Post-test nutrition knowledge of learners after the ESM intervention

The ESM intervention did not show any improvement but rather a decline in the learner's overall mean knowledge score as can be seen by Table 4.3. The overall mean knowledge pre-test total was 29.8% (6.85 ±1.95) and this decreased to 28.8% (6.63 ±2.52) after the post-test. The minimum and maximum scores also decreased to 2 (8.7%) and 13 (56.5%) respectively.

Table 4.3: Total nutrition knowledge scores for the ESM group post-test (n=97)

	Number of learners	Number of questions	Minimum score		Maximum score		Mean		Std deviation
			n	%	n	%	n	%	
Pre-test	97	23	3	13.0	14	60.9	6.85	29.8	1.954
Post-test	97	23	2	8.7	13	56.5	6.63	28.8	2.522

A Spearman's correlation coefficient was used to determine the relationship between the pre- and post-test scores for the ESM and a weak correlation was shown (rho=0.146, n=97, p=0.154). In addition a paired-sample t-test was conducted and showed no statistically significant increase in the total nutrition knowledge scores from ESM pre-test (6.85 ±1.954) to ESM post-test (6.63 ±2.522), t(96)=0.71, p=0.485 (two-tailed).

The sub-sections for the ESM were examined for improvement and the results are displayed in Table 4.4. The first two sections showed no improvement, however, the nutrient content section and the nutritional benefits and deficiencies section showed a 1.1% and 3% increase in scores between pre-and post-test. When a paired sample t-test was conducted to determine statistical significance using $p<0.05$ it was seen the FBDG knowledge section had a p-value of p=0.036 indicating significance. However, when the pre-test mean (2.35 ±1.090) was compared with the post-test mean (2.00 ±1.216) it revealed that there was a decrease in scores rather than an increase, thus the statistical significance in this case showed deterioration rather than an improvement. The other sections, where the post test scores increased slightly, did not show any significant changes (Table 4.5).

Table 4.4: Total nutrition knowledge scores for each section of the ESM group post-test (n=97)

		Number of questions	Min score		Max score		Mean		Std deviation
			n	%*	n	%	n	%	
FBDG knowledge	Pre-test	4	0	0.0	4	100	2.35	58.8	1.090
	Post-test	4	0	0.0	4	100	2.00	50.0	1.216
Food groups	Pre-test	9	0	0.0	5	55.6	2.21	24.6	1.060
	Post-test	9	0	0.0	5	55.6	2.07	23.0	1.184
Nutrient content	Pre-test	5	0	0.0	4	80.0	1.26	25.2	0.905
	Post-test	5	0	0.0	4	80.0	1.33	26.6	0.921
Nutritional benefits and deficiencies	Pre-test	5	0	0.0	3	60.0	1.03	20.6	0.783
	Post-test	5	0	0.0	4	80.0	1.18	23.6	0.890

*This percentage indicates the score calculated from the number of questions in each section.

Table 4.5: The significance of each of the questionnaire sections for the ESM group before and after intervention (n=97)

	Mean before (±SD)	Mean after (±SD)	t	df	Sig. (2-tailed)
FBDG knowledge	2.35 (±1.090)	2.00 (±1.216)	2.122	96	0.036
Food group	2.21(±1.060)	2.07(±1.184)	0.862	96	0.391
Nutrient content	1.26 (±0.905)	1.33 (±0.921)	-0.610	96	0.544
Nutritional benefits and deficiencies	1.03 (±0.783)	1.18 (±0.890)	-1.212	96	0.228

The ESM showed that 43.5% of the questions (10 questions) improved from pre- to post-test. Only one question in the FBDG knowledge section showed an improvement of 10.3%, while 4 out of the 9 questions in the food group section showed an improvement. These questions were those on the fortification logo (3.1% improvement), how to include plant proteins into the diet (8.3%), foods high in fat (12.4%), and how often to consume dairy (5.2%). The questions that showed an improvement in the nutrient content section were the food source of calcium (5.1%) and classifying foods containing protein (18.5%). The nutritional benefits and deficiencies section showed an increase in 3 out of the 5 questions, with the function of vitamin A, the function of starch and the function of calcium increasing by 4.1%, 20.6% and 4.1% respectively. Table 4.6 shows the number of correct answers pre- and post-test, with all the questions showing an improvement highlighted in bold. A paired sample t-test was conducted and any questions that showed a significant result were tabulated and presented in

Table 4.7. Only three questions showed a significant increase in results between pre- and post-test. Question 12 looked at foods high in fat (p=0.002), question 17 asked about sources of protein (p=0.006) and question 21 focused on the function of starch (p=0.000).

Table 4.6: A comparison between the number of learners from the ESM group who answered correctly (n=97)

		Pre-test		Post-test	
		n	%	n	%
FBDG Knowledge (Multiple Choice)					
Q1	What does "eat a variety of foods mean"?	61	62.9	50	51.5
Q2	How much water do learners need to drink every day?	48	49.5	43	44.3
Q3	Do you think it is important to exercise?	53	54.6	**63**	**64.9**
Q4	What are good examples of exercise?	66	68.0	38	39.2
Food Groups Knowledge (Multiple Choice)					
Q5	Which foods are high in starch?	49	50.5	40	41.2
Q6	How often should we eat starchy foods every day?	47	48.5	36	37.1
Q7	What does this logo stand for?	6	6.2	**9**	**9.3**
Q8	How could you include more plant proteins into your diet?	10	10.3	**18**	**18.6**
Q9	Do you have to eat fish, chicken, lean meat or eggs every day?	61	62.9	44	45.4
Q10	How can you eat more fruit and vegetables every day?	5	5.2	4	4.1
Q11	What are examples of sugary foods?	9	9.3	6	6.2
Q12	What are examples of foods that have a lot of fat in them?	3	3.1	**15**	**15.5**
Q13	How often should we have milk, maas or yoghurt?	24	24.7	**29**	**29.9**
Nutrient Content Knowledge (Multiple Choice)					
Q14	Which foods contain vitamin A?	52	53.6	43	44.3
Q15	What is the main food source of calcium?	16	16.5	**21**	**21.6**
Q16	Which group of foods contain the most iron?	22	22.7	18	18.6
Q17	In which group of foods do we find the most protein?	18	18.6	**36**	**37.1**
Q18	What can we do to reduce our saturated fat intake?	14	14.4	11	11.3
Nutritional Benefits and Deficiencies Knowledge (Multiple Choice)					
Q19	What is the function of vitamin A in the body?	22	22.7	**26**	**26.8**
Q20	What does protein do for our body?	39	40.2	25	25.8
Q21	What would happen if we did not eat enough starches?	7	7.2	**27**	**27.8**
Q22	What vitamin/mineral helps to prevent weak bones & teeth?	13	13.4	**17**	**17.5**
Q23	What do you get from fruit and vegetables?	19	19.6	19	19.6

Items in bold indicate an improvement from pre- to post-test

Table 4.7: Questions in the ESM group that showed a significant increase in knowledge (n = 97)

		Mean before	Mean after	t	df	Sig.(2-tailed)
Q4	What are good examples of exercise?	0.68	0.39	4.302	96	0.000
Q9	Do you have to eat fish, chicken, lean meat or eggs every day?	0.63	0.45	2.673	96	0.009
Q12	What are some examples of foods that have a lot of fat in them?	0.03	0.15	-3.133	96	**0.002**
Q17	In which group of foods do we find the most protein?	0.19	0.37	-2.808	96	**0.006**
Q20	What does protein do for our body?	0.40	0.26	2.150	96	0.034
Q21	What would happen if we did not eat enough starches?	0.07	0.28	-3.911	96	**0.000**

Items in bold indicate a significant improvement from pre- to post-test

4.2.3 Post-test nutrition knowledge of learners after the game intervention

The overall mean knowledge score for the game increased to 35.5%, with a minimum score of 3 and a maximum score of 16 out of 23 (2.2% increase). A 4.3% improvement was seen in the minimum score. Table 4.8 shows the mean, standard deviation, minimum and maximum score for both the pre- and post-test. In order to determine the significance of this increase in the overall mean knowledge score a paired-sample t-test was conducted. This allowed the impact of the nutrition education game on the nutrition knowledge of Grade 5 learners to be critically evaluated. No statistically significant increase was seen between the overall mean nutrition knowledge scores from the pre-test (7.65 ±2.346) and the post test (8.17 ±2.916), t(88)=-1.543, p=0.126 (two-tailed).

Table 4.8: Total nutrition knowledge scores for the game group post-test (n=89)

	Number of learners	Number of questions	Minimum score		Maximum score		Mean		Std deviation
			n	%	n	%	n	%	
Pre-test	89	23	2	8.7	17	73.9	7.65	33.3	2.346
Post-test	89	23	3	13.0	16	69.6	8.17	35.5	2.916

Three of the sections in the post-test showed an improvement in the mean score. The food groups section increased to 31.4% (2.83 ±1.308), the nutrient content section increased to 31.6% (1.58 ±1.0852), and the nutritional benefits and deficiencies section showed a 5.2% (from 0.78 to 1.04) increase (Table 4.9). There was, however, a decrease in the FBDG

knowledge section from 2.81 ±1.086 (70.3%) to 2.70 ±1.049 (67.5%). Most of the maximum scores remained fairly similar.

When looking at the significance of these increases another paired sample t-test was conducted using the pre- and post-test scores for each section. Table 4.10 shows the statistically significant increase in the knowledge of nutritional benefits and deficiencies from pre-test 15.6% (0.78 ±0.794) to post-test 20.8% (1.04 ±0.904). The other sections in the table showed no significant difference despite their increases.

Table 4.9: Total nutrition knowledge scores for each section of the game post-test (n=89)

		Number of questions	Min score		Max score		Mean		Std deviation
			n	%	n	%	n	%	
FBDG knowledge	Pre-test	4	0	0.0	4	100	2.81	70.3	1.086
	Post-test	4	0	0.0	4	100	2.70	67.5	1.049
Food groups	Pre-test	9	0	0.0	6	66.7	2.62	29.1	1.211
	Post-test	9	0	0.0	6	66.7	2.83	31.4	1.308
Nutrient content	Pre-test	5	0	0.0	4	80.0	1.45	29.0	0.954
	Post-test	5	0	0.0	4	80.0	1.58	31.6	1.085
Nutritional benefits and deficiencies	Pre-test	5	0	0.0	3	60.0	0.78	15.6	0.794
	Post-test	5	0	0.0	4	80.0	1.04	20.8	0.940

Table 4.10: The significance of each of the sections for the game group before and after intervention (n=89)

	Mean before (±SD)	Mean after (±SD)	t	df	Sig. (2-tailed)
FBDG knowledge	2.81 (±1.086)	2.70 (±1.049)	0.784	88	0.435
Food group	2.62 (±1.211)	2.83 (±1.308)	-1.135	88	0.259
Nutrient content	1.45 (±0.954)	1.58 (±1.085)	-0.909	88	0.366
Nutritional benefits and deficiencies	0.78 (±0.794)	1.04 (±0.940)	-2.165	88	**0.033**

Items in bold indicate a significant improvement from pre- to post-test

The individual questions for the game revealed that more than half of the questions increased in the final score. Table 4.11 shows each of the questions with the corresponding number of learners who answered correctly (n and %) for the pre- and post-test. Those questions where the number of correct answers post-test is larger than the number of correct answers pre-test indicated an improvement in knowledge scores. In the first section the questions regarding

water consumption showed a 6.7% increase, while questions about starchy food, the fortification logo, fruit and vegetables, sugary foods and fatty foods saw an increase of 2.2%, 30.4%, 3.4%, 13.5% and 10.1% respectively in the food group section. The nutrient content section had 3 questions that showed improvement; the question about sources of calcium (23.6% post-test), foods containing iron (33.7% post-test) and ways to reduce saturated fat (12.4% improvement). In the final section only one question did not show an improvement while the rest (function of vitamin A, starch, calcium, and fruit and vegetables) showed an increase of between 3% and 9%.

The question about the fortification logo showed the biggest improvement overall, and when tested using a paired sample t-test was shown to be statistically significant ($p=0.000$). The questions in Table 4.12 are those questions that showed statistically significant improvement or deterioration. Those questions where the mean of the pre-test is smaller than the mean of the post-test are positively significant, while those questions where the mean is larger before intervention show a statistically significant decrease in their knowledge scores. As can be seen by Table 4.12, the questions asking about sugary foods ($p=0.001$), foods high in fat ($p=0.028$) and ways to reduce saturated fat intake ($p=0.011$) also showed statistically significant improvements.

Table 4.11: The number of learners who answered correctly and the related percentage for the game group (n=89)

		Pre-test		Post-test	
		n	%	n	%
FBDG Knowledge (Multiple Choice)					
Q1	What does "eat a variety of foods mean"?	63	70.8	50	56.2
Q2	How much water do learners need to drink every day?	50	56.2	**56**	**62.9**
Q3	Do you think it is important to exercise?	72	80.9	69	77.5
Q4	What are good examples of exercise?	65	73.0	65	73.0
Food Groups Knowledge (Multiple Choice)					
Q5	Which foods are high in starch?	62	69.7	45	50.6
Q6	How often should we eat starchy foods every day?	34	38.2	**36**	**40.4**
Q7	What does this logo stand for?	1	1.1	**28**	**31.5**
Q8	How could you include more plant proteins into your diet?	24	27.0	22	24.7
Q9	Do you have to eat fish, chicken, lean meat or eggs every day?	57	64.0	54	60.7
Q10	How can you eat more fruit and vegetables every day?	5	5.6	**8**	**9.0**
Q11	What are examples of sugary foods?	2	2.2	**14**	**15.7**
Q12	What are examples of foods that have a lot of fat in them?	5	5.6	**14**	**15.7**
Q13	How often should we have milk, maas or yoghurt?	43	48.3	31	34.8
Nutrient Content Knowledge (Multiple Choice)					
Q14	Which foods contain vitamin A?	50	56.2	48	53.9
Q15	What is the main food source of calcium?	13	14.6	**21**	**23.6**
Q16	Which group of foods contain the most iron?	27	30.3	**30**	**33.7**
Q17	In which group of foods do we find the most protein?	34	38.2	26	29.2
Q18	What can we do to reduce our saturated fat intake?	5	5.6	**16**	**18.0**
Nutritional Benefits and Deficiencies Knowledge (Multiple Choice)					
Q19	What is the function of vitamin A in the body?	15	16.9	**22**	**24.7**
Q20	What does protein do for our body?	22	24.7	21	23.6
Q21	What would happen if we did not eat enough starches?	5	5.6	**12**	**13.5**
Q22	What vitamin/mineral helps to prevent weak bones & teeth?	16	18	**19**	**21.3**
Q23	What do you get from fruit and vegetables?	11	12.4	**19**	**21.3**

Items in bold indicate an improvement from pre- to post-test

Table 4.12: Questions in the game group that showed a significant increase in knowledge

		Mean before	Mean after	t	df	Sig. (2 tailed)
Q1	What does "eat a variety of foods mean"?	0.71	0.56	2.247	88	0.027
Q5	Which foods are high in starch?	0.70	0.51	2.616	88	0.010
Q7	What does this logo stand for?	0.01	0.31	-5.886	88	**0.000**
Q11	What are examples of sugary foods?	0.02	0.16	-3.391	88	**0.001**
Q12	What are some examples of foods that have a lot of fat in them?	0.06	0.16	-2.231	88	**0.028**
Q18	What can we do to reduce our saturated fat intake?	0.06	0.18	-2.604	88	**0.011**

Items in bold indicate knowledge retention

The relationship between the answers in the pre- and post-test was investigated using Spearman's correlation coefficient, but there was no strong correlation between pre- and post-test scores for any of the significant questions (rho<0.3 for all indicating a small correlation only). There was however, a medium, positive correlation between the total pre-test score and the total post-test score for the game (rho=0.296, n=89, p<0.005) with high scores in the pre-test associated with high scores in the post-test. These results differ from those in the control.

