# DEVELOPMENT OF A FOOD KNOWLEDGE TEST FOR FIRST-YEAR STUDENTS AT A UNIVERSITY OF TECHNOLOGY IN THE WESTERN CAPE, SOUTH AFRICA

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**OPSOMMING**

Die doel van hierdie studie was om ‘n geldige en betroubare toets te ontwikkel om die voedselkennis van eerstejaar-studente by ‘n universiteit van tegnologie in die Wes-Kaap, Suid-Afrika, te bepaal. Daar is op twee kennisvelde, naamlik vrugte en groente en vette en olies, gefokus aangesien die dieetinname van jong volwassenes oor die algemeen gekenmerk word deur ‘n hoë vetinname en minder as die aanbevole daaglikse inname van vrugte en groente. Toetsitems het die keuse, aankope, stoor, voorbereiding en gaarmaakmetodes van hierdie voedselsoorte ingesluit. Aangesien geen geldige voedselkennis-toets binne ‘n Suid-Afrikaanse konteks opgespoor kon word nie, is al die items wat in die toets ingesluit is van nuuts af ontwikkel. Die toets bestaan uit veelvoudige keuse-items wat aan die reëls van item-konstruksie voldoen. Die items is deur ‘n paneel met kennis en ervaring van voedselwetenskap en voeding, asook die verwagte kennisvlak van eerstejaar-studente, geëvalueer. Die lede van die paneel het die inhouds- en voorkomsgeldigheid van die items nagegaan.

Die toets is deur groepe studente van verskillende studierigtings beantwoord met die veronderstelling dat hulle sou verskil ten opsigte van hul voedselkennis. Die toets is drie keer afgelê om genoegsame items (20 tot 25), wat aan die kriteria vir item-analise voldoen, te verkry. Na die eerste en tweede herhaling van die eerste toets het onderskeidelik tien en dertien van die oorpronklike 72 items behoue gebly. Addisionele items is na elke herhaling bygevoeg. Die tweede toets, wat uit 135 items bestaan het, is slegs een keer afgelê aangesien 74 items na afloop van die item-analise behoue gebly het. Die 74 items verteenwoordig 49 items in die vrugte- en groente- kennisveld, en 25 items in die vette- en olies-kennisveld. Die tweede en finale toetse het slegs drie afleiers vir elke veelvoudige keuse-item gehad, terwyl die eerste toets vier afleiers gehad het vir elke item. Die resultate van die item-analise dui daarop dat dit moeilik is om vier suksesvolle afleiers te ontwikkel.

Die finale toets het ‘n betroubaarheidskoëffisiënt van 0,934 soos aangedui deur die Kuder-Richardson-formule 20 (K-R20), sowel as die Cronbach’s alpha-koëffisiënt. ‘n Betekenisvolle verskil ($p < 0,001$) in kennis is tussen die groepe studente verkry deur van die Mann-Whitney-toets gebruik te maak ($z = 9,74$). Omdat daar meer as die verwagte aantal toetsitems oorgebly het ná die item-analise van die tweede toets, is die geldigheid en betroubaarheid van die twee kennisvelde, naamlik vrugte en groente en vette en olies, as onafhanklike toetse bepaal. Aangesien beide kennisvelde aan die kriteria voldoen, kan dit as afsonderlike toetse in ‘n groep- of individuele verband gebruik word. Data wat verskaf word deur die aflegging van hierdie toetse kan gebruik word om programme op te stel wat die basiese voedselkennis, keuses van en voedselvoorbereiding deur eerstejaar-studente kan verbeter. Die toetse wat tydens hierdie studie ontwikkel is, is die eerste in hulle soort binne die Suid-Afrikaanse konteks.

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## INTRODUCTION

The dietary practices of students are a matter of concern as it affects more than their present health and well-being. There is the added risk that dietary practices established during early adulthood can continue into later life (Fitzgerald *et al*, 2010). Poor dietary practices increase the likelihood of hyperlipidaemia, hypertension, diabetes mellitus and other chronic diseases of lifestyle (Malinauskas *et al*, 2006). Numerous studies have found that young adults do not consume the recommended daily intake of fruit and vegetables along with dietary fibre (Story *et al*, 2002; Peltzer, 2004; Strong *et al*, 2008). In addition, their typical food choices generally consist of high-fat products (Ayranci *et al*, 2010; Venter & Winterbach, 2010) with low nutrient density (Temple *et al*, 2006). Over the last decade, many international and national studies investigated the impact of nutrition knowledge on the dietary intake and the dietary practices of young adults (Wardle *et al*, 1997; Klemmer, 2002; Kolodinsky *et al*, 2007; Oosthuizen *et al*, 2011; Van't Riet *et al*, 2011). However, very little information is available on the food knowledge of individuals or groups, pertaining to the choice, purchasing, storage, preparation and cooking of food items.

As young adults move into an independent living situations upon entering tertiary education, their risk of following unhealthy dietary practices increases as they become more self-reliant in terms of food choices and the preparation of meals (Wardle *et al* 1997; Klemmer, 2002). First-year students experience more freedom of choice and are also faced with an increased academic workload. These factors may form barriers to maintaining or adopting a healthy lifestyle (Von Ah *et al*, 2004; Fitzgerald *et al*, 2010). Students may also give less attention to healthy eating habits as convenience foods are more available and affordable to them (Betts *et al*, 1997).

The most common barriers facing students, aged 18 to 23 years, in preparing a healthy and balanced meal are: lack of time (Larson *et al*, 2006), lack of knowledge, having no interest in earning food skills and/or an overestimation of their food knowledge (Byrd-Bredbenner, 2004; Soliah *et al*, 2006). Limited food knowledge may prevent individuals from fully implementing general food preparation recommendations designed to improve the nutritional value of food (Byrd-Bredbenner, 2004).

Food knowledge and skills are defined as the knowledge and skills involved in "purchasing, preparing and cooking food ingredients using available resources to produce a meal that is appropriate to the age and nutritional needs of the individuals consuming it" (Fordyce-Voorham, 2011). Instruction in basic food preparation and meal planning skills need to be part of any long-term solution to improve the quality of the diets of young adults (Lichtenstein & Ludwig, 2010). All children should receive comprehensive food education while at school (Stitt, 1996), which should include instruction in basic food preparation and meal planning skills (Lichtenstein & Ludwig, 2010). It is believed that cooking is a life skill and unless children are taught cooking skills, their ability to eat and live healthily is challenged. To make informed choices about diet and health, young adults need to have a good understanding of food and nutrition (Stitt, 1996).

The objective of this study has been to develop a valid and reliable self-administered questionnaire, in the format of a test, to determine the food knowledge of first-year students at a university of technology (UOT) in the Western Cape, South Africa (SA). The test focused on the choice, purchase, storage, preparation and cooking methods regarding two food domains, i.e. fruit and vegetables and fats and oils as dietary constituents.

## METHODOLOGY

### Ethics approval

Ethics approval was granted by the Cape Peninsula University of Technology (CPUT) Faculty of Applied Sciences Research Ethics Committee after acceptance of the research proposal by the Faculty Research Committee. Students forming the samples groups were fully informed regarding the aim of the study and signed an information leaflet and consent form. All students participated voluntarily and anonymously.