4.2.4 Post-test nutrition knowledge of learners in the control group

The overall mean nutrition knowledge score for the control was 7.79 ±2.680 (33.9%) out of 23. Minimum scores remained the same after the post-test while maximum scores increased slightly from 60.9% to 65.2%. Table 4.13 shows the comparison between the pre- and post-test for the control. The results of a paired sample t-test for the overall mean knowledge score before and after intervention indicate a significant increase in the scores pre- and post-test from 30.4% (7.00 ±2.006) to 33.9% (7.79 ±2.680).

Table 4.13: Total nutrition knowledge scores for the control group post-test (n=80)

	Number of learners	Number of questions	Minimum score		Maximum score		Mean		Std deviation
			n	%	n	%	n	%	
Pre-test	80	23	2	8.7	14	60.9	7.00	30.4	2.006
Post-test	80	23	2	8.7	15	65.2	7.79	33.9	2.680

Three sections of the control showed an improvement in mean knowledge scores while the FBDG knowledge section showed retention of knowledge as the mean score remained the

same even after the post-test (2.45, 63.5%). The standard deviations differed with the pre-test (±1.030) and the post-test (±1.158) thus indicating a closer range of scores for the pre-test. The food group section, nutrient content section and nutritional benefits and deficiencies section all increase with a total mean percent of 28.9%, 29.6% and 23.2% respectively (Table 4.14). A paired sample t-test was conducted to determine any significant increase and this is displayed in Table 4.15. Results show a significant increase in only one of the four sections, namely nutrient content, which showed a significance of p=0.003.

Table 4.14: Total nutrition knowledge scores for each section of the control group post-test (n=80)

		Number of questions	Min score		Max score		Mean		Std deviation
			n	%	n	%	n	%	
FBDG knowledge	Pre-test	4	0	0.0	4	100	2.54	63.5	1.030
	Post-test	4	0	0.0	4	100	2.54	63.5	1.158
Food groups	Pre-test	9	0	0.0	6	66.7	2.44	27.1	1.054
	Post-test	9	0	0.0	6	66.7	2.60	28.9	1.383
Nutrient content	Pre-test	5	0	0.0	4	80.0	1.04	20.8	0.863
	Post-test	5	0	0.0	4	80.0	1.48	29.6	0.993
Nutritional benefits and deficiencies	Pre-test	5	0	0.0	3	60.0	0.99	19.8	0.703
	Post-test	5	0	0.0	3	60.0	1.16	23.2	0.803

Table 4.15: The significance of each of the sections for the control group pre-test and post-test (n=80)

	Mean before (±SD)	Mean after (±SD)	t	df	Sig. (2-tailed)
FBDG knowledge	2.54 (±1.030)	2.54 (±1.158)	0.000	79	1.000
Food group	2.44 (±1.054)	2.60 (±1.383)	-0.911	79	0.365
Nutrient content	1.04 (±0.863)	1.48 (±0.993)	-3.054	79	**0.003**
Nutritional benefits and deficiencies	0.99 (±0.703)	1.16 (±0.803)	-1.693	79	0.094

Items in bold indicate a significant improvement from pre- to post-test

The individual questions in the control were fairly well answered with learners giving correct answers for 13 of the 23 questions (56.5%) in the post-test (Table 4.16). The question in the FBDG knowledge section about variety increased from 60% to 71.3%, while question in the food groups section ranged from a 1.3% increase to a 17.5% increase from pre- to post-test. In the nutrient content section all the questions improved except the question about sources of

vitamin A which decreased by 7.5%. In the nutritional benefits and deficiencies sections the function of protein, the function of starch and the function of fruit and vegetables all saw an improvement of 3.8%, 12.5% and 2.5% respectively. When examining the statistical significance of all the questions that showed an improvement it can be seen that five of the questions showed a significant improvement. Questions 10 which asked how to eat more fruit and vegetables had a p-value of 0.000, while question 11 looked at sugary foods (p=0.017) and question 16 asked about foods that contain iron (p=0.015). Question 17 and 21 which looked at the sources of protein (p=0.000) and the function of starch (p=0.012) also improved significantly (Table 4.17).

Table 4.16: The number of learners who answered correctly per question and the related percentage for the control group (n=80)

		Pre-test		Post-test	
		n	%	n	%
FBDG Knowledge (Multiple Choice)					
Q1	What does "eat a variety of foods mean"?	48	60.0	**57**	**71.3**
Q2	How much water do learners need to drink every day?	49	61.3	47	58.8
Q3	Do you think it is important to exercise?	49	61.3	48	60.0
Q4	What are good examples of exercise?	57	71.3	51	63.8
Food Groups Knowledge (Multiple Choice)					
Q5	Which foods are high in starch?	52	65.0	43	53.8
Q6	How often should we eat starchy foods every day?	45	56.3	31	38.8
Q7	What does this logo stand for?	4	5.0	5	6.3
Q8	How could you include more plant proteins into your diet?	14	17.5	**20**	**25.0**
Q9	Do you have to eat fish, chicken, lean meat or eggs every day?	46	57.5	**55**	**68.8**
Q10	How can you eat more fruit and vegetables every day?	2	2.5	**16**	**20.0**
Q11	What are examples of sugary foods?	4	5.0	**14**	**17.5**
Q12	What are examples of foods that have a lot of fat in them?	6	7.5	**7**	**8.8**
Q13	How often should we have milk, maas or yoghurt?	22	27.5	17	21.3
Nutrient Content Knowledge (Multiple Choice)					
Q14	Which foods contain vitamin A?	43	53.8	37	46.3
Q15	What is the main food source of calcium?	8	10.0	**12**	**15.0**
Q16	Which group of foods contain the most iron?	15	18.8	**28**	**35.0**
Q17	In which group of foods do we find the most protein?	8	10.0	**28**	**35.0**
Q18	What can we do to reduce our saturated fat intake?	9	11.3	**13**	**16.3**
Nutritional Benefits and Deficiencies Knowledge (Multiple Choice)					
Q19	What is the function of vitamin A in the body?	18	22.5	18	22.5
Q20	What does protein do for our body?	28	35.0	**31**	**38.8**
Q21	What would happen if we did not eat enough starches?	5	6.3	**15**	**18.8**
Q22	What vitamin/mineral helps to prevent weak bones & teeth?	17	21.3	16	20.0
Q23	What do you get from fruit and vegetables?	11	13.8	**13**	**16.3**

Items in bold indicate an improvement from pre- to post-test

Table 4.17: Questions in the control group that showed a significant increase in knowledge

		Mean before	Mean after	t	df	Sig.(2-tailed)
Q6	How often should we eat starchy foods every day?	0.56	0.39	2.270	79	0.026
Q10	How can you eat more fruit and vegetables every day?	0.03	0.20	-3.779	79	**0.000**
Q11	What are examples of sugary foods?	0.05	0.18	-2.428	79	**0.017**
Q16	Which group of foods contain the most iron?	0.19	0.35	-2.491	79	**0.015**
Q17	In which group of foods do we find the most protein?	0.10	0.35	-3.975	79	**0.000**
Q21	What would happen if we did not eat enough starches?	0.06	0.19	-2.587	79	**0.012**

4.2.5 A comparison of all three groups

When looking at the ESM, game and control together it can be seen that the game has the highest overall mean nutrition knowledge score post-test. Despite this the control was the only group that showed a statically significant improvement in overall results. Table 4.18 shows that the game overall mean score is 8.17 (35.5%) as opposed to the control mean score of 7.79 (33.9%). However the increase in mean scores from pre- to post-test in the control group resulted in a statistically significant increase where p=0.011 while the p-value for the game is only 0.126. Figure 4.1 represents a bar graph showing the average total percentages for each of the three groups pre-test and post-test.

Table 4.18: Comparison between pre- and post- test results (t-test) (n=266)

	Mean	Std. dev	95% confidence interval		t	Df	Sig. (2-tailed)
			Lower	Upper			
ESM before	6.85	1.954	-0.367	0.830	0.701	96	0.485
ESM after	6.63	2.522					
Game before	7.65	2.346	-1.182	0.149	-1.543	88	0.126
Game after	8.17	2.916					
Control before	7.00	2.006	-1.392	-0.183	-2.592	79	0.011
Control after	7.79	2.680					

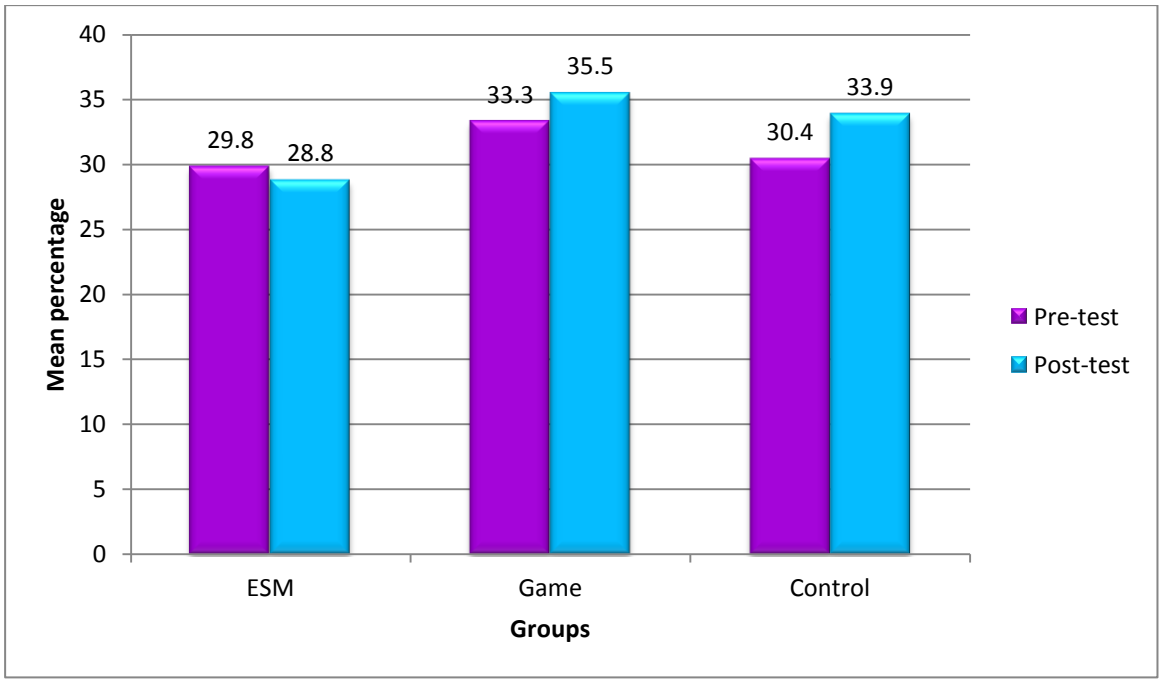

Figure 4.1: Bar graph of the mean percent for each of the groups pre- and post-test

The results were broken down into the four sections and compared in Table 4.19. From this it can be seen that the group with the largest mean score in the FBDG knowledge section is the game group (67.5%). The control has a mean score of 63.5% for this section and the ESM only 50%. Similarly, the food group section and the nutrient content section showed the highest score in both the pre- and post-test result for the game group (31.4% and 31.6% respectively). The control and ESM had a post-test score of 28.9% and 23.0% for the food group section, and 29.6% and 26.6% for the nutrient content group respectively. The last section, nutritional benefits and deficiencies, did not have the highest post-test mean score (only 20.8% as opposed to 23.2% and 23.6%), however, it did show the greatest improvement with an increase of 5.2% compared to the control (3.4%) and ESM (3.0%).

Table 4.19: Average scores obtained for the ESM, game and control groups (n=266)

		Number of learners	Number of questions	Pre-test							Post-test						
				Minimum score		Maximum score		Mean		Std deviation	Minimum score		Maximum score		Mean		Std deviation
				n	%	n	%	n	%		n	%	n	%	n	%	
ESM	FBDG knowledge	97	4	0	0.0	4	100	2.35	58.8	1.090	0	0.0	4	100	2.00	50.0	1.216
	Food groups	97	9	0	0.0	5	55.6	2.21	24.6	1.060	0	0.0	5	55.6	2.07	23.0	1.184
	Nutrient content	97	5	0	0.0	4	80.0	1.26	25.2	0.905	0	0.0	4	80.0	1.33	26.6	0.921
	Nutritional benefits/ deficiencies	97	5	0	0.0	3	60.0	1.03	20.6	0.783	0	0.0	4	80.0	1.18	23.6	0.890
Game	FBDG knowledge	89	4	0	0.0	4	100	2.81	70.3	1.086	0	0.0	4	100	2.70	67.5	1.049
	Food groups	89	9	0	0.0	6	66.7	2.26	29.1	1.211	0	0.0	6	66.7	2.83	31.4	1.308
	Nutrient content	89	5	0	0.0	4	80.0	1.45	29.0	0.954	0	0.0	4	80.0	1.58	31.6	1.085
	Nutritional benefits/ deficiencies	89	5	0	0.0	3	60.0	0.78	15.6	0.794	0	0.0	4	80.0	1.04	20.8	0.940
Control	FBDG knowledge	80	4	0	0.0	4	100	2.54	63.5	1.030	0	0.0	4	100	2.54	63.5	1.158
	Food groups	80	9	1	11.1	6	66.7	2.44	27.1	1.054	0	0.0	6	66.7	2.60	28.9	1.383
	Nutrient content	80	5	0	0.0	4	80.0	1.04	20.8	0.863	0	0.0	4	80.0	1.48	29.6	0.993
	Nutritional benefits/ deficiencies	80	5	0	0.0	3	60.0	0.99	19.8	0.703	0	0.0	3	60.0	1.16	23.2	0.803

These results can be further extrapolated into individual questions which allow a closer comparison of the control, the ESM and the game. When looking at the individual questions for the pre- and post-test and comparing the total scores for each intervention group it can be seen that there is more deterioration in the ESM than in the game. The ESM group showed only a 43.5% increase in correct answers submitted whereas the game resulted in an improvement of 52.2%. Table 4.20 shows each of the questions with the number of learners choosing the correct answer (n) as well as the corresponding percentage (%) and consequent outcome of deterioration, retention or improvement.

Table 4.21 presents those questions from each group that show a statistical significance. The game shows the highest number of learners choosing the correct answer in 12 of the 23 questions; three in the first section, four in the second section, three in the third section and 2 in the last section. However, this does not indicate the greatest improvement as many of the questions in the game group had not improved and yet was still the largest number. For example, question 3 on the importance of exercise decreased for the game from 80.9% to 77.5% and yet it was still higher than the percentage for the ESM which increased from 54.6% to 64.9%. When looking at the significant increase for each of these questions a commonality can be seen between the ESM and the game in that both groups show a statistical significant increase for question 12 (foods high in fat). Similarly, a significant improvement in question 21 (function of starch) occurs in both the ESM group and the control, and in question 11 (sugary foods) among the game and the control. Possible reasons for this will be discussed in the following chapter.

Table 4.20: The total score for each question in the pre and post-test for the control, the ESM and the game groups (n=266)

	Control				ESM					Game				
	Pre-test		Post-test		Pre-test		Post-test		Outcome	Pre-test		Post-test		Outcome
	n	%	N	%	n	%	N	%		n	%	n	%	
The Guidelines (Multiple Choice)														
What does "eat a variety of foods mean"?	48	60.0	**57**	**71.3**	61	62.9	50	51.5	Deteriorated	63	70.8	50	56.2	Deteriorated
How much water do learners need to drink every day?	49	61.3	47	58.8	48	49.5	43	44.3	Deteriorated	50	56.2	**56**	**62.9**	Improved
Do you think it is important to exercise?	49	61.3	48	60.0	53	54.6	**63**	**64.9**	Improved	72	80.9	69	77.5	Deteriorated
What are good examples of exercise?	57	71.3	51	63.8	66	68.0	38	39.2	Deteriorated	65	73.0	65	73.0	Deteriorated
Food groups (Multiple Choice)														
Which foods are high in starch?	52	65.0	43	53.8	49	50.5	40	41.2	Deteriorated	62	69.7	45	50.6	Deteriorated
How often should we eat starchy foods every day?	45	56.3	31	38.8	47	48.5	36	37.1	Deteriorated	34	38.2	**36**	**40.4**	Retained
What does this logo stand for?	4	5.0	5	6.3	6	6.2	**9**	**9.3**	Improved	1	1.1	**28**	**31.5**	Improved
How could you include more plant proteins into your diet?	14	17.5	**20**	**25.0**	10	10.3	**18**	**18.6**	Improved	24	27.0	22	24.7	Retained
Do you have to eat fish, chicken, lean meat or eggs every day?	46	57.5	**55**	**68.8**	61	62.9	44	45.4	Deteriorated	57	64.0	54	60.7	Deteriorated
How can you eat more fruit and vegetables everyday if you need to?	2	2.5	**16**	**20.0**	5	5.2	4	4.1	Deteriorated	5	5.6	**8**	**9.0**	Improved
What are examples of sugary foods?	4	5.0	**14**	**17.5**	9	9.3	6	6.2	Deteriorated	2	2.2	**14**	**15.7**	Improved
What are some examples of foods that have a lot of fat in them?	6	7.5	**7**	**8.8**	3	3.1	**15**	**15.5**	Improved	5	5.6	**14**	**15.7**	Improved
How often should we have milk, maas or yoghurt?	22	27.5	17	21.3	24	24.7	**29**	**29.9**	Improved	43	48.3	31	34.8	Deteriorated
Nutrient Content (Multiple Choice)														
Which foods contain vitamin A?	43	53.8	37	46.3	52	53.6	43	44.3	Deteriorated	50	56.2	48	53.9	Deteriorated
What is the main food source of calcium?	8	10.0	**12**	**15.0**	16	16.5	**21**	**21.6**	Improved	13	14.6	**21**	**23.6**	Improved
Which group of foods contain the most iron?	15	18.8	**28**	**35.0**	22	22.7	18	18.6	Deteriorated	27	30.3	**30**	**33.7**	Improved
In which group of foods do we find the most protein?	8	10.0	**28**	**35.0**	18	18.6	**36**	**37.1**	Improved	34	38.2	26	29.2	Deteriorated
What can we do to reduce our saturated fat intake?	9	11.3	**13**	**16.3**	14	14.4	11	11.3	Deteriorated	5	5.6	**16**	**18.0**	Improved
Nutritional Benefits and Deficiencies (Multiple Choice)														
What is the function of vitamin A in the body?	18	22.5	18	22.5	22	22.7	**26**	**26.8**	Improved	15	16.9	**22**	**24.7**	Improved
What does protein do for our body?	28	35.0	**31**	**38.8**	39	40.2	25	25.8	Deteriorated	22	24.7	21	23.6	Retained
What would happen if we did not eat enough starches?	5	6.3	**15**	**18.8**	7	7.2	**27**	**27.8**	Improved	5	5.6	**12**	**13.5**	Improved
What vitamin/mineral helps to prevent weak bones and teeth?	17	21.3	16	20.0	13	13.4	**17**	**17.5**	Improved	16	18	**19**	**21.3**	Improved
What do you get from fruit and vegetables?	11	13.8	**13**	**16.3**	19	19.6	19	19.6	Deteriorated	11	12.4	**19**	**21.3**	Improved

Items in bold indicated a increase in scores from pre- to post test

Table 4.21: Questions in the test that showed a significance of $p < 0.05$ for the ESM, game and control groups (n=266)

Certain questions score before and after			Mean before	Mean after	95% confidence interval		t	df	Sig.(2-tailed)	r	p-value
					Lower	Upper					
ESM	Q4	What are good examples of exercise?	0.68	0.39	0.155	0.422	4.302	96	0.000	-0.005	0.959
	Q9	Do you have to eat fish, chicken, lean meat or eggs every day?	0.63	0.45	0.045	0.305	2.673	96	0.009	0.143	0.163
	Q12	What are some examples of foods that have a lot of fat in them?	0.03	0.15	-0.202	-0.045	-3.133	96	**0.002**	0.088	0.390
	Q17	In which group of foods do we find the most protein?	0.19	0.37	-0.317	-0.054	-2.808	96	**0.006**	-0.092	0.369
	Q20	What does protein do for our body?	0.40	0.26	0.011	0.278	2.150	96	0.034	0.002	0.981
	Q21	What would happen if we did not eat enough starches?	0.07	0.28	-0.311	-0.102	-3.911	96	**0.000**	-0.005	0.964
Game	Q1	What does “eat a variety of foods mean”?	0.71	0.56	0.017	0.275	2.247	88	0.027	0.180	0.092
	Q5	Which foods are high in starch?	0.70	0.51	0.046	0.336	2.616	88	0.010	-0.017	0.847
	Q7	What does this logo stand for?	0.01	0.31	-0.406	-0.201	-5.886	88	**0.000**	-0.072	0.501
	Q11	What are examples of sugary foods?	0.02	0.16	-0.214	-0.056	-3.391	88	**0.001**	0.143	0.182
	Q12	What are some examples of foods that have a lot of fat in them?	0.06	0.16	-0.191	-0.011	-2.231	88	**0.028**	0.029	0.790
	Q18	What can we do to reduce our saturated fat intake?	0.06	0.18	-0.218	-0.029	-2.604	88	**0.011**	0.013	0.905
Control	Q6	How often should we eat starchy foods every day?	0.56	0.39	0.022	0.328	2.270	79	0.026	0.029	0.798
	Q10	How can you eat more fruit and vegetables every day?	0.03	0.20	-0.267	-0.083	-3.779	79	**0.000**	0.120	0.289
	Q11	What are examples of sugary foods?	0.05	0.18	-0.227	-0.023	-2.428	79	**0.017**	-0.106	0.351
	Q16	Which group of foods contain the most iron?	0.19	0.35	-0.292	-0.033	-2.491	79	**0.015**	0.118	0.299
	Q17	In which group of foods do we find the most protein?	0.10	0.35	-0.375	-0.125	-3.975	79	**0.000**	0.017	0.878
	Q21	What would happen if we did not eat enough starches?	0.06	0.19	-0.221	-0.029	-2.587	79	**0.012**	0.141	0.214

Items in bold indicated a statistically significant increase in pre- and post-scores

To determine whether gender or age had an effect on the outcome of the total scores (deteriorated, retained, or improved) an independent sample t-test with a p-value <0.05, and a One-way ANOVA was conducted. The results showed no significant relationship between the two variables (total score and outcome) and any of the three groups.

When using Pearson's correlation to determine the impact of the method of intervention on the total score of the individual and on the resulting outcome Table 4.22 shows a small positive correlation exists between method of intervention and total score (r=0.191, n=266, p <0.002). This indicates that the game had a greater impact on the total score than the ESM. Similarly, a significant correlation at the 0.05 level (2-tailed) was seen between the method of intervention and the final outcome (r=0.133, n=266, p=0.03). This once again indicates that the game had a larger effect on the retention of knowledge and even the improvement of it than the ESM. These results are statistically significant as the p-value is <0.05. The previous nutrition knowledge, however, had no effect on either the total score or the outcome as can be seen in Table 4.22.

Table 4.22: Correlation between the total score and outcome and the method of intervention and previous nutrition knowledge

	Method of intervention			Previous nutrition knowledge		
	n	r	Sig. (2-tailed)	n	r	Sig. (2-tailed)
Total score	266	0.191**	0.002	266	-0.023	0.706
Outcome	266	0.133*	0.030	266	0.008	0.893

**Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Overall, the game was found to be more effective than the ESM in retaining and improving total scores. There was no significant improvement for any of the sections or questions across the board but a significant correlation was found between the type of intervention used and the total score and outcome. No other significant correlations were found among age, gender or previous nutrition knowledge. These results show that the ESM proved fairly ineffective as many of the questions showed deterioration in the nutrition knowledge of the learners in that group. Conversely, the control group improved their nutrition knowledge without any outside help from an intervention. The educators may have had an impact on the learners' nutrition

knowledge and thus the educators and their responses to the interventions will now be presented.

4.2.6 Educators' use and opinions of the ESM and the game

Eight educators were involved in the study but only six were given questionnaires to fill in as the other two were part of the control group and thus had nothing to comment on. The educators' questionnaire asked about the demographics of the educators; age, gender and race, as well as the NE experience which included attending training or conferences on nutrition and/or teaching others about it. The questionnaire also aimed to find out the educators responses to the clarity and ease of use, the effectiveness and the general evaluation of the ESM and game. Only six educators were involved in the study and could thus fill out the educator questionnaire. This is too small a number to gain a "significant" idea therefore the responses should be treated cautiously.

4.2.6.1 Sample demographics

The educators all belong to the Black African race group, most of them fell into the age category of 30-49 years old and 5 out of the 6 were female (83.3%). The educators were asked if they had received any training on NE or if they had given a talk or run a training session themselves. All 6 educators completed tertiary education (100%) and all taught and received some kind of additional NE. Forty percent (n=2) had received the information on nutrition that their tertiary institutions provided, while another 20% (n=2) attended additional courses to improve their nutrition knowledge. The last 20% obtained extra NE from other sources such as reading pamphlets or talking to experts in the field. As far as teaching NE, 4 out of the 5 educators only taught nutrition as was required for teaching, while 1 provided outside talks or did further research on the topic.

4.2.6.2 Educators' responses to clarity of explanation and ease of use of the ESM or game

Overall the educators found the NE tool useful, all felt that it was explained clearly and that they were given time to ask questions if they needed to. All of them also expressed that they were instructed on how to use the game or the ESM in their classrooms alongside their current

curriculum, and that when using the NE tool they found it easy to work with. When asked about using the game 66.7% said the game was easy to use and that the activities were simple and fun. One educator reported that she found it easy because the information was interesting. A question was asked about having the necessary resources and all educators said that they had everything they needed while one said she had easy access to whatever she might need. Four out of the six educators felt that there was no setting up to do while one felt that the game required a fair amount of setting up before starting, she felt it took more than 10 minutes to set up. For the ESM education a further question was asked about preparation time for each lesson being manageable and one said it was quick and easy, while the other reported that it would be manageable if there were only 3 lessons a week or less to prepare. The educators involved in the game were asked whether they would use the game outside of a nutrition lesson and all three said yes, with one explaining that it was convenient and learners enjoyed it, while the other two said they would only use it outside a lesson if they had someone around to help supervise.

4.2.6.3 Educators' responses to effectiveness and general evaluation of the ESM or game

The educators opinion on whether the game or ESM was effective was measured by asking if they thought the learners understood the game or ESM, if they felt it was age appropriate, and whether or not they believe the learners learnt anything by using the NE tool. For both interventions all the educators felt that they learners were able to participate and learn, and all of them agreed that the game or ESM was age appropriate. Three out of the five educators thought that the learners learnt a lot while the other two educators felt that they were able to learn some things. Table 4.23 presents the "general evaluation" section with each question and the responses of either strongly agree, agree, neutral, disagree, or strongly disagree. For the purpose of this study strongly agree and agree will be collated into agree, and disagree and strongly disagree will be collated into disagree. Generally educators found that the ESM or the game useful, interesting and easy to use, they found that the learners enjoyed playing it and were able to learn something. For the ESM two educators requested a more detailed plan on what to do each day with the curriculum and the material however neither of them felt training would have been useful. The educators using the game also found it helpful and effective but some were neutral about making the game more detailed for this age group and others agreed.

Table 4.23: Responses of the educators to each of the questions in the general evaluation section (n=3 for ESM; n=3 for game)

ESM		Agree	Neutral	Disagree	Game		Agree	Neutral	Disagree
As an educator, how did you find the material?					As an educator, did you find the game helpful?				
a.	It was very informative	3			a.	It was quick and easy to use	3		
b.	I liked the activities suggested	2	1		b.	The learners learnt while having fun	3		
c.	There was too much information	1	2		c.	It was distracting			3
d.	It was time consuming			3	d.	I didn't get a chance to use it			3
e.	I didn't get a chance to use it			3					
What do you enjoy most about the material?					What do you enjoy most about the game?				
a.	It is easy to use	3			a.	It is easy to use	3		
b.	I don't have to do a lot of work preparing for it	3			b.	I don't have to preparing anything in order to use it	2	1	
c.	The learners enjoy it	3			c.	The learners enjoy it and it keeps them busy	3		
d.	The learners are learning something	3			d.	The learners are learning something	3		
e.	I have everything I need for it and so I can use it properly	3							
What did you enjoy least about the material?					What did you enjoy least about the game?				
a.	I don't understand it or how to use it			3	a.	I don't understand it or how to use it			3
b.	It requires a lot of preparation time which I don't have			3	b.	It requires watching the learners and I don't have time			3
c.	The learners found it boring			3	c.	The learners find it boring and don't learn anything			3
d.	I do not feel like the learners learnt anything			3	d.	I could not use it once the original resources are finished			3
e.	I don't have the all the things I need to use it			3					
What would you change/improve about the material?					What would you change/improve about the game?				
a.	Nothing, it works well	3			a.	Nothing, it works well	3		
b.	Make it easier to understand and use	1	1	1	b.	Make it easier to understand and use	2	1	
c.	Provide a detailed outline for each day	2	1		c.	Make it more detailed for this age group	2	1	
d.	Have a training session on how to use it before starting			3	d.	Make the questions harder			3
Would you recommend it to other educators?					Would you recommend this game to other educators?				
a.	Yes	3			a.	Yes	3		
b.	No				b.	No			

4.3 Summary of results

The results of the learner questionnaire that was used to determine the retention of nutrition knowledge in Grade 5 learners was presented in this chapter, as well as the results of the opinion of the educators about the game or ESM. The following findings were important:

The mean age of the participants was 10.71 year old and comprised 54% males and 46% females. The most common age group was 10 year old females (38.8%, n=57) and a small number of learners (4.3%, n=11) fell outside the normal age range for Grade 5 (9-12 years). Fifty eight percent of the learners responded that school was the only source of nutrition information, while 19.2% indicated that they and never learnt about nutrition before.

Baseline nutrition knowledge was assessed to determine how much the learner knew at the start of the intervention. The average overall score for the pre-test was 7.16 out of 23 (31.1%). When looking at the different sections it was found that the mean score at baseline for FBDG knowledge was 64%, food groups was 26.8%, nutrient content was 25.2% and nutritional benefits and deficiencies was 18.6%. Thus it can be seen that at baseline many learners had a poor knowledge and understanding of the basic FBDG's.

After conducting an intervention using the ESM and game as interventions, nutrition knowledge was reported as having either improved, retained or deteriorated. The mean total score of the ESM, game and control post-test was 28.8%, 35.5% and 33.9% respectively. When comparing total scores for the pre- and post-test, results showed no improvement or even retention of nutrition knowledge in the ESM group. However, in the game group, although no significant improvement was found an improvement was seen between the pre- and post-test scores (33.3% to 35.5%).

Three of the four sections in the game and two of the four sections in the ESM group showed an improvement. However, only the FBDG knowledge section in the ESM group and the nutrient benefits and deficiencies section in the game group showed any significant improvement ($p=0.036$ and $p=0.033$ respectively).