### Study design

In this study a valid and reliable knowledge test, consisting of a sufficient number of test items, was constructed. The test was adjusted and administered more than once as insufficient test

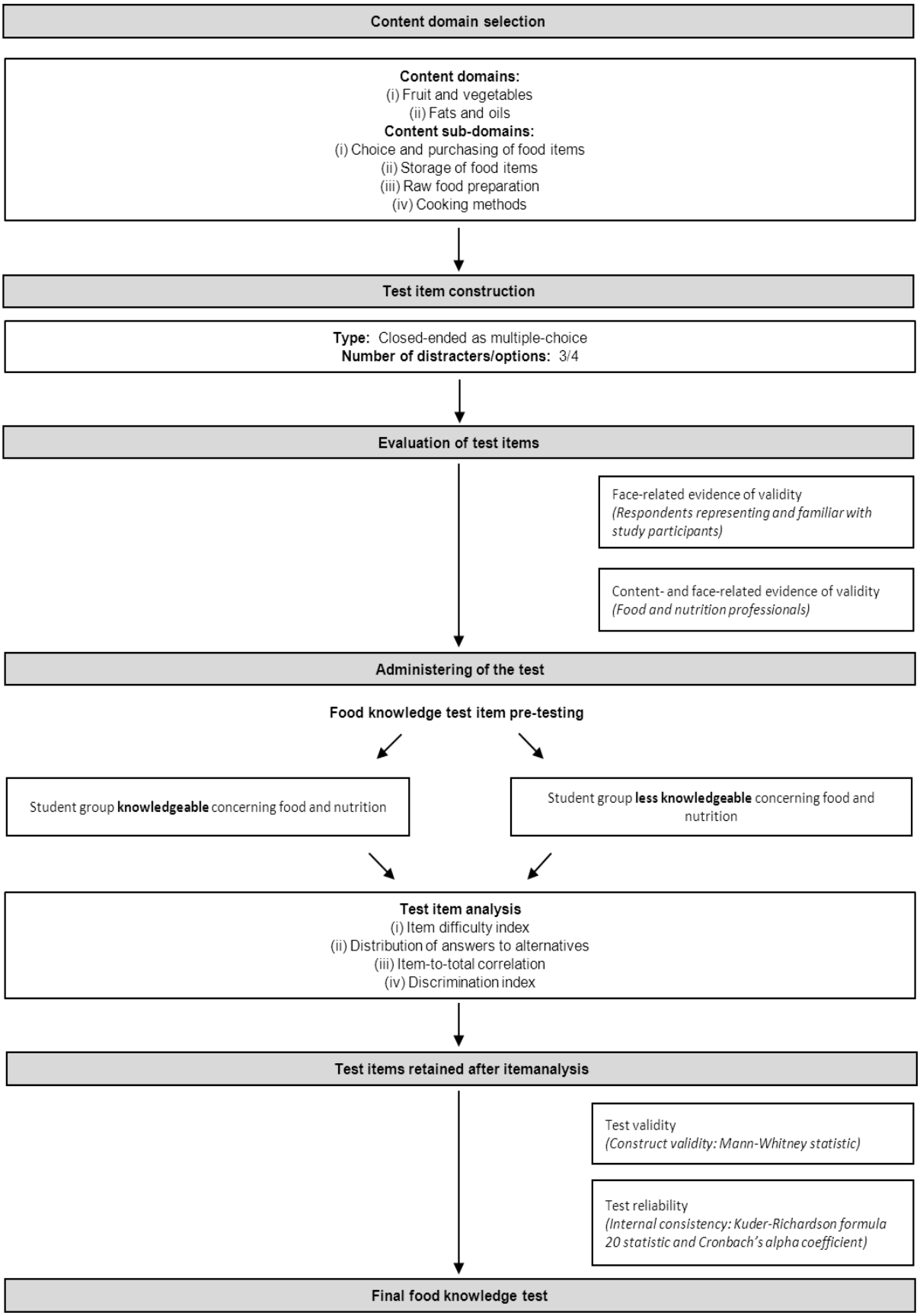


**FIGURE 1: OUTLINE OF THE PHASES AND STEPS INCLUDED IN THE DEVELOPMENT OF THE FOOD KNOWLEDGE TEST**

**TABLE 1: NUMBER OF TEST ITEMS WITHIN EACH CONTENT DOMAIN AFTER THE CONTENT AND FACE VALIDITY EVALUATIONS OF THE FIRST AND SECOND FOOD KNOWLEDGE TESTS**

| | Pre-phase evaluations | Test content domains | Number of test items | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Developed | | | Discarded | | Retained | |
| | | | Retained* | New | Total | n | % | n | % |
| First test | Pre-phase 1** | Section A: Fruit and vegetables | - | 54 | 54 | 34 | 63,0 | 20 | 37,0 |
| | | Section B: Fats and oils | - | 55 | 55 | 41 | 74,5 | 14 | 25,5 |
| | **Total** | | **-** | **109** | **109** | **75** | **68,8** | **34** | **31,2** |
| | Pre-phase 2** | Section A: Fruit and vegetables | 20 | 40 | 60 | 21 | 35,0 | 39 | 65,0 |
| | | Section B: Fats and oils | 14 | 34 | 48 | 19 | 39,6 | 29 | 60,4 |
| | **Total** | | **34** | **74** | **108** | **40** | **37,0** | **68** | **62,7** |
| | Pre-phase 3** | Section A: Fruit and vegetables | 39 | 2 | 41 | 1 | 2,4 | 40 | 97,6 |
| | | Section B: Fats and oils | 29 | 11 | 40 | 1 | 2,4 | 39 | 97,5 |
| | **Total** | | **68** | **13** | **81** | **2** | **2,5** | **79** | **97,5** |
| | Final pre-phase*** | Section A: Fruit and vegetables | 40 | - | 40 | 4 | 10,0 | 36 | 90,0 |
| | | Section B: Fats and oils | 39 | - | 39 | 3 | 7,7 | 36 | 92,3 |
| | **Total** | | **79** | **-** | **79** | **7** | **8,9** | **72** | **91,1** |
| Second test | Pre-phase 1** | Section A: Fruit and vegetables | 24# | 64 | 88 | 0 | 0,0 | 88 | 100,0 |
| | | Section B: Fats and oils | 22## | 30 | 52 | 0 | 0,0 | 52 | 100,0 |
| | **Total** | | **46** | **94** | **140** | **0** | **0,0** | **140** | **100,0** |
| | Final pre-phase **** | Section A: Fruit and vegetables | 88 | - | 88 | 3 | 3,4 | 85 | 96,6 |
| | | Section B: Fats and oils | 52 | - | 52 | 4 | 7,7 | 48 | 92,3 |
| | **Total** | | **140** | | **140** | **7** | **5,0** | **133^** | **95,0** |

** Retained = Item kept as is and/or slightly adapted
** Evaluation undertaken by two expert panelists
*** Evaluation undertaken by six expert panelists and a student group represented by 36 second-year students from the programme Consumer Science: Food and Nutrition
**** Evaluation undertaken by eight expert panelists
# 12 items discarded on item analyses performed on administrations of the first test
## 14 items discarded on item analyses performed on administrations of the first test
^ An additional two items developed (n = 135)

items remained after the first completion. The steps followed in the development of the first and second versions of the test, were similar (Figure 1) and included: i) pre-phase content and face validity evaluations by expert panelists; ii) completion of the test by the sample groups; iii) item analysis; and iv) the determination of construct validity and reliability.