The relationship between the method of intervention and the total score and final outcome of the questionnaire were examined and a significant impact was found with a p-value of 0.002 and 0.030 respectively. This indicates that the game had a small but significant impact of the knowledge retention of the learners.

Educators were also given questionnaires to establish what their opinions were on the use and effectiveness of the ESM and game. All educators found it useful and felt that the learners improved their knowledge on nutrition. They reported that it was clearly understood and fairly quick to prepare for and set up. Both interventions were found to be informative and enjoyable, and no improvements or changes were suggested besides possibly making it more detailed for this age group. All the educators said that they would recommend the intervention to other educators.

Overall it was determined the game was more effective than the ESM in retaining nutrition knowledge. However, although the game promoted knowledge retention no significant improvements were made among the learners. Assessment of the preceding results and possible explanations for the outcome will the addressed in the following chapter.

CHAPTER 5: DISCUSSION

This study was conducted in order to determine the effectiveness of a modified FBDG NE game and ESM on supplementing NE to improve retention of knowledge in Grade 5 learners living in Sweetwaters, KwaZulu-Natal. Four research objectives were developed in order to address the research question and these objectives were as follows: Firstly to determine the baseline nutritional knowledge regarding the FBDG of Grade 5 learners. Secondly to determine whether the ESM improved the learners' retention of nutritional knowledge surrounding the FBDG. Thirdly to determine whether a nutrition education game would improve the learners' retention of knowledge surrounding the FBDG. The fourth objective was to determine the opinions of the educators on the effectiveness and ease of use of both the ESM and the NE game. This chapter will discuss the results that were presented in the previous chapter.

5.1 Demographic characteristics of the sample

A look at the age of the learners revealed that although only Grade 5 learners participated in the study the age group ranged from 8 to 15 years old. This is unusual for Grade 5 learners and they are generally between the ages of 9 and 12 years (27.2%). A possible reason for this is that the learners started school later as they were unable to afford the school fees or they had failed over previous years and had to repeat. This percentage of learners, although small, may have contributed to the poor results of baseline knowledge as the learners were not keeping up with their school work well previously.

When asked about nutrition knowledge 58% of the learners responded that school was their only source of nutrition information, while a further 19% reported having never learnt about nutrition before. NE was part of the old school curriculum and has been added into the new CAPS programme which could explain why the largest percentage of learners suggested school as their primary source of nutrition information. The other 19% is a reflection of the fact that although primary schools are required to teach nutrition there is often not enough time in a rural or semi-rural school because other subjects take preference or the learners were not aware that they were officially receiving NE (Powers *et al* 2005). The DOE has allocated 1.5 hours per week to "Personal and Social Well-being" of which only a third can be used for health and environmental responsibilities, and 1 hour per week for "Physical

Education" in which learners participate in a variety of physical activities (DOE 2011) thus limiting time for further education on nutrition.

5.2 Baseline nutrition knowledge (pre-test)

This study found that the overall baseline nutrition knowledge mean score was 31.1% (7.16 out of 23). Internationally, the results of baseline nutrition knowledge have been very different as seen by Seher (2008) in the USA who reported an average total score of 85% following a nutrition knowledge test amongst 31 Grade 4 learners. Similarly, in the UK, Lakshman *et al* (2010) also found high pre-test scores where Grade 5 and 6 learners received 78.6% among their intervention and 75.8% for the control. However the study by Lakshman *et al* (2010) included 2519 learners which is a very large sample size and makes the results more reliable. Although the baseline results for this study are low for the 9-12 year old age group they are not uncommon in South Africa as Oosthuizen *et al* (2011a) also found that the multiple choice questions in their study were poorly answered by learners, aged 9-13 years, in an informal settlement in Gauteng.

The sample size and age range for Oosthuizen *et al* (2011a) study was very similar to this study (experimental n = 82 and control n = 91) thus making the two comparable. However the dropout rate in the Oosthuizen *et al* (2011a) study was quite high with 27 learners from the experimental group unable to complete the short term post-test and 70 learners in the control group. This was even higher for the long term measurement.

This study and Oosthuizen *et al* (2011a) show a very low level of nutrition knowledge amongst learners, especially when compared to developed countries such as the USA and UK. These low levels can be attributed to a number of factors, mainly a lack of time and under-staffing. Park *et al* (2006) surveyed 3141 educators across Korea about the current status of nutrition education, problematic areas, education time and methods and the proper nutrition educator ratio. It was found that 95.5% of educators felt that NE is urgently needed and suggested that one nutrition educator be placed in each school to help with this area of education (Park *et al* 2006). Other factors may include poor teaching at school level or an educators interpreting and teaching the curriculum based on their personal beliefs and attitudes (Carless 2004). Carless (2004) found that three main issues arose in teaching when looking at a classroom setting. These included the use of the educators' mother tongue,

discipline problems and use of the prescribed language. If educators revert back to their mother tongue when teaching it reduces the use of the prescribed language (Carless 2004). This may have occurred in the schools involved in this study which would worsen their understanding of English and the use of it in the game and questionnaire. Discipline problems are also present in the Sweetwaters classrooms due to the big classes and "teacher-fronted" activities, as mentioned by Carless (2004). Carless found that in an attempt to improve the prescribed language, learners were often less effective in successfully completing a task because they were not proficient in the language of the task. Similarly, the educators in this study may sacrifice quality of work to try and teach English. Insufficient or incorrect information being passed down from families has been noted in the community. Poor nutrition which has resulted in poor cognitive development may also cause reduced ability to retain knowledge (Kimani-Murage *et al* 2010). As has been shown, low nutrition knowledge leads to poor food choices and eating habits which results in a large problem with both over- and under-nutrition.

5.2.1 Learners' knowledge of FBDG

At baseline the learners appeared to have some knowledge on the FBDG that were not directly related to food, such as eating a variety of foods, exercise and drinking water (2.56 out of 4, 64%). This was unlike the findings of Oldewage-Theron and Egal (2009) where only 3.1% of children gave the correct answer for the amount of water that should be consumed daily, however Oosthuizen *et al* (2011a) found that learners in their study had a better knowledge of water consumption (52.7%). There were high scores in the first four questions of this study. This indicated that the learners had a good basic knowledge of common nutrition concepts in that 65.4% knew that exercise was important and 70.7% could choose the correct options for good examples of exercise. Oosthuizen *et al* (2011a) and Oldewage-Theron & Egal (2009) found that although an understanding of the importance of exercise at baseline was not low, it was not among the top scoring questions and only 37.8% and 47.8% of their sample respectively chose the correct answer. Oosthuizen *et al* (2011a) showed a low pre-test score of only 19.2% for variety in the diet which was different to this study where the concept of eating a variety of foods as well as water consumption were quite well answered with 64.7% and 55.3% of learners choosing correctly for these two questions.

5.2.2 Learners' knowledge of food groups

The food groups section was not answered as well as the FBDG section (average score was 40%), but better than Oldewage-Theron & Egal (2009) who found that even less of the children in their study were aware of the food groups (13.4%). However in this study, only 4.1% could identify a fortification logo, and 4.5% could explain what they could do in order to increase their fruit and vegetable intake if they needed to. Other studies have generally focused on the number of servings that should be consumed in each of the food groups rather than how to increase or decrease certain food groups from the diet as this study did. Questions asked by Oldewage-Theron & Egal (2009) and Oosthuizen *et al* (2011a) about fruit and vegetables were generally fairly well answered at baseline with a correct score of between 42% and 50% (Oldewage-Theron & Egal 2009) and 74.1% (Oosthuizen *et al* 2011a). Nevertheless, it was found that more specific questions regarding the main function of fruits and vegetables or the sources of certain vitamins were poorly answered in both studies. A similar finding was made in this study where only 15.4% were able to correctly answer the questions asking what we get from fruits and vegetables.

Other questions that were poorly answered were those about foods high in fat (5.3%) and sugary foods (5.6%). For those questions where the learner could choose "all of the above" there seemed to be a problem. Learners were given a few different options that were all correct and they needed to choose all of them in combination thus although many of them chose answers that were not incorrect, they were not the answer that was required. This may have contributed to the low scores for the above mentioned questions. Other studies found that learners had a slightly better knowledge of which foods should be eaten occasionally or avoided altogether (Oldewage-Theron & Egal 2009; Seher 2008). These low pre-test results further reinforce the necessity for implementing strategies such as a game or ESM because it shows clearly that the information that is taught is not being retained effectively.

Even at baseline 61.3% of the learners knew which foods made up the starchy food group, possibly because this is the staple food group in this area, as is with most rural areas in KZN. This is contradictory to what Oldewage-Theron & Egal (2009) found where only 23.7% could classify foods into this group, as well as Seher (2008) in the USA who found that learners could correctly identify foods in the grain less often than those in the fruit, vegetable and dairy groups.

5.2.3 Learners' knowledge of nutrient content

The number of correct answers continued to decline with the average total for nutrient content being 25.2% (1.26 out of 5) and the rest of the questions in that section scored between 10% and 24%. The learners were aware of the basic concepts of nutrition but knew little about the nutrient content and the results of intake. This can be seen by the way the individual questions were answered.

Interestingly, the question in this study asking about foods that contained vitamin A was answered better than the rest of the section on nutrient content (54.5%) which was very poorly answered (for example, 10.5% correctly answered on how to reduce saturated fat intake). This was poorly correlated with the small percentage of learners (20.7%) who could answer what the function of vitamin A was. A similar result (33.3%) was found by Oosthuizen *et al* (2011a) when participants were asked the same question.

5.2.4 Learners' knowledge of nutrient benefits and deficiencies

The total percentage of correct answers in this section was just less than 19%. A possible reason for these questions being poorly answered may be that this section is more detailed and requires a better understanding of nutrition. The learners in this study seemed to have very little knowledge on what the benefits and deficiencies of macro- and micronutrients found in certain foods are. This is consistent with Oosthuizen *et al* (2011a) who asked a question about oranges helping to heal sores and only 13.5% answered correctly.

5.3 Knowledge retention and improvement (post-test)

Many other studies implemented either a NE teaching programme (Shariff *et al* 2008; Fahlman *et al* 2008; Panunzio *et al* 2007; Walsh, Dannhauser & Joubert 2003; Walsh, Dannhauser & Joubert 2002; Kandiah & Jones 2002), a NE game alone (Piziak 2012), or a combination of the game and ESM together (Oosthuizen *et al* 2011a; Lakshman *et al* 2010; Oldewage-Theron & Egal 2009; Seher 2008). None have investigated the effects of a game and ESM separately, but in the same study, making this study unique. Therefore the uniqueness of this study makes exact comparisons difficult.

In the post-test the total score that most of the learners (n=38, 14.3%) received was eight out of 23 (35%) which is a 4.4% improvement, where Walsh *et al* (2003) who had 672 participants writing the post-test, found an overall improvement of 10.4% and Oosthuizen *et al* (2011a) a 13.4% improvement. Lakshman *et al* (2010) found an even smaller increase of only 1.1% in total knowledge scores, however the findings were significant. Other studies also saw a vast and statistically significant improvement in their intervention groups (Oosthuizen *et al* 2011a; Oldewage-Theron & Egal 2009; Shariff *et al* 2008) whereas this study found no statistically significant increase between the pre-test and post-test scores of the ESM or game, despite the improvement in total scores. The improvement seen by Oldewage-Theron and Egal (2009) has a sample size of only 88 learners which may have inflated outcomes, however in the study conducted by Shariff *et al* (2008) the sample size was 335, slightly more than this study. A similar outcome was found by Seher (2008) in an economically disadvantaged population of primary school children who also saw an increase in the mean nutrition knowledge score from 85% to 89% yet with no statistical significance. Seher (2008) felt that this may have been due to a number of participants being lost to follow up, and the small sample size of the study which may have affected the results quite significantly. Another idea was that the individual classes within the intervention group fared quite differently but when grouped together gave an average that had no significance. This may also have been the case in this study which would explain the lack of significant results.

It was interesting to note that, although unexpected, there was a statistical significance in the increase of knowledge shown by the control group. This outcome was noteworthy because although the total score of the post-test was not higher than the game group, the pre-test score was much lower and thus the increase in total scores from pre- to post-test resulted in a significant improvement. This could possibly be attributed to the fact that the classes were randomly chosen for this group and the control possibly had more dynamic educators or focused learners and thus were able to understand the concepts taught from the standard curriculum with greater clarity. Oosthuizen *et al* (2011a) suggested that an unexpected improvement may have been seen in their control group due to friends of the learners attending a different school that was involved in the intervention. A similar outcome could be the cause of the increase in the control results in this study, as the community is small and thus may have interacted during church or youth events. Although this result was not anticipated it is not unexpected as it has occurred in previous studies.

5.3.1 ESM Group

Interestingly, the nutrition knowledge of ESM group decreased from a pre-test average of 29.8% (6.85 out of 23) to a post-test average of 28.9% (6.63 out of 23). This was not anticipated as the support material was intended to play a similar role as the game of reinforcing what the learners were being taught. The results for the overall total were not significant. When looking at the four sections and the mean total scores for each it was once again seen that there was no improvement in the FBDG knowledge section.

5.3.1.1 Learners knowledge retention of FBDG

The total mean percent for this section decreased from 58.8% to 50%. However, when examining the individual questions in this section, the question that asked about the importance of exercise increased from 54.6% to 64.9%. Oosthuizen *et al* (2011a) used a text and activity book, similar to this study, and the results related to that material showed a substantial increase of 32.8% in the score for this question and this remained in 61.9% of the learners' long term memories. This indicates that learners are able to retain knowledge about the basic FBDG if taught in an innovative and interesting way.

5.3.1.2 Learners knowledge retention of food groups

The food group section also showed no improvement in the total mean knowledge score (24.6% to 23%). Seher (2008) used the food groups as sub-sections and the results showed that a greater percentage of learners could correctly identify all the foods items listed in each group. Fruit, vegetables and dairy were all correctly identified by more than 85% of the learners while meat and bean by only 59.3%, and grains and fats and oils by only 33.3% of learners. These results differ from this study as it was found that the food group section as a whole showed no improvement with the ESM group and no subdivisions were made within this section to further assess this. Oldewage-Theron and Egal (2009) had a teaching component to their intervention and the results, although not focused specifically on the teaching material, also showed a substantial increase in the section on food groups (average increase of 40.7%). The study by Powers *et al* (2005) in the USA included 1100 poorer Grade 2 and 3 learners and found a significant increase in classifying foods into their food groups ($p<0.001$). Garcia-Lascurain, Kicklighter, Jonnalagadda, Boudolf & Duchon (2006)

investigated 9-12 year old English-as-a-second-language (ESL) learners who were taught about the Food Guide Pyramid. It was found that, unlike Powers *et al* (2005), the nutrition knowledge scores did not improve significantly. The results were closer to this present study as only a small improvement of 10% was seen in the food group section although the sample size was much smaller.

Questions that showed a significant improvement in the ESM group were regarding fat and protein classification (12.4% and 18.5%). Similarly, Oosthuizen *et al* (2011a) found a 15.6% increase in knowledge scores regarding fat classification while Oldewage-Theron and Egal (2009) found an improvement in the protein section of their questionnaire (31.9%), however this was a much greater increase than seen in this study.

5.3.1.3 Learners knowledge retention of nutrients content, benefits and deficiencies

The nutrient content section and nutrient benefits and deficiencies section did show a slight improvement (26.6% and 23.6%) but this was not statistically significant. The individual questions gave a more detailed look at the successes of the learners in that two of the five questions in the nutrient content section improved and three in the benefits and deficiencies section. These questions focused on the main sources of calcium and protein, as well as the function of vitamin A, starch and calcium in the body. This is contrary to Oldewage-Theron and Egal (2009) who found in their study that the question on the function of fruits and vegetable in protecting against infection decreased in the number of correct answers from 23.4% to 11%, yet Oosthuizen *et al* (2011a) found a 12.7% increase in answers regarding the source of calcium. In this study the questions regarding the sources of protein from the nutrient content section showed a significant improvement of 18.5% ($p=0.006$), and the question regarding the main function of starch from the benefits and deficiencies section saw a 20.6% ($p=0.000$) increase. Garcia-Lascurain *et al* (2006) found that learners' ability to identify the benefits of different foods decreased from pre- to post-test of 10% and when asked to recall the foods that are higher in fat and sugar the post-test score remained the same. Garcia-Lascurain *et al* (2006) suggested that the reason for the poor results may have occurred due to the language barrier which made complex terms more difficult to understand and retain. Another consideration was that too much information was provided in the amount of time available. The conditions of the study by Garcia-Lascurain *et al* (2006) are similar to those in this study where learners were not first language English speakers and the time

allocated to teach nutrition was limited. The similarity in results indicates that these restraints to learning are a relevant issue and greater consideration needs to be paid to them by the DOE.

5.3.1.4 Barriers to success with an ESM

Contento (2008) states the importance of teaching learners basic concepts in such a way that they can implement the information into their lives to produce long term change. The basics of nutrition are easy to teach and simpler to understand, but educators working with second language learners tend to neglect the relevance of the information thus it becomes ineffective outside of the classroom. The researcher observed that the educators often spent their school time teaching how to read and write English and so may not have enough time to spend on nutrition (Powers *et al* 2005). Therefore only basic necessary nutrition was taught, such as eating fruit and vegetables, much like Garcia-Lascurain *et al* (2006) found in their study.

Educators in this study also battled because they have so many learners in their class with limited space and resources thus making it difficult to engage the class in an interactive activity. The maximum number of learners in a classroom was 45. The educators are also required to teach subjects such as English and Mathematics in order to prepare the learners for high school, thus nutrition was very seldom a focus of the classroom discussions. The study by Shariff *et al* (2008) allowed the educators to teach nutrition during the Health and Physical Education (PE) class which gave the educators an hour of time specifically dedicated to nutrition. The result was a significant increase in the knowledge, attitude and practice scores of the learners in the intervention group of the study. This is a possible option if permission is given by the DOE to use the physical education class time to teach. However this is rather impractical because learners should be participating in PE as this may be the only form of exercise that they partake in.

Educators are often not well trained to improvise or modify the curriculum to suit the learners and the learning environment, and do not have the support and encouragement they need to learn and develop as an educator. This rigidity in the lesson schedule makes it difficult to add supplementary material to the already full curriculum. Many of the activities in the ESM required marking or follow up and this was time consuming and created additional work with no incentive for the educators to make that time. This may be a reason why the game had a

more effective outcome; the educators could leave the learners to play on their own as a form of revision without creating more work for themselves.

5.3.2 Game group

Once separated into intervention types, the game group, showed an increase in the total mean score of their post-test (35.5%) compared to the pre-test (33.3%). Although this improvement is 2.2% it is far from the improvement of 13.4 % found by Oosthuizen *et al* (2011a), which was similar to the 12.3% found by Oldewage-Theron and Egal (2009) in a neighbouring area. Shariff *et al* (2008) found a much smaller but still significant improvement in the average total knowledge score (2.17%) when working with children in Malaysia, while Lakshman *et al* (2010) in the UK found an even smaller improvement of only 1.1%. An increase was expected for this study as the children were being taught about nutrition as part of the curriculum as seen in most of the studies examined (Oosthuizen *et al* 2011a; Lakshman *et al* 2010; Oldewage-Theron & Egal 2009; Shariff *et al* 2008). Unfortunately the increase in nutrition knowledge in this study was not significant despite being greater than the control group.

5.3.2.1 Learners knowledge retention of FBDG

The game group showed a decrease in the FBDG knowledge section (70.3% to 67.5%). Oldewage-Theron and Egal (2009) found an opposing outcome for the question about how many glasses of water should be drunk per day. This question was poorly answered at baseline (3.1%) and yet increased to 63.6 % after the intervention. Although the pre-test scores were not as low, Oosthuizen *et al* (2011a) also saw a significant increase in the number of correct answers relating to water consumption after intervention (52.7% to 86.8%). Similarly, an improvement in the physical activity questions and the question about variety was also noted.

5.3.2.2 Learners knowledge retention of food groups

The sections on food groups improved in mean total score by 2.3% however there was no statistical significance seen. The game group showed a significant increase with 31.5% of the learners correctly answering the question about the fortification logo (30.4% increase), 15.7%

for examples of sugary foods (13.5% increase) and foods high in fat (10.1% increase), and 18% for how to reduce saturated fat intake (12.4% increase). These increases are smaller than those found by Oldewage-Theron and Egal (2009) who saw a 38.6% increase in the classification of foods that should be avoided (those high in fat and sugar) and those that belong to the protein group (31.9%), however the study sample size was half the size of the present study. Seher (2008) found that the questions related to "sometimes" foods was originally not well understood but once explained showed a 30.3% increase which is higher than the 13.5% (sugary foods) and 10.1% (fatty foods) improvement found in this study for similar questions. Conversely, the results for the meat and bean category showed a decrease of 5.2% while an 18.5% increase was seen in this study. No other studies asked about the fortification logo or how the learners could practically change their behaviour (for example, how to reduce saturated fats in to the diet or how to increase fruit and vegetable intake) thus no comparison can be made. Lakshman *et al* (2010) and Shariff *et al* (2008) did not discuss individual questions but rather group classification and the related question discussed by Oosthuizen *et al* (2011a) showed no significant improvement as in this study.

5.3.2.3 Learners knowledge retention of nutrients content, benefits and deficiencies

The nutrient content section increased to 31.6% but this was not significant. Three individual questions also showed an increase, sources of calcium and sources of iron, as well as how to reduce saturated fat, with the fat question showing a significant increase of 12.4% ($p=0.01$). Oosthuizen *et al* (2011a) found an increase in the sources of calcium question (12.7%) but did not ask any questions related to how saturated fat can be reduced. The last sections on nutrient benefits and deficiencies showed a small yet significant increase of 5.2 % (p-value=0.033) which is consistent with Oosthuizen *et al* (2011a) and Lakshman *et al* (2010) who both found significant improvements in related questions. However, the difference between pre- and post-test for the function of starch was slightly lower (5.8% increase) in Oldewage-Theron & Egal (2009) study than in this one (7.9% increase). A reason may be that the game in this study had a specific question regarding the function of starch in the body whereas the game in the Oldewage-Theron & Egal (2009) study may have only eluded to it. Alternatively, the pictorial representation of this concept may have been well portrayed in this study allowing the learners to remember it better and thus retain the information until the post-test.

5.3.2.4 Barriers to success of the game

Firstly, the learners should be taught in English at Grade 5 level but are still new to the language and thus are considered low-literacy learners (Walker, 2013). Unfortunately, these learners often read too slowly to grasp whole concepts and thus battle to understand and learn properly (Contento 2011, p458). Another challenge in this study was the large number of learners in each class which may have negatively impacted on their ability to learn. There was limited space to play in the classroom and too many learners per class to play the game effectively thus reducing the overall benefit of the game. Unfortunately the researcher of this study noticed that the educators were nervous about allowing the learners to play the game on their own as they feared the learners would damage the game. As a result the game was not played often enough to promote retention or improvement of knowledge.

5.3.3 Control group

The control showed an improvement in three of the sections with retention of knowledge in the first section. The section on nutrient content improved significantly from 20.8% to 29.6% (p=0.003). Oosthuizen *et al* (2011a) found only a small improvement in the control pre- and post-test (1.3% between them), however, one question related to increasing fruit and vegetable intake showed a significant increase. Similarly, Oosthuizen *et al* (2011b) and Lakshman *et al* (2010) found an improvement in the control group but none with statistical significance. Oldewage-Theron & Egal (2009) did not have a control group thus no comparisons can be made.

An independent sample t-test was done to determine if the intervention as a whole had any significant impact on the total score and the final outcome (deterioration, retention or improvement). The results found that the game had a significant impact on both the total score and the final outcome (p=0.000 and p=0.046 respectively), while the ESM had no significant effect. A reason may have been that the learners enjoyed the game more as it was something new and interesting and enjoyable, and educators preferred to let them play that then have to prepare and mark an activity. Another possibility may have been that the game inspires some competition which encourages active learning and this helps promote knowledge retention (Baytak & Land 2010).

5.4 Feedback from the educators

The sample size of the educators is very small and thus all the information gleaned from these results must be interpreted with caution. The educators all felt that the tool they were given was useful and effective. They reported that the tool was explained to them properly regarding how it should be used and how it should run concurrently while they taught all subjects. When asked if they felt they should have been given further training on how to use the ESM all the educators felt that what was given was enough. Yet it is the opinion of the researcher that the post-test scores indicate a lack of understanding of how to use the game or ESM alone and alongside the curriculum.

The study by Panunzio *et al* (2007) compared the effects of an educator versus an outside nutritionist on the ability to promote fruit, vegetable and legume consumption in children. The outcome was very interesting in that the educators had a greater impact on the learners than the trained professionals because the learners knew the educator and the educator understood the schooling system and so was able to add nutrition teaching into other subjects and aspects of the school day. A similar outcome could possibly be seen with the educators in this study if more detailed training was taught.

Other researchers have mentioned the need for creative and inexpensive teaching material (Oldewage-Theron & Napier 2011; Perez-Rodrigo & Aranceta 2003), and this was echoed by the educators in Seher (2008) study who were looking for a readily available NE programme that did not require nutrition training or expensive resources and could be used without time constraints. The educators in this study indicated that the game or ESM they were given fell into this category. Many said it was “interesting and fun”, some commented that it was “informative”, and all but one felt that they had all the resources needed who reported that the resources she might need were readily available. No NE training was required as both tools worked off of the current curriculum and thus was already understood by the educators and any possible confusion with the ESM was explained by the material given. Four out of the five educators felt that there was no setting up to do while one felt it took more than 10 minutes to set up of the game. For the ESM most educators found preparation of lessons quick and easy or manageable.

When asked about using the game or ESM outside of a nutrition lesson three educators reported that they would because it was convenient and learners enjoyed it, while two other

felt that this would only be possible if someone helped facilitate. This is consistent with Seher (2008) who also mentioned the need for a facilitator when more than one activity was being run at a time. Some educators in this study felt that more detail was required for this age group and yet many learners showed by their total scores that they did not understand what was required of them even at the level they were taught at. Similarly Seher (2008) found that learners requested something "more challenging" and yet even after the intervention were unable to excel in the questionnaire.

Although all the educators overall seem to find the tool easy to use and effective in helping the learners, there were certain factors outside of the intervention that may have influenced the results. This was seen by Shariff *et al* (2008) who found that although educators were all trained the same a difference in their teaching styles and ability to carry out the intervention may have had an effect on the learners' outcomes. Nevertheless, educators commented that it was good for improving the learners language (as found by Piziak 2012) and helped promote group work. Thus based on the educators' responses the game and ESM were both successful regardless of the outcome of the test results.

5.5 Acceptance or rejection of the hypotheses

Hypothesis 1: Rejected – The baseline nutrition knowledge of the learners was not on par with other studies conducted in South Africa using primary school learners.

Hypothesis 2: Rejected – More than half the learners did not retain their nutrition knowledge after the interventions.

Hypothesis 3: Rejected – A significant improvement was not seen in nutrition knowledge after the interventions.

Hypothesis 4: Accepted – Educators found the game and ESM effective and easy to use.

CHAPTER 6: CONCLUSION

The original concern of underweight and stunting, although still a problem, has been recently overtaken by the growing number of obese and overweight children in this country. This issue brings into question the effectiveness of the South African Food Based Dietary Guidelines that were developed to meet the specific need of this country. Despite the availability of this tool as a form of NE there still seems to be a large portion of the population making poor food choices. One of the most effective settings in which to educate children is at school because learners spend a large portion of their day here and attendance is mandatory. This environment encourages learning and the educators to positively influence the learners. Thus a NE tool was required in order to take the FBDG and make them relevant to children in such a way that it promotes knowledge retention and ultimately long term behavioural change. This investigation was important to determine whether a NE game and ESM could be used in rural isiZulu speaking schools to help improve knowledge retention of Grade 5 learners. The FBDG were incorporated into the NE tools.

A pre-test nutrition knowledge questionnaire was carried out on the learners involved in the study, followed by an intervention of either a game or an ESM. After 6 weeks a post-test learner questionnaire was conducted and educators were also given a questionnaire to complete as a form of feedback on the intervention. These results were collected to determine the impact of the intervention on the nutrition knowledge of the learners and to gain insight into how the educators found the game or ESM with regards to use and effectiveness.

The following objectives were investigated in this study

- To determine the baseline nutritional knowledge regarding the Food Based Dietary Guidelines of Grade 5 learners attending a rural school.
- To determine whether ESM would improve the learners' retention of nutritional knowledge surrounding the Food Based Dietary Guidelines.
- To determine whether a NE revision game would improve the learners' retention of knowledge surrounding the Food Based Dietary Guidelines.
- To determine the opinions of the educators on the effectiveness and ease of use of both the ESM and the NE game.

6.1 Determination of baseline nutrition knowledge

The study found that at baseline learners had a good understanding of basic nutrition concepts such as exercise and water consumption. However, when asked about nutrition in more detail the level of nutrition knowledge decreased indicating a poor understanding of topics related to the nutrient content of foods and the benefits or deficiencies associated with these foods.

6.2 Nutrition knowledge retention after using the ESM

The post-test revealed that the ESM group did not show either retention or improvement of nutrition knowledge. Although the nutrient content section and the nutritional benefits and deficiencies section showed a slight improvement it was not significant. Similarly, certain questions were answered better after the intervention yet only three questions showed a significant improvement. This is not a poor reflection of the ESM but rather the situation in which it was used, where educators had little time to incorporate the information and activities into the current curriculum.

6.3 Nutrition knowledge retention after using the game

Six weeks later the game showed improvement in that an increase was seen in the overall nutrition knowledge scores between pre- and post-test. The increase overall was not significant however, some individual questions did show a significant increase. These included questions about classifying sugary foods and foods high in fat, as well as how to reduce saturated fat in a diet and what the fortification logo stands for. This could be helpful when trying to reduce the number of learners that are overweight by teaching them which foods are high in sugar and fat and how they can decrease their fat intake. A significant correlation was seen between the game and the total score for the learners thus the game has greater potential to be used in rural and semi-rural areas where time and resources are a problem.

6.4 Opinions of the educators

All the educators were positive about both the game and the ESM. Some felt that help may be required when implementing either intervention, such as an educator’s assistant who could

control the learners and be around to monitor the game or ESM if necessary. Educators commented on the effectiveness of the game as a way to improve language skills and promote group work. Although not requested by the educators more detailed training beforehand may have resulted in a better outcome for both groups.

6.5 Recommendations for future use

This study revealed that from Grade 5 many learners in rural and semi-rural areas are being taught in a language that they are not proficient in. This affected the ability to understand the intervention, and thus implementation of what was learned. In addition, the level of knowledge that is required regarding nutrition at a Grade 5 level may be too difficult for a learner who has not been consistently taught about nutrition. It was observed by the researcher that educators focused on teaching basic education such as English and Mathematics and did not have time to include nutrition into the curriculum being taught. Without a solid nutrition foundation it is difficult to understand the more complicated concepts and thus teaching nutrition to older grades in these areas may be futile when there is no base to build on. This was very apparent among the learners in this study. Based on results of the educators training level and the researcher's observations it was seen that educators in rural areas are often not well trained in teaching and thus battle to make lessons interesting and inspiring. Thus it is important for government and schools to make changes regarding curricula, educators and the school environment. It is proposed that:

Government should:

1. Develop different curricula for different levels of schools (rural, semi-rural, urban) thus allowing learners to learn at a pace that meets their needs and abilities.
2. Keep nutrition concepts basic and repetitive in second language schools.
3. Provide training for educators on interesting, fun ways to teach learners about nutrition.
4. Incorporate behaviourally driven activities into the curriculum to help promote change.
5. Increase the number of educators or teacher-aid provided to rural schools to help them cope with the large number of learners in each class.
6. Further modification of CAPS to incorporate the new FBDG and food guide developed specifically for South Africa.