The first test was administered twice and adjusted by adding additional/new test items to form the second test, which was administered only once to obtain a sufficient number of test items to form the final knowledge test. The data obtained after each administration was used for item analysis. Construct validity and reliability determinations were undertaken on the data obtained from the administration of the second test. The second test formed the basis for the final test.

**Content domain and sub-domain selection**

The food content domains covered in the knowledge test are fruit and vegetables and fats and oils. An insufficient fruit and vegetable intake and high fat intake are two major dietary concerns associated with young adults

(Kolodinsky *et al*, 2007). The selection of the sub-domains was based on factors that influence the nutritional value of food consumed raw and cooked (Bennion & Scheule, 2003:303). The sub-domains are: i) the choice and purchasing of food items; ii) the storage of food items; iii) raw food preparation; and iv)cooking methods. These sub-domains were considered during the test item development to ensure representation of all the relevant aspects of food knowledge within each content domain. It was not deemed necessary to have test items from each of the aforementioned sub-domains to be represented or represented equally in the final food knowledge test.

**Item construction**

Huysamen (1988:46) recommends that twice as many items be developed as are required for the final test so that the envisaged number of test items can be retained after the item analysis. The envisaged number of retained items was between 20 and 25. However, after the various pre-phase evaluations 72 and 135 items were included in the first and second tests respectively to allow for items to be discarded based on the item analysis and construct validity and reliability determinations (see Table 1).

Various aspects related to the test item construction were considered. These aspects included item type selection, clarity, ambiguity, length and relevance. The multiple-choice format was chosen as the test item type. The versatility of multiple-choice items allows for the assessment of many aspects of learning, such as definitions, factual curriculum content, association, evaluation, reasoning and skills (Nunnally, 1972:170; Ebel & Frisbie, 1991:154; Gronlund, 1993:46). The stem of the test items were presented as both questions and incomplete statements (Thorndike & Hagen, 1977:228) as it provided more flexibility in the design of the items (Babbie & Mouton, 2010: 233). It is recommended that multiple-choice test items should have at least three options to be classified as a multiple-choice item (Thorndike & Hagen, 1977:228; Gronlund, 1993:41). The first test consisted of four options (i.e. a, b, c and d). It was difficult to develop four options acting as appropriate distracters for each test item (based on item analysis). For this reason only three options (i.e. a, b and c) per test item were developed for the second and final tests.

General item construction rules, obtained from the available literature, were considered in the development of the multiple-choice items. These rules included: The test content being related to important aspects of the subject matter (Nunnally, 1972:172); unnecessary sources of difficulty avoided, i.e. the use of unfamiliar words; negatives used sparingly in the stem and where used, the negative word(s) emphasised in bold and underlined (Gronlund, 1993:51); incorrect answers plausibly related to the problem so that respondents would not rule out the unrelated options as obviously incorrect; correct options not consistently different in appearance from the incorrect options; use of options stating 'none of the above' or 'all of the above' not consi -dered for use (Nunnally, 1972:178; Thorndike & Hagen, 1977:223); and options being clear and short to make it easy for respondents to understand (Babbie & Mouton, 2010:236).

**Pre-testing of preliminary test items**

An evaluation panel consisting of at least three (Lynn, 1985) to five (Burns & Grove, 1993:328) experts is needed to adequately judge the content validity of the knowledge test items. For this study, the expert panel was selected from within the academic fields of food science and nutrition. Face validity refers to the degree to which test items appear, on the basis of subjective evaluation, to serve their purpose in that the indicator measures the construct (Neuman, 2006:192). It can be determined by having an untrained individual determine whether the content appears to be appropriate to the stated outcome of the knowledge test, i.e. gaining rapport with the participants (Huysamen, 1988:42).

The construction of the first test consisted of three pre-phase content and face validity evaluations by two expert panelists familiar with the knowledge-level and curriculum content of first-year students studying a food-related course in order to eliminate and/or correct items, where necessary, before the evaluation by the larger panel. An additional pre-phase content and face validity evaluation was performed by a further four expert panelists and a pre-phase face validity evaluation by a group of 36 second-year students. These students were chosen as they were knowledgeable in having at least two years of formal food science and nutrition education. For the second test, only one pre-phase content and face validity evaluation was conducted by the aforementioned two expert panelists, in addition to one further pre-phase evaluation by the larger panel. Table 1 provides a summary of the number of test items retained

within each content domain after the content and face validity evaluations of the pre-phases of the first and second tests.

The tests were handed out and completed by the respondents in an institutional setting, i.e. during lecture periods, as arranged with the academic staff involved. This type of setting is believed to increase the response rate (Babbie, 1990:187) and allowed for quick reviewing of the completed tests for omissions by respondents which could have lowered the amount of useable data (Singleton *et al*, 1993:265). As is evident from Table 2 different student groups were involved to provide for groups who were deemed to be more knowledgeable and less knowledgeable about the topic. The students also completed a questionnaire to determine their demographic and biographic characteristics. The Pearson's chi-square statistic was used to determine sample correspondence and differentiation between the two sample groups' demographic and biographic data. This statistic was used as additional support for the construct validity based on selected study fields.

**Test item analysis**

Item analysis involved the statistical analysis of the data obtained from administering the tests to identify which test items could be retained and which needed revision or needed to be discarded. Only the test items meeting the analysis criteria were retained and used to determine the validity and reliability of the final test. The data of the completed tests were entered into a Microsoft Excel spreadsheet and the item analysis conducted using IBM SPSS Statistic (version 21,0).

**Item difficulty index (IDI)** The IDI refers to the percentage of the respondents who answer an item correctly (Nunnally, 1972:186). A range of 0,35 and 0,85 was used with the test items found to be too easy (i.e. answered correctly by more than 85% of the respondents) or too difficult (i.e. answered correctly by fewer than 35% of the respondents) discarded.

**Discrimination index** The percentage of respondents in the top 27% and bottom 27% choosing the correct answer was determined, after which the percentage of the bottom group was subtracted from the percentage of the top group. A 20% difference was required per test item to ensure discrimination between the top/ good performers and the bottom/poor performers (Nunnally, 1972:192).

**Item-to-total correlation** The Pearson's correlation to calculate the item-to-total correlations was used with 0,20 as the minimum correlation (Parmenter & Wardle, 2000).

**Distribution of answers to alternatives** A 5% standard was used, i.e. replacing or discarding options that were chosen as the test item answer by fewer than 5% of the respon-

**TABLE 2: NUMBER OF TEST ITEMS WITHIN EACH CONTENT DOMAIN AFTER THE CONTENT AND FACE VALIDITY EVALUATIONS OF THE FIRST AND SECOND FOOD KNOWLEDGE TESTS**

| Pre-testing | Sample group | Sample size (n) | Participants |
|---|---|---|---|
| Pre-testing of first test: First administration | Knowledgeable | 101 | ND*: Consumer Science: Food and Nutrition |
| | Less-knowledgeable | 112 | BEd**: General Education and Training |
| Pre-testing of first test: Second administration*** | Knowledgeable | *ND: Consumer Science: Food and Nutrition sample group retained (n = 101)* | |
| | Less-knowledgeable | 68 | ND: Environmental Management |
| Pre-testing of second test **** | Knowledgeable | 119<br>Male: 33 (27,7%)<br>Female: 86 (72,3%) | ND: Consumer Science: Food and Nutrition<br>ND: Hospitality Management: Professional Cookery *or* Food and Beverage |
| | Less-knowledgeable | 91<br>Male: 21 (23,1%)<br>Female: 70 (76,9%) | ND: Environmental Management<br>ND: Public Relations Management |

* ND National Diploma
** BEd Bachelor of Education
*** Seven months after first administration of the first test
**** Five months after the second administration of the first test

**TABLE 3: ITEM ANALYSIS OF THE ADMINISTRATION OF THE SECOND TEST**

| Question number | Item difficulty index (IDI) (%)* | Item Discrimination index (%)** | Item-to-total correlation (r)# | Distribution of answers to alternatives (%)## | | | Item outcome |
|---|---|---|---|---|---|---|---|
| | | | | a | b | c | |
| 1 | 50.95 | 51.5 | 0.420 | 35.71 | 50.95 | 13.33 | Retained |
| 2 | 54.29 | 18.2 | 0.169 | 6.19 | 54.29 | 39.52 | Discarded |
| 3 | 30.00 | 20.6 | 0.187 | 30.00 | 62.38 | 7.62 | Discarded |
| 4 | 37.62 | 17.8 | 0.140 | 37.62 | 29.05 | 33.33 | Discarded |
| 5 | 69.52 | 33.4 | 0.245 | 4.29 | 26.19 | 69.52 | Discarded |
| 6 | 50.95 | 5.8 | 0.001 | 16.67 | 50.95 | 32.38 | Discarded |
| 7 | 47.62 | 44.4 | 0.335 | 38.57 | 49.62 | 13.81 | Retained |
| 8 | 87.62 | 24.9 | 0.281 | 4.76 | 7.62 | 87.62 | Discarded |
| 9 | 67.14 | 28.0 | 0.236 | 10.00 | 22.86 | 67.14 | Retained |
| 10 | 50.00 | -24.2 | 0.166 | 43.33 | 50.00 | 6.67 | Discarded |
| 11 | 61.90 | -26.9 | 0.188 | 61.90 | 26.19 | 11.90 | Discarded |
| 12 | 71.90 | 6.4 | 0.041 | 17.14 | 71.90 | 10.95 | Discarded |
| 13 | 35.24 | 12.1 | 0.071 | 26.67 | 38.10 | 35.24 | Discarded |
| 14 | 76.67 | 55.2 | 0.459 | 15.24 | 8.10 | 76.67 | Retained |
| 15 | 70.95 | 33.4 | 0.293 | 7.62 | 70.95 | 21.43 | Retained |
| 16 | 51.43 | 30.3 | 0.275 | 33.81 | 51.43 | 14.76 | Retained^ |
| 17 | 71.90 | 29.4 | 0.286 | 10.48 | 17.62 | 71.90 | Retained^ |
| 18 | 34.29 | 45.3 | 0.383 | 44.76 | 34.29 | 20.95 | Discarded |
| 19 | 63.33 | 39.7 | 0.314 | 23.81 | 12.86 | 63.33 | Retained |
| 20 | 41.90 | 23.4 | 0.181 | 46.67 | 11.43 | 41.90 | Discarded |
| 21 | 63.81 | 64.8 | 0.531 | 63.81 | 22.86 | 13.33 | Retained |
| 22 | 39.05 | 19.3 | 0.151 | 32.8 | 28.57 | 39.05 | Discarded |
| 23 | 79.5 | 41.8 | 0.407 | 10.48 | 79.52 | 10.00 | Retained |
| 24 | 58.10 | 34.5 | 0.261 | 18.57 | 23.33 | 58.10 | Retained |
| 25 | 62.86 | 52.7 | 0.352 | 7.62 | 29.52 | 62.86 | Retained |
| 26 | 67.14 | 30.4 | 0.234 | 67.14 | 23.81 | 9.05 | Retained |
| 27 | 53.81 | 31.2 | 0.242 | 21.90 | 24.29 | 53.81 | Retained^ |
| 28 | 83.33 | 45.3 | 0.418 | 83.33 | 10.95 | 5.71 | Retained |
| 29 | 89.52 | 30.2 | 0.354 | 2.86 | 7.62 | 89.52 | Discarded |
| 30 | 57.14 | 54.5 | 0.466 | 57.14 | 17.14 | 25.71 | Retained |
| 31 | 53.33 | 25.9 | 0.164 | 28.10 | 53.33 | 18.57 | Discarded |
| 32 | 69.05 | 55.4 | 0.453 | 25.24 | 5.71 | 69.05 | Retained |
| 33 | 38.10 | 49.0 | 0.332 | 7.14 | 54.76 | 38.10 | Retained |
| 34 | 53.33 | 34.5 | 0.281 | 12.86 | 53.33 | 33.81 | Retained |
| 35 | 39.52 | 8.3 | 0.090 | 35.71 | 39.52 | 24.76 | Discarded |
| 36 | 52.86 | 39.1 | 0.263 | 52.86 | 14.29 | 32.86 | Retained |
| 37 | 43.33 | 26.5 | 0.217 | 32.86 | 43.33 | 23.81 | Retained |
| 38 | 56.67 | 17.1 | 0.130 | 36.67 | 56.67 | 6.67 | Discarded |
| 39 | 55.24 | 42.2 | 0.327 | 33.81 | 10.95 | 55.24 | Retained^ |
| 40 | 72.86 | 46.1 | 0.349 | 72.86 | 13.33 | 13.81 | Retained |
| 41 | 74.76 | 45.6 | 0.403 | 16.67 | 74.76 | 8.57 | Retained^ |
| 42 | 69.05 | 60.9 | 0.524 | 69.05 | 21.90 | 9.05 | Retained |
| 43 | 83.81 | 19.8 | 0.177 | 83.81 | 8.57 | 7.62 | Discarded |
| 44 | 64.29 | 68.7 | 0.554 | 9.52 | 26.19 | 64.29 | Retained |
| 45 | 60.95 | 52.4 | 0.398 | 14.76 | 24.29 | 60.95 | Retained |
| 46 | 71.43 | 49.9 | 0.418 | 71.43 | 8.10 | 20.48 | Retained |
| 47 | 30.00 | 9.6 | 0.110 | 33.33 | 30.00 | 36.67 | Discarded |
| 48 | 53.81 | 70.8 | 0.570 | 22.38 | 23.81 | 53.81 | Retained |
| 49 | 71.90 | 38.5 | 0.354 | 11.43 | 71.90 | 16.67 | Retained^ |