Schools should:

1. Give educator's regular training to encourage and improve their teaching skills.
2. Include school nutrition projects, such as vegetable gardens or community nutrition projects to create awareness of healthy eating and the related benefits.

6.6 Study critique

The main limitations for this study were that of time and a school environment that was not conducive for an intervention of this kind. A healthy classroom environment should have educators that are teaching with passion and enthusiasm, classrooms where each learner has their own desk and chair with enough space around them to feel uninhibited. Learners should be encouraged to participate and give feedback rather than simply sitting and listening. Exciting and stimulating learning activities should be included in the teaching material. The school setting should monitor the feeding scheme and tuck shop to reflect those concepts being taught as well as a general health promoting focus, that includes posters and pictures on healthy eating. This will aid in enhancing and reinforcing nutrition and the benefits of making healthy choices. Many of these factors were not seen in the schools chosen for this study. More time with the game and a longer study may have allowed a greater improvement in the results, however, due to holidays and the pressure of the government testing programme there was not much time available. In addition it was discovered that the environment in many of these schools is not conducive to effective learning and not suitable for encouraging healthy food choices. The game and ESM developed in this study have the potential to be very successful in a school setting. The following changes will make them even more effective:

6.6.1 The game

- The game should be in isiZulu, the first language of the learners as well as English. Although they are being taught in English from Grade 5 their language skills are not developed enough to motivate true enjoyment if played in English alone. Future studies should consider a game developed in both languages similar to the one by Piziak (2012) who used a combination of Mexican (the native language) and English.
- Another recommendation would be to provide more than one game per class as many of the classes were very big and thus could not all play the game at the same time. Alternatively, the game should be modified to suit the rural classroom environment where

one game caters for up to 50 learners. This could be done by providing 5 or 6 packs of cards and 5 or 6 die thus allowing the game to be played in small groups all at the same time. The game was intended to be played in small groups in between lessons rather than as a whole class which is the reason this was not modified earlier.

- A needs assessment would be useful to determine what the learners knew and what they needed help with, instead of assuming a level of knowledge based on the education requirements at government level. This could also be an avenue for progress where learners start off with a pack of cards asking simpler questions and then are provided with a higher level of cards once knowledge of those concepts are fully understood. A longer intervention time would also have been beneficial as this would have allowed a longer time for the game to be played and perhaps for the information to be retained more effectively.

6.6.2 ESM and training

An important recommendation, although not agreed with by the educators, would be to have improved training regarding the use of the ESM and how to play the game. This was not done in this study as educators were busy and did not have time during the school term to spend a day training. As a result they only dedicated a minimum number of hours to this study.

6.6.3 The questionnaires

In terms of the learner questionnaire, a greater use of pictures for each question would have possibly allowed the learners to understand more clearly what was being asked of them. The current questionnaire had only one question that was pictorially represented and this question showed the greatest improvement after the post-test, thus validating this recommendation. Learners appeared more likely to retain the knowledge if they could recognise a picture. However, the pictures used in the questionnaire and the game should be tested for understanding amongst the learners as this may have affected the outcome of the study. In addition, a questionnaire in isiZulu would remove the uncertainty of whether the learners answered poorly due to a lack of knowledge or as a result of poor understanding.

When examining the questionnaires as a whole more focus could have been placed on ensuring that the techniques used to validate the questionnaires were clearly shown.

Chronbach α statistical tests can be effective in determining the reliability of the measuring instrument and were not used in this study making this a limitation.

6.7 Implications for further research

The focus of this study was on knowledge retention; however a study on behavioural change produced when using a similar study design could be the topic of a future study. The potential for a change in behaviour could be investigated regarding the food choices of learners after using the game or ESM. This would be useful as much research is pointing towards a focus on behavioural change rather than simple information dissemination, but could only be done once the recommendations made from this study are taken into account.

Behavioural change may also have been affected by the reliance of the learner on the family and thus a study including family involvement would aid in determining the best way to produce a long term change in eating patterns.

The use of a local game modified for nutrition in an isiZulu-speaking community has great potential in helping educators in these areas to improve knowledge retention of learners. This specific area has not been researched in South Africa and would prove very useful in alleviating the problems of over- and under-nutrition.

REFERENCES

American Dietetic Association (ADA) (1996). Position of the American Dietetic Association: Nutrition education for the public. *Journal of the American Dietetic Association* 96(11): 1183-1187.

American Dietetic Association (ADA) (2003). Position of the American Dietetic Association, Society for Nutrition Education, and American School Food Service Association Nutrition series: An essential component of comprehensive school health programs. *Journal of the American Dietetic Association* 103(4): 505-514.

American Dietetic Association (ADA) (2010). Position of the American Dietetic Association: Child and Adolescent Nutrition Assistance Programs. Position of the American Dietetic Association: Child and Adolescent Nutrition Assistance Programs. *Journal of the American Dietetic Association* 110(5): 791-799.

Auld GW, Romaniello C, Heimendinge J, Hambidge C & Hambidge M (1998). Outcomes from a school-based nutrition education program using resources educators and cross disciplinary models. *Journal of NE* 30(5): 268-280.

Baytak & Land (2010). A case study of educational game design *by* kids and *for* kids. *Procedia Social and Behavioural Sciences* 2: 5242-5246.

Birley G, Moreland N (1999). *A practical guide to academic research*. Kogan Page. London.

Brace I (2004). *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research*. Kogan Page. London.

Carless (2004). Issues in teachers' reinterpretation of a task-based innovation in primary schools. *TESOL Quarterly* 38(4): 639-662.

Centre for Disease Control and Prevention (CDC) (1996). Guidelines for school health programs to promote lifelong healthy eating. *Morbidity and Mortality Weekly Report* 45(9): i-42.

Cheadle A, Cahill C, Schwartz PM, Edmiston J, Johnson S, Davis L & Robbins C (2012). Engaging youth in learning about healthful eating and active living: An evaluation of educational theatre programs. *Journal of Nutrition Education and Behavioural* 44(2): 160-165.

Chopra M (2003). Risk factors for undernutrition of young children in a rural area of South Africa. *Public Health Nutrition* 6(7): 645-652.

Contento IR (2011). Nutrition education: Linking Research, Theory, and Practice. Second Ed. Jones and Bartlett Publishers, Sudbury, USA.

Contento IR (2008). Nutrition education: linking research, theory, and practice. *Asia Practical Journal of Clinical Nutrition* 17(1): 176-179.

Contento IR, Balch GI, Bronner YL, Paige DM, Gross SM, Bisignani L *et al* (1995). The effectiveness of nutrition education and implications for nutrition education policy, programs and research – a review of research. *Journal of Nutrition Education* 27(6): 279-418.

Crush J, Frayne B & McLachlan M (2011). Rapid Urbanisation and the nutrition transition in Southern Africa. African Food Security Urban Network. Idasa Publishing, Cape Town.

Department of Basic Education (DOE) (2013). *CAPS curriculum: Intermediate Phase.* http://www.education.gov.za/Curriculum/CurriculumAssessmentPolicyStatements/tabid/49/Default.aspx

Department of Health (DOH) (2012). The SA Guidelines for Healthy Eating. Ed; C Brown. In Press; Nutrition Week National Nutrition Week 2012. Food Groups.

Dollahite J, Hosig KW, Adeletti White K, Rodibaugh R & Holmes TM (1998). Impact of a school based community intervention program on nutrition knowledge and food choices in elementary school children in the rural Arkansas Delta. *Journal of Nutrition Education* 30(5): 289-301.

Educational Testing Service (ETS) (2008). *The Praxis Series: Principles of learning and teaching Grade 5*. http://www.ets.org/c/praxis_connection/2012/19380.

Engle PL, Bentley M, Pelto G (2000). The role of care in nutrition programmes: current research and research agenda. *Proceedings of the Nutrition Society* 59: 25-35.

Faber M & Wenhold F (2007). Nutrition in Contemporary South Africa. *Water SA* 33(3): 393-400.

Fahlman MM, Dake JA, McCaughtry N & Martin J (2008). A pilot study to examine the effects of a nutrition intervention on nutrition knowledge, behaviours, and efficacy expectations in middle school children. *Journal of School Health* 78(4): 216-222.

Food and Agriculture Organisation of the United Nations (FAO) (2004). *The state of food insecurity in the world*. http://www.fao.org/docrep/007/y5650e/y5650e00.htm.

Food and Agriculture Organisation of the United Nations (FAO) (2013). *Nutrition education*. http://www.fao.org/docrep/w0078e/w0078e10.htm.

García-Casal MN, Landaeta-Jiménez M, Puche R, Leets I, Carvajal Z, Patiño E & Ibarra C (2011). A programme of NE in schools reduced the prevalence of iron deficiency in students. *Anaemia*.

Garcia-Lascurain MC, Kicklighter JR, Jonnalagadda SS, Boudolf EA & Duchon D (2006). Effect of a nutrition education program on nutrition-related knowledge of English-as second language elementary school students: A pilot study. *Journal of Immigrant and Minority Health* 8(1): 57-65.

Hoelscher DM, Evans A, Parcel GS, Kelder SH (2002). Designing effective nutrition interventions for adolescents. *Journal of American Dietetic Association* 102(3): S52 S63.

Jackson CJ, Mullis RM & Hughes M (2009). Development of a theatre-based nutrition and physical activity intervention for low-income, urban, African American adolescents. *Progress in Community Health Partnerships: Research, Education, and Action* 4(2): 89-98.

Jinabhai CC, Taylor M & Sullivan (2003). Implications of the prevalence of stunting, overweight and obesity amongst South African primary school children: a possible nutritional transition? *European Journal of Clinical Nutrition* 57(2): 358-65.

Kabahenda M, Mullis RM, Erhardt JG, Northrop-Clewes C & Nickols SY (2011). Nutrition education to improve dietary intake and micronutrient nutriture among children in less areas: a randomised control intervention in Kabarole district, western Uganda. *South African Journal of Clinical Nutrition* 24(2): 83-88.

Kandiah J & Jones C (2002). Nutrition knowledge and food choices of elementary school children. *Early Child Development and Care* 172(3): 269-273.

Kimani-Murage EW, Kahn K, Pettifor JM, Tollman SM, Dunger DB, Gómez-Olivé XF & Norris SA (2010). The prevalence of stunting, overweight and obesity, and metabolic disease risk in rural South African children. *BMC Public Health* 10(158): 1-13.

Kothari CR (2004). *Research Methodology: Methods & Techniques*. Second Ed. New Age International. New Delhi.

Labadarios, Steyn NP, Maunder E, MacIntryre U, Gericke G, Swart R, Huskisson J, Dannhauser A, Vorster HH, Nesmvuni AE & Nel JH (2005). National Food Consumption Survey (NFCS): South Africa, 1999. *Public Health Nutrition* 8(5): 533 543.

Lakshman RR, Sharp SJ, Ong KK & Forouhi NG (2010). A novel school-based intervention to improve nutrition knowledge in children: cluster randomised controlled trail. *BMC Public Health* 10(123): 1-9.

Leedy PD, Ormrod JE (2001). *Practical research: planning and design 7th ed*. New Jersey: Prentice Hall.

Love PV (2002). Developing and assessing the appropriateness of the preliminary Food Based Dietary Guidelines for South Africans. Unpublished thesis.

Lytle LA & Achterberg CL (1995). Changing the diet of America's children: what works and why? *Journal of NE* 27: 250-260.

Lytle LA, Eldridge Al, Kotz K, Piper, Williams S & Kalina B (1997). Children's interpretation of nutrition messages. *Journal of NE* 29: 128–136.

McCarthy (2008). Pretest-posttest control group (classical experiment).

NFCS-FB-1 (2005). Executive Summary of the National Food Consumption Survey Fortification Baseline, South Africa. *South African Clinical Journal of South Africa* 21(3): 245-300.

Oldewage-Theron WH & Egal AA (2009). The evaluation of a nutrition education programme on the nutrition knowledge of children ages six and seven years. *Journal of Ecology and Consumer Sciences* 37: 45-51.

Oldewage-Theron WH & Napier CE (2011). Nutrition education tools for primary school children in the Vaal region. *Development Southern Africa* 28 (2): 283-292.

Oosthuizen D (2010). Impact of a nutrition education programme on nutrition knowledge and dietary intake practices of primary school children in Biopatong. Unpublished thesis.

Oosthuizen D, Oldewage-Theron WH & Napier C (2011a). Impact of a nutrition education programme on the nutrition knowledge of primary school children. *African Journal for Physical, Health Education, Recreation and Dance* 17(1): 141-155.

Oosthuizen D, Oldewage-Theron WH & Napier C (2011b). The impact of a nutrition programme in the dietary intake patterns of primary school children. *South African Journal of Clinical Nutrition* 24(2): 75-81.

Painter J, Rah J, Lee Y (2002). Comparison of international Food Guide pictorial representations. *Journal of American Dietetic Association* 102(4): 483-489.

Panunzio MF, Antoniciello A, Pisano A & Dalton S (2007). Nutrition education intervention by educators may promote fruit and vegetable consumption in Italian students. *Nutrition Research* 27: 524-528.

Park YH, Kim HH, Shin KH, Shin EK, Bae IS & Lee YK (2006). A survey on practice of nutrition education and perception for implementing nutrition education by nutrition teacher in elementary schools. *Korean Journal of Nutrition* 39(4): 403-416.

Perez-Rodrigo C & Aranceta J (2001). School-cased nutrition education: lessons learned and new perspectives. *Public Health Nutrition* 4(1A): 131-139.

Perez-Rodrigo C & Aranceta J (2003). Nutrition education in schools: experiences and challenges. *European Journal of Clinical Nutrition* 57(1): S82-S85.

Perez-Rodrigo C, Klepp K, Yngve A, Sjöström M, Stockley L & Aranceta J (2001). The school setting: an opportunity for the implementation of dietary guidelines. *Public Health Nutrition* 4(2B): 717-724.

Piziak V (2012). A pilot study of a pictorial bilingual nutrition education game to improve the consumption of healthful foods in a Head Start population. *International Journal of Environmental Research and Public Health* 9: 1319-1325.

Powell CA, Walker SP, Chang SM & Grantham-McGregor SM (1998). Nutrition and education: a randomised trial of the effects of breakfast in rural primary school children. *The American Journal of Clinical Nutrition* 68: 873-879.

Powers AR, Struempler BJ, Guarino A & Parmer SM (2005). Effects of a nutrition education program on the dietary behavior and nutrition knowledge of second-Grade and third Grade students. *Journal of School Health* 75(4): 129- 133.

Räiha T, Tossavainen K, Turunen H, Enkenberg J & Kiviniemi V (2012). Effects of a nutrition health intervention on pupils' nutrition knowledge and eating habits. *Scandinavian Journal of Educational Research* 56(3): 277-294.

Reichardt CS (2009). *The SAGE Handbook of Quantitative Methods on Psychology: Quasi experiment design.* SAGE Publishers. London.

Ruel M and Hoddinott J (2008). Investing in Early Childhood Nutrition. *Policy Brief No. 8,* IFPRI, Washington.