**TABLE 3: ITEM ANALYSIS OF THE ADMINISTRATION OF THE SECOND TEST - continued**

| Question number | Item difficulty index (IDI) (%)* | Item Discrimination index (%)** | Item-to-total correlation (r)# | Distribution of answers to alternatives (%)## | | | Item outcome |
|---|---|---|---|---|---|---|---|
| | | | | a | b | c | |
| 50 | 43.81 | 33.9 | 0.302 | 22.86 | 33.33 | 43.81 | Retained |
| 51 | 60.48 | 39.9 | 0.334 | 9.52 | 60.48 | 30.00 | Retained |
| 52 | 58.10 | 36.7 | 0.266 | 58.10 | 27.62 | 14.29 | Retained |
| 53 | 45.24 | -25.7 | 0.100 | 45.24 | 9.52 | 45.24 | Discarded |
| 54 | 68.57 | 32.0 | 0.233 | 16.19 | 68.57 | 15.24 | Retained^ |
| 55 | 51.90 | 47.7 | 0.403 | 17.62 | 51.90 | 30.48 | Retained |
| 56 | 19.05 | 21.6 | 0.241 | 69.05 | 11.90 | 19.05 | Discarded |
| 57 | 68.10 | 40.8 | 0.363 | 8.57 | 68.10 | 23.33 | Retained |
| 58 | 49.05 | 51.8 | 0.426 | 49.05 | 30.95 | 20.00 | Retained |
| 59 | 69.52 | 77.4 | 0.616 | 17.62 | 12.86 | 69.52 | Retained |
| 60 | 53.33 | 27.5 | 0.251 | 26.19 | 53.33 | 20.48 | Retained^ |
| 61 | 42.38 | 40.8 | 0.361 | 31.90 | 25.71 | 42.38 | Retained |
| 62 | 91.43 | 22.8 | 0.308 | 5.24 | 91.43 | 3.33 | Discarded |
| 63 | 77.14 | 58.7 | 0.486 | 77.14 | 10.95 | 11.90 | Retained |
| 64 | 49.05 | 52.4 | 0.441 | 28.57 | 49.05 | 22.38 | Retained |
| 65 | 72.38 | 51.1 | 0.466 | 72.38 | 16.67 | 10.95 | Retained |
| 66 | 62.38 | 70.5 | 0.551 | 62.38 | 20.00 | 17.62 | Retained |
| 67 | 19.05 | -9.3 | 0.000 | 35.24 | 45.71 | 19.05 | Discarded |
| 68 | 77.14 | 62.4 | 0.536 | 77.14 | 12.86 | 10.00 | Retained |
| 69 | 62.86 | 39.9 | 0.284 | 23.33 | 13.81 | 62.86 | Retained^ |
| 70 | 57.62 | 35.3 | 0.286 | 17.62 | 57.62 | 24.76 | Retained |
| 71 | 64.29 | 57.6 | 0.450 | 64.29 | 23.81 | 11.90 | Retained |
| 72 | 11.90 | 13.0 | 0.130 | 11.90 | 61.43 | 26.67 | Discarded |
| 73 | 42.38 | 17.8 | 0.156 | 12.86 | 42.38 | 44.76 | Discarded |
| 74 | 61.90 | 51.2 | 0.418 | 11.90 | 61.90 | 26.19 | Retained |
| 75 | 59.52 | 54.5 | 0.418 | 59.52 | 15.24 | 25.24 | Retained |
| 76 | 82.86 | 39.9 | 0.442 | 8.57 | 82.86 | 8.57 | Retained |
| 77 | 42.38 | 37.2 | 0.310 | 42.38 | 26.19 | 31.43 | Retained |
| 78 | 32.86 | 30.8 | 0.259 | 16.19 | 50.95 | 32.86 | Discarded |
| 79 | 48.57 | 51.0 | 0.389 | 48.57 | 26.19 | 25.24 | Retained |
| 80 | 58.10 | 31.1 | 0.264 | 13.81 | 28.10 | 58.10 | Retained^ |
| 81 | 41.43 | 37.5 | 0.264 | 20.95 | 41.43 | 37.62 | Retained |
| 82 | 52.86 | 67.2 | 0.515 | 21.43 | 25.71 | 52.86 | Retained |
| 83 | 63.81 | 53.3 | 0.480 | 26.19 | 63.81 | 10.00 | Retained |
| 84 | 71.43 | 67.9 | 0.589 | 71.43 | 18.57 | 10.00 | Retained |
| 85 | 48.10 | 56.8 | 0.479 | 48.10 | 41.90 | 10.00 | Retained |
| 86 | 75.71 | 53.5 | 0.456 | 10.95 | 13.33 | 75.71 | Retained |
| 87 | 15.71 | 7.6 | 0.060 | 45.71 | 38.57 | 15.71 | Discarded |
| 88 | 48.57 | 37.5 | 0.309 | 29.05 | 22.38 | 48.57 | Retained^ |
| 89 | 65.24 | 60.9 | 0.487 | 65.24 | 22.38 | 12.38 | Retained |
| 90 | 78.10 | 49.2 | 0.450 | 5.24 | 78.10 | 16.67 | Retained |
| 91 | 54.29 | 13.2 | 0.120 | 34.29 | 54.29 | 11.43 | Discarded |
| 92 | 78.10 | 56.8 | 0.495 | 78.10 | 12.38 | 9.52 | Retained |
| 93 | 75.24 | 43.9 | 0.399 | 75.24 | 16.19 | 8.57 | Retained^ |
| 94 | 34.76 | -1.5 | 0.000 | 41.90 | 34.76 | 23.33 | Discarded |
| 95 | 59.52 | 52.2 | 0.385 | 17.62 | 22.86 | 59.52 | Retained |
| 96 | 55.71 | 43.5 | 0.353 | 55.71 | 24.29 | 20.00 | Retained |
| 97 | 47.62 | 53.7 | 0.397 | 28.10 | 24.29 | 47.62 | Retained |
| 98 | 65.24 | 40.0 | 0.315 | 19.05 | 65.24 | 15.71 | Retained^ |