Sahota P, Rudolf MCJ, Dixey R, Hill AJ, Barth JH & Cade J (2001). Evaluation of implementation and effect of primary school based intervention on reduced risk factors for obesity. *BMJ* 323: 1-4.

SANHANES-1 (2013). Nutritional status of children. Media release 2. Human Science Research Council.

Sapp SG, Jensen HH (1997). Reliability and validity of nutrition knowledge and diet-health awareness tests developed from the 1989-1991 diet and health knowledge surveys. *Journal of Nutrition Education* 29(2): 63-72.

Seher CL (2008). Efficacy of *Game On! The Ultimate Wellness Challenge* in increasing nutrition knowledge among elementary school children. Unpublished thesis.

Shariff ZM, Bukhari SS, Othman N, Hasim N, Ismail M, Jamil Z, Kasim SM, Piam L, Samah BA & Hussein ZAM (2008). Nutrition education intervention improves nutrition knowledge, attitudes and practices of primary school children: A pilot study. *International Electronic Journal of Health Education* 11: 119-132.

Stats SA (2011). Census: Municipality Report KZN and Provinces at a Glance. *Statistics South Africa*. Report number 03-01-53 and 03-01-43. www.statssa.gov.za

Tanumihardjo SA, Anderson C, Kaufer-Horwitz M, Bode L, Emenaker NJ, Haqq AM, Satia JA, Silver HJ, Stadler DD (2007). Poverty, obesity, and malnutrition: An international perspective recognizing the paradox. *Journal of American Dietetic Association* 107(11): 1966-1972.

United Nations Development Programme (UNDP) (2010). Millennium Development Goals. Country Report 2010.

United States Department of Agriculture (USDA) (2011). Development of *2010 Dietary Guidelines for Americans*: Consumer message and new food icon. Centre for Nutrition Policy and Promotions.

United Nations Children Fund (UNICEF) (2013). Malnutrition in children worldwide. http://www.childinfo.org/malnutrition_status.html

Vandongen R, Jenner DA, Thompson C, Taggart AC, Spickett EE, Burke V, Beilin LJ, Mulligan RA and Dunbar DL (1995). A controlled evaluation of a fitness and nutrition Intervention program on cardiovascular health in 10- to 12-year old children. *Preventive Medicine* 24: 9-22.

Vorster HH (2012). The new South African food-based dietary guidelines in perspective. *Centre of Excellence for Nutrition.*

Vorster HH, Love P, Browne C (2001). Development of Food Based Dietary Guidelines for South Africa – The process. *South African Journal of Clinical Nutrition* 14(3): S3-S6.

Wall DE, Least CL, Gromis JG & Lohse BL (2012). Nutrition education intervention improves vegetable related attitudes, self-efficacy, preference, and knowledge of fourth-Grade students. *The Journal of School Health* 82(1): 37-43.

Walsh CM, Dannhauser A, Joubert G (2003). Impact of a nutrition education programme on nutrition knowledge and dietary practices of lower socioeconomic communities in the Free State and Northern Cape. *South African Journal of Nutrition* 16(3): 89-95.

Walsh CM, Dannhauser A, Joubert G (2002). The impact of a nutrition education programme on the anthropometric nutritional status of low-income children in South Africa. *Public Health Nutrition* 5(1): 3-9.

Walker S (2013). Programme co-ordinator, iThemba Projects, South Africa. Personal communication, 16 April 2013.

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APPENDIX A: LEARNER QUESTIONNAIRE

Consent:

QUESTIONNIARE FOR LEARNERS

Section A: Demographics and source of prior nutrition knowledge

Age (in years): a) 9 ☐ b) 10 ☐ c) 11 ☐ d) 12 ☐

Gender: a) Male ☐ b) Female ☐

Race: a) Black ☐ b) White ☐ c) Indian ☐ d) Coloured ☐ e) Other ☐

Where have you learnt about nutrition? (Choose one)

a) I have never learnt about it before ☐
b) I learnt some of it at school ☐
c) I listened to a talk at the clinic ☐
d) I read about it in a pamphlet ☐

Section B: Nutrition Knowledge

Answer the following questions by choosing the best answer for each question and then ticking that box.

FBDG Knowledge

1. What does "eat a variety of foods mean"?

		Tick one
a.	Eat the same type of food every day	
b.	To eat different kinds of foods from all the food groups at each meal or each day	
c.	To eat a lot of food at each meal, it doesn't matter what type	

2. How much water do primary school learners need to drink every day?

		Tick one
a.	1 cup a day is fine	
b.	6 – 8 cups a day	
c.	8 – 10 cups a day	

3. Do you think it is important to exercise?

		Tick one
a.	Yes	
b.	Only if you are fat	
c.	No, only if you want to	

4. What are good examples of exercise?

		Tick one
a.	Playing sport, house work, garden work	
b.	Watching TV	
c.	Playing computer games	

Food Groups:

5. Which foods are high in starch?

		Tick one
a.	Beans, meat, eggs	
b.	Carrots, apples, chicken liver	
c.	Biscuits, samoosas, milk	
d.	Phutu, bread, rice	

6. How often should we eat starchy foods every day?

		Tick one
a.	Only once	
b.	At most meals	
c.	As much as you want	

7. What does this logo stand for?

		Tick one
a.	Happy children	
b.	Fortification	
c.	Families are important	

8. How could you include more plant proteins into your diet?

		Tick one
a.	Add beans, split peas and lentils to soups and stews as part of a mixed meal	
b.	Eat an extra vegetable every day	
c.	Take more bread to school for lunch	

9. Do you have to eat fish, chicken, lean meat or eggs every day?

		Tick one
a.	Yes	
b.	No	

10. How can you eat more fruit and vegetables everyday if you need to?

		Tick one
a.	Drink diluted 100% fruit juice	
b.	Take some cut up salad vegetables to school to eat	
c.	Buy a fruit instead of sweets as a snack	
d.	All of the above	

11. What are examples of sugary foods?

		Tick one
a.	Sweets, cakes, ice-cream and chocolate	
b.	Fizzy drinks, juices and ice lollies	
c.	White bread with polony	
d.	a and b	

12. What are some examples of foods that have a lot of fat in them?

		Tick one
a.	Boerewors, polony, yellow cheese	
b.	Vetkoek, cakes, biscuits	
c.	Chips and crisps	
d.	All of the above	

13. How often should we have milk, maas or yoghurt?

		Tick one
a.	Every day	
b.	Once a week	
c.	When we are going to eat meat	
d.	When we are sick	

Nutrient content:

14. Which foods contain vitamin A?

		Tick one
a.	Orange vegetables like butternut	
b.	Fish with bones	
c.	Rice	
d.	Water	

15. What is the main food source of calcium?

		Tick one
a.	Dairy products	
b.	Fruit and vegetables	
c.	Starchy foods	
d.	Oil and margarine	

16. Which group of foods contain the most iron?

		Tick one
a.	Cheese, phutu, fruit	
b.	Liver, meat, spinach	
c.	Milk, cakes, rice	
d.	Bread, alcohol, sugar	

17. In which group of foods do we find the most protein?

		Tick one
a.	Fruit, vegetables and water	
b.	Meat, beans and milk	
c.	Bread, cake and oil	

18. What can we do to reduce our saturated fat intake?

		Tick one
a.	Use dripping or lard when cooking	
b.	Eat more beans and lentils instead of red meat	
c.	Cut all skin and fat off meat before cooking	
d.	Drink only full cream milk	
e.	b and c	

Nutritional benefits and deficiencies:

19. What is the function of vitamin A in the body?

		Tick one
a.	Helps build bones and teeth	
b.	Keeps eyes healthy with good night vision	
c.	Gives you energy	

20. What does protein do for our body?

		Tick one
a.	Repairs and builds our muscles	
b.	Gives us strong teeth	
c.	Prevents the immune system from functioning	
d.	a and c	

21. What would happen if we did not eat enough starches?

		Tick one
a.	We would become very thin	
b.	Our bones would break easily	
c.	We would not have enough energy to do anything	
d.	a and c	

22. What vitamin/mineral helps to prevent weak bones and teeth?

		Tick one
a.	Vitamin B	
b.	Calcium	
c.	Vitamin D	
d.	Iron	

23. What do you get from fruits and vegetables?

		Tick one
a.	Fibre	
b.	Minerals	
c.	Vitamins	
d.	All of the above	

THE END ☺

Thank you for participating in this questionnaire.

APPENDIX B: EDUCATOR QUESTIONNAIRE (ESM)

QUESTIONNIARE FOR EDUCATORS

Demographics (tick one)

Age (in years): a) 21-29 ☐ b) 30-49 ☐ c) 50-60 ☐ d) over 60 ☐

Gender: a) Male ☐ b) Female ☐

Race: a) Black ☐ b) White ☐ c) Indian ☐ d) Coloured ☐ e) Other ☐

Nutrition education received:
- Nothing ☐
- That taught at further studies ☐
- Additional course ☐
- Other information, e.g. NGO's, pamphlets ☐

Nutrition education given:
- Nothing ☐
- Only what is required for teaching ☐
- Outside talks, or further research done ☐

Answer the following questions by choosing the most accurate answer for the multiple choice questions and filling in what you think is the correct answer for the other questions.

Clarity of explanation:

1. Was the support material explained properly at the start?

		Tick one
a.	Yes, it was explained clearly	
b.	No, some parts were confusing	
c.	No, I had no idea what to do and so wasn't able to use it effectively	

2. Do you feel you had time to familiarise yourself with the material and ask questions if necessary?

		Tick one
a.	Yes, the researcher and her assistant were very helpful	
b.	Yes, but my questions weren't answered well	
c.	No, I felt like there was too much to read through it a short space of time	
d.	No, no one was available to help me	

3. Did someone explain to you how to use the material in your classroom with the current curriculum?

		Tick one
a.	Yes, I understood it well	
b.	Yes, but I was still confused about some parts	
c.	No	

Ease of use:

4. Was the material easy to work with?

		Tick one
a.	Yes	
c.	No	

5. How so? (tick the most appropriate)

		Tick one
a.	The information was interesting	
b.	The activities were simple yet fun	
c.	There was too much information to go through	
d.	It was difficult to incorporate it into what I already had.	

6. Did you have all the resources needed to use the material?

		Tick one
a.	Yes, I had everything I needed	
b.	Yes, all the things I needed were easily available around me	
c.	No, it required things that I didn't have	
d.	No, I needed a helper to conduct some of the activities	

7. Was there a lot of preparation required before using the material?

		Tick one
a.	Yes	
c.	No	

8. Please elaborate on Question 7.

		Tick one
a.	I spent more than 2 hours preparing each lesson	
b.	It took a while but it was fun	
c.	I was able to prepare quickly and without effort	
d.	I didn't really prepare at all	

9. Was the preparation time for each lesson manageable?

		Tick one
a.	Yes, it was quick and easy	
b.	Yes, if I have less than 3 lessons a week to prepare	
c.	No, it was too time consuming	

Effectiveness:

10. Did your learners understand what was being taught?

		Tick one
a.	Yes, they were all able to participate and learn	
b.	Yes, but not all the learners got involved in the learning process	
c.	No, the learners were not willing to participate	
d.	No, the learners found the activities too difficult to complete	

11. Was the material suitable for the age of learners that you are teaching?

		Tick one
a.	Yes, they all understood it	
b.	No, there was too much information	
c.	No, the information/ activities were too complicated	

12. Do you think the learners learnt anything by using the material?

		Tick one
a.	Yes, they learnt a lot	
b.	Yes, they learnt some things	
c.	No, they didn't listen and/or were bored	

General evaluation: (tick the most appropriate answer for each)

13. As an educator, how did you find the material?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	It was very informative					
b.	I liked the activities suggested					
c.	There was too much information					
d.	It was time consuming					
e.	I didn't get a chance to use it					

14. What did you enjoy most about the material?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	It is easy to use					
b.	I don't have to do a lot of work preparing for it					
c.	The learners enjoy it					
d.	The learners are learning something					
e.	I have everything I need for it and so I can use it properly					
f.	Other_____ _____					

15. What did you enjoy least about the material?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	I don't understand it or how to use it					
b.	It requires a lot of preparation time which I don't have					
c.	The learners found it boring					
d.	I do not feel like the learners learnt anything					
e.	I don't have the all the things I need to use it					
f.	Other_____ _____					

16. What would you change/improve about the material?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	Nothing, it works well					
b.	Make it easier to understand and use					
c.	Provide a detailed outline for each day with related resources					
d.	Have a training session on how to use it before starting					

17. Would you recommend it to other educators?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	Yes					
b.	No					

THE END ☺

Thank you for participating in this questionnaire.

APPENDIX C: EDUCATOR QUESTIONNAIRE (GAME)

QUESTIONNIARE FOR EDUCATORS

Demographics (tick one)

Age (in years): a) 21-29 ☐ b) 30-49 ☐ c) 50-60 ☐ d) over 60 ☐

Gender: a) Male ☐ b) Female ☐

Race: a) Black ☐ b) White ☐ c) Indian ☐ d) Coloured ☐ e) Other ☐

Nutrition education received:
- Nothing ☐
- That taught at further studies ☐
- Additional course ☐
- Other information, e.g. NGO's, pamphlets ☐

Nutrition education given:
- Nothing ☐
- Only what is required for teaching ☐
- Outside talks, or further research done ☐

Answer the following questions by choosing the most accurate answer for the multiple choice questions and filling in what you think is the correct answer for the other questions.

Clarity of explanation:

1. Was the function of the game explained properly at the start?

		Tick one
a.	Yes, it was explained clearly	
b.	No, some parts were confusing	
c.	No, I had no idea what to do and so wasn't able to use it effectively	

2. Do you feel you had time to familiarise yourself with the game and ask questions if necessary?

		Tick one
a.	Yes, the researcher and her assistant were very helpful	
b.	Yes, but my questions weren't answered well	
c.	No, no one was available to help me	

3. Did someone explain to you how to use the game in your classroom alongside your current curriculum?

		Tick one
a.	Yes, I understood it well	
b.	Yes, but I was still confused about some parts	
c.	No	

Ease of use:

4. Was the game easy to work with?

		Tick one
a.	Yes	
c.	No	

5. How so?

		Tick one
a.	It was very simple to understand	
b.	It was easy to use	
c.	I didn't understand how to play properly	
d.	It was difficult to incorporate it into what I already had.	

6. Did you have all the resources needed to play the game?

		Tick one
a.	Yes, I had everything I needed	
b.	No, I didn't have anything once the game resources provided ran out	
c.	No, I needed a helper to facilitate the learners	

7. Was there a lot of setting up required before using the game?

		Tick one
a.	Yes	
c.	No	

8. Please elaborate on Question 7.

		Tick one
a.	It took more than 10 minutes to set up	
b.	I was able to set up quickly and without effort	
c.	I didn't set up at all, the learners could do it on their own	

9. Would you be willing use this game outside of a nutrition lesson?

		Tick one
a.	Yes	
c.	No	

10. Please give more detail on Question 9.

		Tick one
a.	It is convenient and the learners enjoy it	
b.	If someone is around to supervise	
c.	It was too distracting	
d.	The learners did not enjoy it that much	

Effectiveness:

11. Did the children understand how to play the game?

		Tick one
a.	Yes, they were all able to participate and learn	
b.	Yes, but not all the learners go involved in the game properly	
c.	No, the learners were not willing to participate	
d.	No, the learners found it too difficult to play	

12. Was the game suitable for the age of children that you are teaching?

		Tick one
a.	Yes, they all understood	
b.	No, the questions were too difficult	
c.	No, the game was too simple	

13. Do you think the learners learnt anything by using the material?

		Tick one
a.	Yes, they learnt a lot	
b.	Yes, they learnt some things	
c.	No, they were bored and/or confused	

General evaluation: (tick the most appropriate answer for each)

14. As an educator, did you find the game helpful?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	It was quick and easy to use					
b.	The learners learnt while having fun					
c.	It was distracting					
d.	I didn't get a chance to use it					

15. What do you enjoy most about the game?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	It is easy to use					
b.	I don't have to preparing anything in order to use it					
c.	The learners enjoy it and it keeps them busy					
d.	The learners are learning something					
e.	Other _____ _____					

16. What did you enjoy least about the game?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	I don't understand it or how to use it					
b.	It requires someone to watch the children and I don't have time for that					
c.	The learners find it boring and don't learn anything					
d.	I could not use it once the original resources are finished, I did not have more					
e.	Other _____ _____					

17. What would you change/improve about the game?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	Nothing, it works well					
b.	Make it easier to understand and use					
c.	Make it more detailed for this age group					
d.	Make the questions harder					
e.	Other_____ _____					

18. Would you recommend this game to other educators?

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a.	Yes					
b.	No					

THE END ☺

Thank you for participating in this questionnaire.