**TABLE 3: ITEM ANALYSIS OF THE ADMINISTRATION OF THE SECOND TEST - continued**

| Question number | Item difficulty index (IDI) (%)* | Item Discrimination index (%)** | Item-to-total correlation (r)# | Distribution of answers to alternatives (%)## | | | Item outcome |
|---|---|---|---|---|---|---|---|
| | | | | a | b | c | |
| 99 | 54.29 | 40.3 | 0.339 | 54.29 | 18.10 | 27.62 | Retained |
| 100 | 60.95 | 12.8 | 0.120 | 22.38 | 60.95 | 16.67 | Discarded |
| 101 | 69.52 | 48.0 | 0.433 | 69.52 | 21.90 | 8.57 | Retained^ |
| 102 | 51.43 | 31.4 | 0.200 | 20.95 | 51.43 | 27.62 | Retained^ |
| 103 | 30.48 | 9.8 | 0.090 | 29.05 | 40.48 | 30.48 | Discarded |
| 104 | 63.81 | 35.3 | 0.328 | 21.90 | 63.81 | 14.29 | Retained^ |
| 105 | 33.81 | -6.9 | 0.000 | 33.81 | 31.90 | 34.29 | Discarded |
| 106 | 79.05 | 32.7 | 0.286 | 7.62 | 79.05 | 13.33 | Retained |
| 107 | 54.76 | 45.3 | 0.394 | 21.90 | 23.33 | 54.76 | Retained^ |
| 108 | 50.00 | 33.8 | 0.286 | 22.38 | 50.00 | 27.62 | Retained |
| 109 | 64.29 | 52.2 | 0.428 | 10.95 | 24.76 | 64.29 | Retained |
| 110 | 64.29 | 72.0 | 0.587 | 64.29 | 20.00 | 15.71 | Retained |
| 111 | 50.00 | 71.3 | 0.527 | 30.00 | 20.00 | 50.00 | Retained |
| 112 | 68.57 | 44.2 | 0.334 | 12.86 | 18.57 | 68.57 | Retained^ |
| 113 | 41.43 | 53.2 | 0.447 | 41.43 | 31.90 | 26.67 | Retained |
| 114 | 51.90 | 27.8 | 0.242 | 33.81 | 14.29 | 51.90 | Retained^ |
| 115 | 41.90 | 2.8 | 0.020 | 23.33 | 41.90 | 34.76 | Discarded |
| 116 | 34.29 | -10.3 | 0.000 | 36.67 | 34.29 | 29.05 | Discarded |
| 117 | 72.38 | 62.6 | 0.529 | 72.38 | 13.81 | 13.81 | Retained |
| 118 | 13.81 | -6.6 | 0.000 | 13.81 | 67.14 | 19.05 | Discarded |
| 119 | 52.38 | 51.5 | 0.328 | 52.38 | 17.14 | 30.48 | Retained |
| 120 | 47.62 | 59.7 | 0.398 | 47.62 | 36.19 | 16.19 | Retained |
| 121 | 54.76 | 58.1 | 0.380 | 26.67 | 54.76 | 18.57 | Retained |
| 122 | 27.14 | -4.2 | 0.000 | 38.57 | 34.29 | 27.14 | Discarded |
| 123 | 69.05 | 71.9 | 0.612 | 69.05 | 17.62 | 13.33 | Retained |
| 124 | 36.19 | 22.2 | 0.214 | 13.81 | 50.00 | 36.19 | Retained^ |
| 125 | 54.29 | 16.6 | 0.170 | 51.29 | 16.19 | 29.52 | Discarded |
| 126 | 40.95 | 21.9 | 0.157 | 20.00 | 40.95 | 39.05 | Discarded |
| 127 | 28.10 | -11.5 | 0.000 | 52.86 | 28.10 | 19.05 | Discarded |
| 128 | 51.43 | 28.9 | 0.216 | 16.19 | 32.38 | 51.43 | Retained^ |
| 129 | 55.24 | 61.7 | 0.472 | 55.24 | 18.10 | 26.67 | Retained |
| 130 | 65.71 | 36.8 | 0.306 | 16.19 | 65.71 | 18.10 | Retained |
| 131 | 42.38 | 54.9 | 0.451 | 29.52 | 28.10 | 42.38 | Retained |
| 132 | 58.57 | 27.3 | 0.210 | 28.57 | 58.57 | 12.86 | Retained |
| 133 | 27.14 | 5.3 | 0.100 | 58.57 | 27.14 | 14.29 | Discarded |
| 134 | 65.71 | 53.5 | 0.420 | 65.71 | 20.00 | 14.29 | Retained |
| 135 | 57.62 | 52.1 | 0.415 | 27.14 | 15.24 | 57.62 | Retained |

**Item analysis criteria:**

* Item difficulty index: 0.35 – 0.85 (Nunnally, 1972:189)
** Item discrimination index: ≥ 0.20 (Thorndike *et al*, 1972:191)
\# Item-to-total correlation: ≥ 0.20 (Parmenter & Wardle, 2000:272)
## Distributions of answers to alternatives: ≥ 5% (Nunnally, 1972:190)
^ Retained item discarded on not providing a significant difference ($p > 0.05$) in knowledge between the knowledgeable and less-knowledgeable groups (Mann-Whitney Test)

dents (Nunnally, 1972:190).

**Food knowledge test validity and reliability**

**Validity** Construct-related evidence of validity requires that the construct that is presumed to be reflected in the test scores actually do account for differences in the test performance (Gronlund, 1993:166). This was achieved by comparing the scores of known sample groups to determine whether the scores differentiated between the groups, as was predicted on the grounds of the relevant construct (Steenhuis *et al*, 1996; Parmenter & Wardle, 1999) (i.e. food knowledge) (see Table 2). It was predicted that there would be a difference in food knowledge between the knowledgeable and less-knowledgeable sample groups, based on their different study fields. The Mann-Whitney Test was used to determine the construct-related evidence of validity of the final test, which is determined by whether or not the test could distinguish between groups of respondents having different levels of knowledge (Bordens & Abbott, 2011:456).

**Reliability** The reliability was determined by an internal consistency method (Ebel & Frisbie, 1991:81), which involves administering the tests and computing the consistency of the responses within the test. The Kuder-Richardson 20 statistic (K-R20) was used as it determines the average of all the split-half reliabilities that could be derived from splitting the test into two halves in every possible way. Furthermore, the Cronbach's alpha statistic was used with the following guidelines as indication of the reliability: > 0,9 indicates excellent/strong reliability; > 0,8 indicates good reliability; > 0,7 acceptable reliability; > 0,6 questionable/marginal reliability; > 0,5 poor reliability; while < 0,5 indicates low/ unacceptable reliability (Cohen *et al*, 2007:506).

**Norm scores on retained items**

The mean and median scores of the final knowledge test (incorporating the items that met the item analysis criteria and were found valid and reliable) for the two student sample groups were calculated. The mean and median scores for the knowledgeable group indicate an above average/good score, whereas the mean and median scores for the less-knowledgeable group indicate a below average/poor score. Tests which interpret each respondent's relative standing among other respondents or can compare individual respondent's performance with that of other respondents are norm referenced (Gronlund, 1993:12). The norm scores are only used for individual respondents where the reliability coefficients are high enough. The generally accepted minimum reliability standards of 0,65 and 0,85 for groups and individuals respectively were used (Ebel & Frisbie, 1991:87).

**RESULTS**

**Preliminary test item analysis**

The first administration of the first test yielded 77,8% retained items and the second administration 81,9% based on the IDI. The retained items for the item discrimination index were 62,5% and 80,6% for the first and second administrations respectively. After considering the item-to-total correlation, 68,1% and 77,8% items were retained after the first and second administrations respectively, while only 23,6% and 30,6% of the items were retained based on the distribution of answers to alternatives in the two administrations respectively. Although the results of the different analyses seem to result in higher percentages of retained items after each administration, in reality only ten (13,9%) of the 72 test items and 13 (18,1%) of the 72 test items were retained after the item analysis of two administrations of the first test. These were the only items that had 'passed' the different analyses applied to the items.

The second test was administered only once. The results of the item analysis are indicated in Table 3. Ninety-five (70%) of the 135 items were retained after the item analysis of the second test. After considering the IDI, 116 items (86%) were retained. Of the 19 discarded items, 16 were deemed too difficult and three too easy. Based on the item discrimination index, 106 items (79%) were retained. A hundred-and-two (76%) items were retained based on the item-to-total correlation and 131 (97%) items were retained based on the distribution of answers to alternatives.