INFORMATION FOR YOUR TEACHER

Cap-it is a nutrition education tool designed to be used to aid children in further learning through a fun and interactive game. The tool is based on the National Curriculum and Assessment Policy Statement (CAPS) from the Life Skills teacher's resource manual. The focus is based on Unit 6 teaching on Healthy Eating. It should be played at the end of teaching the Healthy Eating section of the curriculum.

Cap-it should be played in small groups of 4- 6 learners per group. All the learners will be actively participating and the game is simple enough to be played without the help of the teacher. This will allow the teacher an opportunity to move around the classroom and assess how much the learners have learnt as well as help any learners having difficulty or sort out disputes.

THE RULES

Hi, I'm Jabulani, and this is how to play my game

> ***I hear and I forget. I see and I remember. I do and I understand.***
>
> **Chinese Proverb**

What you need:

- Each player will need a printed sheet of the Cap-it boy, a silver board to press on, 2 black clips to hold the paper onto the board, and some crayons to share.
- Take out the dice and the pack of the prepared question cards. Place the cards writing side down on the desk.

Rules to play:

1. Divide into groups of 4 – 6 players. Clip your paper to your silver board using the black clips provided.
2. Choose someone to start. That person will throw the dice. You may only start when you have thrown a number 1 (the body). If you do not throw a number 1 then the next person has a turn. If you do throw a number 1, the person on the RIGHT removes a card from the pile and asks the question. The person whose turn it is must answer. If they answer CORRECTLY they can colour-in the tummy of the Cap-it boy. (If another player shouts out the answer and the person whose turn it is wants to use that answer, they may.) If they answer incorrectly, they may not colour-in the tummy and the next person has a turn. Once used, each question card must be placed at the bottom of the pile. If all the question cards are used up before the game is finished, they should be reshuffled and reused.
3. The game rotates CLOCK-WISE i.e. the next person on the left has a turn to throw the dice. They have their turn and again, the person who asks them the question will be the person who has just had a turn.
4. The dice does not have to be thrown in order (i.e. 1-6). Once a 1 is thrown to start, either a 2 (the arms) or a 3 (the legs) or a 4 (the head) can be throw and the appropriate part of the body coloured in. This is because they are all touching the tummy (number 1). However, if a 5 is thrown (the hair) before a 4 (the head) then a questioned cannot be asked because the boy cannot have hair before he has a head. Note the dice has to be thrown twice for the arms (number 2) and legs (number 3) to be coloured-in. Both cannot be coloured-in in the same turn. However once the body (numbers 1) have been drawn, the arms and legs can be added on in any order provided the question is answered correctly.

> ***"What we learn with pleasure we never forget."***
>
> **Alfred Mercier**

5. When you have coloured-in the whole body, only then can you throw a 6 to answer three final questions. Once done correctly, you can stick on a cap on the boy and shout CAP-IT!!! to indicate that you have won!
6. The game will either stop at this point or continue until others have finished.

APPENDIX E: CONSENT AND ASSENT FORMS

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

THE SCHOOL PRINCIPAL

Dear Sir / Madam,

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN YOUR SCHOOL

I am a student at the University of KwaZulu-Natal studying towards my Masters of Science (Dietetics). My research topic is entitled *"The effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators support material in supplementing nutrition education to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal."*

I am hereby requesting permission to use your school in my study. I would like to provide the Grade 5 educators with additional tools to help in teaching nutrition education and then assess their learners to determine their knowledge retention and thus the effectiveness of the tools provided. Should you agree to participate, I will formally request consent from the parents/guardians of your learners, as well as assent from the learners.

The information obtained from your school and learners will be collected on an anonymous, strictly confidential and voluntary basis. You may withdraw the participation of your school at any stage of the study. There will not be any negative or undesirable consequences should you choose to do so.

Should you have any queries regarding my research, please feel free to contact me on 084 789 1059 or resteves.dietician@gmail.com

Yours Sincerely,

Rebecca Esteves	Dr Nicky Wiles	Annette Van Onselen
Masters Student	Masters Supervisor	Masters Supervisor
084 789 1059	033 260 5430	033 260 6154
resteves.dietician@gmail.com	wilesn@ukzn.ac.za	vanonselen@ukzn.ac.za

INFORMED CONSENT FROM THE SCHOOL PRINCIPAL:

- I hereby confirm that I have been informed by UKZN Masters student Rebecca Esteves about the nature of her study *"The effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators support material in supplementing nutrition education to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal."*
- I have also received, read and understood the written information in the letter requesting permission to use my school in this study.
- I understand that I may contact Ms Esteves (084 789 1059, resteves.dietician@gmail.com) or her supervisors Dr Nicky Wiles (033 260 5430) or Annette Van Onselen (033 260 6154) at any time if I have questions about the research.
- I understand that my school's involvement in the study is on a strictly anonymous, confidential and voluntary basis and that both assent and consent for any learner participation will be requested from the learner and their parent / guardian.
- I understand that I may withdraw my school's participation in the study without any fear of negative or undesirable consequences should I choose to do so.

I hereby consent for my school to participate.

Name:_____ Signature:_____

School Name:_____ Date:_____

GRADE 5 EDUCATORS

Dear Primary School educators,

RE: REQUEST FOR CONSENT TO PARTICIPATE IN A STUDY

I am a student at the University of KwaZulu-Natal studying towards my masters, and my research topic is entitled *"The effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators support material in supplementing nutrition education to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal."*

I am hereby requesting your permission to participate in my study. Should you agree to participate, I will formally request consent from the school, parents/guardians, and assent from the learners.

The information obtained from you will be collected on an anonymous, strictly confidential and voluntary basis. You may withdraw your participation at any stage of the study. There will not be any negative or undesirable consequences should you choose to do so.

Should you have any queries regarding my research, please feel free to contact me on 084 789 1059 or resteves.dietician@gmail.com

Yours Sincerely,

Rebecca Esteves
Masters Student
084 789 1059
resteves.dietician@gmail.com

Dr Nicky Wiles
Masters Supervisor
033 260 5430
wilesn@ukzn.ac.za

Annette Van Onselen
Masters Supervisor
033 260 6154
vanonselen@ukzn.ac.za

INFORMED CONSENT FROM THE PRIMARY SCHOOL LEARNER:

- I hereby confirm that I have been informed by UKZN Masters student Rebecca Esteves about the nature of her study *"The effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators support material in supplementing nutrition education to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal."*
- I have also received, read and understood the written information in the letter requesting permission to use my school in this study.
- I understand that I may contact Ms Esteves (084 789 1059, resteves.dietician@gmail.com) or her supervisor Dr Nicky Wiles (033 260 5430) at any time if I have questions about the research.
- I understand that my involvement in the study is on a strictly anonymous, confidential and voluntary basis and that consent to participate will be requested from the school that I work at, the parents/guardians, and the learners.
- I understand that I may withdraw my participation in the study without any fear of negative or undesirable consequences should I choose to do so.

I hereby consent to participate in this study.

Name:_____ Signature:_____

School Name:_____ Date:_____

GRADE 5 LEARNERS

Dear Primary School learner,

RE: REQUEST FOR ASSENT TO PARTICIPATE IN A STUDY

I am a student at the University of KwaZulu-Natal studying towards my masters, and my research topic is entitled *"The effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators support material in supplementing nutrition education to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal."*

I am hereby requesting your permission to participate in my study. Should you agree to participate, I will formally request consent from the parents/guardians.

The information obtained from you will be collected on an anonymous, strictly confidential and voluntary basis. You may withdraw your participation at any stage of the study. There will not be any negative or undesirable consequences should you choose to do so.

Should you have any queries regarding my research, please feel free to contact me on 084 789 1059 or resteves.dietician@gmail.com

Yours Sincerely,

Rebecca Esteves
Masters Student
084 789 1059
resteves.dietician@gmail.com

Dr Nicky Wiles
Masters Supervisor
033 260 5430
wilesn@ukzn.ac.za

Annette Van Onselen
Masters Supervisor
033 260 6154
vanonselen@ukzn.ac.za

INFORMED ASSENT FROM THE PRIMARY SCHOOL LEARNER

- I hereby confirm that I have been informed by UKZN Masters student Rebecca Esteves about the nature of her study *"The effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators support material in supplementing nutrition education to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal."*
- I have also received, read and understood the written information in the letter requesting permission to use my school in this study.
- I understand that I may contact Ms Esteves (084 789 1059, resteves.dietician@gmail.com) or her supervisor Dr Nicky Wiles (033 260 5430) at any time if I have questions about the research.
- I understand that my involvement in the study is on a strictly anonymous, confidential and voluntary basis and that consent to participate will be requested from my parents / guardians.
- I understand that I may withdraw my participation in the study without any fear of negative or undesirable consequences should I choose to do so.

I hereby assent to participate in this study.

Name:_____ Signature:_____

School Name:_____ Date:_____

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

PARENT / GUARDIAN OF LEARNER

Dear Sir / Madam,

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH INVOLVING YOUR CHILD

I am a student at the University of KwaZulu-Natal studying towards my masters, and my research topic is entitled *"The effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators support material in supplementing nutrition education to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal."*

I am hereby requesting permission to obtain information from your child for use in my study. This information will be collected on an anonymous, strictly confidential and voluntary basis. Your child may withdraw from participating in my study at any point should they wish. They will not face any negative or undesirable consequences should they choose to withdraw.

Should you have any queries regarding my research, please feel free to contact me on 084 789 1059 or resteves.dietician@gmail.com

I would be most grateful if you could sign the attached form and return it to your child's school as soon as possible.

Yours Sincerely,

Rebecca Esteves	Dr Nicky Wiles	Annette Van Onselen
Masters Student	Masters Supervisor	Masters Supervisor
084 789 1059	033 260 5430	033 260 6154
resteves.dietician@gmail.com	wilesn@ukzn.ac.za	vanonselen@ukzn.ac.za

INFORMED CONSENT FROM THE PARENT OF THE PARTICIPANT:

- I hereby confirm that I have been informed by UKZN Masters student Rebecca Esteves about the nature of her study *"The effectiveness of a modified Food Based Dietary Guideline nutrition education game and educators support material in supplementing nutrition education to improve retention of knowledge in rural Grade 5 learners, living in Sweetwaters, KwaZulu-Natal."*
- I have also received, read and understood the written information in the letter requesting permission to use my child in this study.
- I understand that I may contact Ms Esteves (084 789 1059, resteves.dietician@gmail.com) or her supervisor Dr Nicky Wiles (033 260 5430) at any time if I have questions about the research.
- I understand that my child's involvement in the study is on an anonymous, strictly confidential and voluntary basis.
- I also understand that my child may withdraw from participating in this study at any point should they wish, without fear of any negative or undesirable consequences.

I hereby consent for my child to participate. ☐

Name:_____ Signature:_____

Child's Name:_____ Child's Class:_____

School Name:_____ Date:_____

I would not like my child to participate in this study. ☐

MZALI WOMNTWANA

LESI ISICELO SEMVUMO YOKWENZA UCWANINGO OLUBANDAKANYA UMNTWANA WAKHO

Ngingumfundi wase Nyuvesi yakwa Zulu- Natal owenza izuqu ezibizwa ngo kuthi ezemasters. Ngenza ucwaningo mayelana nokufundaswa ngokudla, isihloko socwaningo lwami sithi "Amathuluzi noma izinto ezisetshenziswayo uma kufundiswa ngokudla ebantwanani ezisiza ekutheni bakhumbule kangcono lokhu ebekade bekufundiswa" Ucwaningo lugxile ebantwaneni base Sweetwaters abenza ibanga lesi hlanu "uGrade 5".

Ngakho ke, ngicela imvumo ukuba ngisebenzise umntwana wakho kulolu cwaningo. Ulwazi noma izimpendulo esizobe sizithola kuye ziyi mfihlo, okusho ukuthi akekho omunye umuntu ozokwazi ngazo zizosetshenziselwa lolu cwaningo nje kuphela, futhi akaphoqekile umntwana ukuba asize kulolucwaningo, ngalokho uvumelekile ukuyeka noma ngabe inini futhi akukho okuzokwenzeka kuyena uma ekhetha ukushiya sisephakathi nocwaningo.
Uma unemibuzo ngalolu cwaningo, ungangithinta kule namba yocingo ethi 084 789 1059 noma I email ethi resteves.dietician@gmail.com

Benginga bonga kakhulu uma bungakwazi ukusayina leli fomu elingaphansi, mase libuyela esikoleni somntwana ngoku phuthuma.

Ngiyabonga.

Rebecca Esteves	Dr Nicky Wiles	Annette Van Onselen
Masters Student	Masters Supervisor	Masters Supervisor
084 789 1059	033 260 5430	033 260 6154
resteves.dietician@gmail.com	wilesn@ukzn.ac.za	vanonselen@ukzn.ac.za

IFOMU LESIVUMELWANO LOMZALI WOMNTWANA:

- Ngiyaqinisekisa ukuthi ngichazeleke kahle mayelana nogcwaningo olwenziwa umfundi wase nyuvesi yakwa Zulu-Natal, uRebecca Esteves olwesi hloko sithi *"Amathuluzi asetshenziswayo ekusizeni ukuba abantwana bakukhumbule kangcono lokho abakufundiswayo mayelana nokudla"* nokuthi lolu gcwaningo lugxile ebantwaneni base sweetwaters Kwazulu Natal abenza ibanga lesi hlanu (grade 5)
- Ngiyaqinisekisa ukuthi ngiyitholile futhi ngiyifundile ngayiqonda incwadi ecela ukuba kusetshenziswe umntwana wami kulolu gcwaningo.
- Ngiyaqonda ukuba ngingaxhumana no Ms Esteves kule number 084 789 1059, resteves.dietician@gmail.com noma umeluleki wakhe uDr Nicky Wales kule namba 033 260 5430 noma inini uma nginemibuzo.
- Ngiyaqonda ukuthi ukuzibandakanya komntwana wami kulolugcwaningo kungokuzikhethela futhi kuyi mfihlo ephakathi kwakhe nomgcwaningi.
- Futhi ngiyaqonda ukuthi umntwana wami engahoxa noma ngabe inini kulolugcwaningo uma esezizwela kufanele, ngaphandle kwezinkinga ezingaba umphumela wogcwaningo.

Ngalokho ngiyamuvumela umntwana wami ukuba azibandakanye kulolugcwaningo. ☐

Igama: _____ isithupha noma umaka: _____

Igama lomntwana: _____ Ibanga lomntwna: _____

Igama le skole: _____ eDate: _____

Cha, angivumi ukuba umntwana wami azibandakanye kulolugcaningo. ☐

APPENDIX F: ETHICAL CLEARANCE FROM UKZN

APPENDIX G: PERMISSION FROM DOE