**Validity and reliability determinations**

**Validity** Because more than the number of envisaged test items were retained after administering the second test, the construct validity was determined for each of the 95 retained test items, as well as for the final food knowledge test as a whole. Based on the individual item results, 21 of the 95 retained test items were discarded due to not providing a statistically relevant difference ($p > 0,05$) in knowledge between the knowledgeable and the less-

**TABLE 4: REPRESENTATION OF THE SUB-DOMAINS ACROSS THE TWO CONTENT DOMAINS OF THE RESPECTIVE FINAL FOOD KNOWLEDGE TESTS**

| Sub-domains | Food knowledge tests | | | | | |
|---|---|---|---|---|---|---|
| | Food, comprising fruit and vegetables as well as fats and oils, as content domain (n = 74) | | Fruit and vegetables as content domain (n = 49) | | Fats and oils as content domain (n = 25) | |
| | n | % | n | % | n | % |
| Choice and purchasing | 34 | 4,9 | 18 | 36,7 | 16 | 64,0 |
| Storage | 7 | 9,5 | 7 | 14,3 | 0 | 0,0 |
| Preparation | 13 | 17,6 | 10 | 20,4 | 3 | 12,0 |
| Cooking | 20 | 27,0 | 14 | 28,6 | 6 | 24,0 |

knowledgeable sample groups (see last column of Table 3). This left a total of 74 test items for the final test (49 items in the fruit and vegetables content domain and 25 items in the fats and oils content domain). All sub-domains were represented in the final food knowledge test. However, the storage sub-domain was not repre-sented in the fats and oils content domain. The representation of the sub-domains across the two content domains of the final food knowledge tests are indicated in Table 4.

The validity of the final test as a whole, based on the Mann-Whitney Test (z = 9,74), was found to be acceptable as a significant difference ($p < 0,001$) in knowledge was found in the expected direction between the two sample groups. The validity of the two separate tests, i.e. fruit and vegetables and fats and oils as content domains, based on the Mann-Whitney Test (z = 9,75 and z = 8,73 respectively) was also found to be acceptable with a significant difference ($p < 0,001$) found in knowledge between the two sample groups.

**Reliability** The reliability of the final knowledge test was determined by the K-R20 and the Cronbach's alpha coefficient. Both the K-R20 and the Cronbach's alpha coefficient for the second test were 0,934. The reliability of the test content domains, i.e. fruit and vegetables and fats and oils, as separate tests, was determined as enough items were retained in both the aforementioned content domains to serve as two separate knowledge tests. For the fruit and vegetable and the fats and oils knowledge tests, both the K-R20 and the Cronbach's alpha coefficient were 0,844 and 0,901 respectively.

**Final participant sample groups' demographic and biographic characteristic correspondence and differentiation**

There was no significant difference ($p > 0,05$) between the sample groups in terms of gender or age. However, the percentage of respondents in the knowledgeable sample group who did study the subject Consumer Studies at secondary school (47%), who indicated that school subjects, such as Life Orientation and Consumer Studies, contributed to their existing food knowledge (45%) and who described their own perceived knowledge about food purchasing, storage and preparation as 'about similar', 'somewhat more' or 'much more' (93%) were significantly higher ($p < 0.001$) than the percentage of respondents in the less-knowledgeable sample (19%, 13% and 55% respectively) (see Table 5).

**Norm scores on retained items**

The proposed norm scores for the knowledge test as a whole, as well as for the two separate tests, i.e. fruit and vegetables and fats and oils as content domains, based on the mean and median scores as obtained by the respondent sample and sample groups are presented in Table 6.

## DISCUSSION

**Test item construction and evaluation**

Parmenter and Wardle (2000) advise that existing measures either be used or modified before developing a new assessment tool. As no published valid and reliable South African-based food knowledge tests could be obtained, all the test items used in this study were newly developed. The benefit of this undertaking was that the items were relevant to the test content domains and to the specific student group. In

**TABLE 5: DEMOGRAPHIC AND BIOGRAPHIC CHARACTERISTICS OF THE FINAL PARTICIPANT SAMPLE AND SAMPLE GROUPS**

| Demographic and biographic characteristics | Responses | Sample (n = 210) | | Samples | | | | p-value |
|---|---|---|---|---|---|---|---|---|
| | | | | Knowledgeable (n = 119) | | Less-knowledgeable (n = 91) | | |
| | | n | % | n | % | n | % | |
| Gender | Female | 156 | 74.3 | 86 | 72.3 | 70 | 76.9 | 0.444 |
| | Male | 54 | 25.7 | 33 | 27.7 | 21 | 23.1 | |
| Age | 18 to 22 years | 152 | 72.4 | 81 | 68.1 | 71 | 78.0 | 0.110 |
| | 23 years and older | 58 | 27.6 | 38 | 31.9 | 20 | 22.0 | |
| Studied the subject Consumer Science in Grade 12 | Yes | 73 | 34.8 | 56 | 47.1 | 17 | 18.7 | 0.000 |
| | No | 137 | 65.2 | 63 | 52.9 | 74 | 81.3 | |
| Source mostly learned from about food choices, purchasing, storage and preparation | At home with family | 87 | 41.4 | 29 | 24.4 | 58 | 63.7 | 0.000 |
| | Friends | 12 | 5.7 | 4 | 3.4 | 8 | 8.8 | |
| | Books, articles in magazines, internet, etc. | 33 | 15.7 | 27 | 22.7 | 6 | 6.6 | |
| | Television and radio | 13 | 6.2 | 6 | 5.0 | 7 | 7.7 | |
| | School health services and school subjects such as Life Orientation and Consumer Studies | 65 | 31.0 | 53 | 44.5 | 12 | 13.2 | |
| Description of own knowledge level about food purchasing, storage and preparation compared to that of other young adults of the same age | Much less | 28 | 13.3 | 2 | 1.7 | 26 | 28.6 | 0.000 |
| | Somewhat less | 22 | 10.5 | 7 | 5.9 | 15 | 16.5 | |
| | About similar | 65 | 31.0 | 37 | 31.1 | 28 | 30.8 | |
| | Somewhat more | 56 | 26.7 | 42 | 35.3 | 14 | 15.4 | |
| | Much more | 39 | 18.6 | 31 | 26.1 | 8 | 8.8 | |
| Provision of mostly consumed meals | Prepared home/ family food | 84 | 40.0 | 35 | 29.4 | 49 | 53.8 | 0.003 |
| | Food bought from kiosks on campus or other kiosks | 33 | 15.7 | 18 | 15.1 | 15 | 16.5 | |
| | Self-prepared food in a CPUT* residence | 41 | 19.5 | 29 | 24.4 | 12 | 13.2 | |
| | Self-prepared food in a private flat/ residence | 51 | 24.3 | 36 | 30.3 | 15 | 16.5 | |
| | Ready-made meals bought from supermarkets | 1 | 0.5 | 1 | 0.8 | 0 | 0.0 | |

the early stages of the test item development process, many of the test items were eliminated by the expert panelists as they were viewed as nutrition- rather than food-based. This difficulty in separation may have occurred because numerous available nutrition knowledge questionnaires were consulted to look at aspects such as the test item types, the test items as such and the test lay-out.

Whati *et al* (2005) used available nutrition-related data associated with younger South African children that were thought to perpetuate into adolescence, as well as issues related to

**TABLE 6: NORM SCORE STANDARDS FOR THE RESPECTIVE FOOD KNOWLEDGE TESTS**

| | Norm score standards | | |
|---|---|---|---|
| **Food knowledge tests** | **Below average/Poor achievement*** | **Average Achievement**** | **Above average/Good achievement***** |
| Food, comprising fruit and vegetables as well as fats and oils as content domains (n=74) | ≤ 33<br>Mean: 33,6 ± 10,64<br>Median: 33 | 45 (34 – 53)<br>Mean: 44,8 ± 14,6<br>Median: 45 | ≥ 54<br>Mean: 53,3 ± 45<br>Median: 54 |
| Fruit and vegetables as content domain (n=49) | ≤ 22<br>Mean: 22,3 ± 7,42<br>Median: 22 | 30 (23 – 35)<br>Mean: 29,7 ± 9,71<br>Median: 30 | ≥ 36<br>Mean: 35,4 ± 7,08<br>Median: 36 |
| Fats and oils as content domain (n=25) | ≤ 11<br>Mean: 11,29 ± 4,22<br>Median: 11 | 16 (12 – 17)<br>Mean: 15,1 ± 5,50<br>Median: 16 | ≥ 18<br>Mean: 17,9 ± 4,56<br>Median: 18 |

* Based on the mean and median knowledge scores obtained by the less-knowledgeable sample group
** Based on the mean and median knowledge scores obtained by the respondent sample as a whole
*** Based on the mean and median knowledge scores obtained by the knowledgeable sample group

adolescents worldwide that appeared to be relevant to South Africans to define the constructs of a questionnaire developed to measure the nutrition knowledge of South African adolescents. With this in mind, the relevance of test items and the expected food knowledge level of first-year students became two major focus points as there were no existing measures to consider for guidance as to the expected food knowledge of young adults. Due to this uncertainty, provision was made for test items to be eliminated by the expert panel during the item analysis by developing a higher than necessary number of test items in each sub-domain within both content domains.

In most instances, the panelists' comments, suggestions and recommendations made in the evaluation and pre-testing phases, addressed general aspects of test item and test development that need to be considered when developing assessment tools. Although published guidelines and recommendations were considered throughout the development process, the application of these guidelines and recommendations was found to be challenging as it can be expected that each assessment tool and its items would differ, based on the expected content and outcomes.

**Test construction**

In the compiled tests, the two content domains, i.e. fruit and vegetables and fats and oils, were kept separate, as advised by Bordens and Abbott (2011:267). Care was also taken with the lay-out of these tests and the intention was to present each test as an easy, attractive and interesting tool in order to motivate the respondents to complete the relatively long tests in full. Short and clear instructions for the completion accompanied each test. As a result, the data of only four of the completed tests of the overall total of 495 completed (for the first and second test administration) had to be discarded because they were not fully completed.

**Item analysis**

In the evaluation of the first test, the use of four options for each test item delivered poor findings for the item analysis. The first administration of the first test delivered 55 of the 72 items not meeting the criterion that an option had to be indicated as the correct answer by at least 5% of the respondents. Either one option (n = 28 items), two options (n = 22 items) or even three options (n = 5 items) did not meet this criterion. Similarly, for the second administration 50 of the 72 items did not meet the criterion with either one option (n = 35 items), two options (n = 14 items) or three options (n = 1 item) not serving as a good distracter. These results provided the support to change the four options to three options during the item design process for the second test. The distribution of the answers to the alternatives in the second test was greatly improved. Of the 135 test items, only four items did not meet the criterion that options had to be chosen by at least 5% of the respondents to be suitable for inclusion. In all four of these items it was only one of the three options that was not adequately selected.

## CONCLUSIONS AND RECOMMENDATIONS

The repetition of the developmental process meant that lessons learnt in the first developmental phase could be implemented in the second phase and as a result more test items than envisaged were retained. This resulted in a food knowledge test that is deemed highly valid and reliable, consisting of 74 multiple-choice test items with three options each, covering the two content domains. Additionally, two separate tests were compiled, one a fruit and vegetable knowledge test consisting of 49 test items and the second a fats and oils knowledge test consisting of 25 test items. The tests meet the criteria for both construct validity and reliability and can therefore be used to assess the food knowledge level of first-year students at a UOT in the Western Cape on a group and even on an individual level. The standard/norm scores determined for the final tests can be used to assess the level of food knowledge as 'average', 'above average/ good' or 'below average/poor'.

The test was developed for use by a specific group, as indicated and the appropriateness of this test for other young adult population groups should be assessed to broaden its use. This would require that the test validity and reliability among student groups at other tertiary institutions be determined by means of pre-testing. This is strongly recommended as no other valid and reliable food knowledge tests have been published in SA. Food knowledge and skills may contribute to an improvement in the dietary habits of individuals.

The following recommendations for the development of a knowledge assessment tool, using a multiple-choice test item type, emerged from this study: The stem of the test items should consist of full sentences but be as concise as possible; the bulk of the reading should be included in the stem of the test items; where possible, answer options should be equal in length or shorter than the stem; and options should consist of equal parts, i.e. include the same number of facts/ideas, as the length of options is often a hint towards the correct answer. In addition, attention should be given to consistency in writing the test items, i.e. punctuation and language use should remain consistent throughout the test; language use should be kept as simple as possible and relevant to the 'everyday' language of the sample group; knowledge tested should be relevant to the student sample group; and test items should be developed with the study objectives in mind. Any researcher planning to develop a knowledge assessment tool should investigate the availability of panelists that are both knowledgeable in the content domain(s) and familiar with the expected knowledge levels of the subjects the test is being developed for. These panelists are required to partake in the face and content validity evaluations throughout the developmental process. Working closely with such an expert panel provides the researcher with invaluable information and insight into aspects such as the relevance of the knowledge tested and appropriate language use. This information cannot be obtained from published sources.

The newly developed food knowledge test may further be used to investigate possible associations between theoretical food knowledge and observed food preparation practices, attitudes towards food preparation and the dietary intake of young adults. If food knowledge in such research undertakings proves to be a contributing factor to the application of food skills and/or the healthfulness of young adults' dietary intake, the importance of teaching young children basic food knowledge should be highlighted. In SA, the importance of school subjects, at secondary level, such as Life Orientation (compulsory subject) and Consumer Studies (elective subject) may be that, for some learners, they provide the only exposure to information related to food choice, purchasing and preparation. There has been an increase in the consumption of food prepared outside the home and fewer households currently rely on home-prepared meals than before. This has led to a decrease in the acquisition of food knowledge and skills by children and adolescents through observation of and participation in food preparation at home. Many young adults, such as students at tertiary institutions, are living independently and have to rely on their existing food knowledge and skills in order to provide food, which should support optimal nutrition provision for themselves.

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