Health Education and a Nutritional Symbol System: The Nexus of Knowledge and Behaviour for School-Aged Children

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ABSTRACT

• Adopting a Health Promoting School approach, a day and boarding school located in the regional area of New South Wales, Australia, addressed health concerns of students in their care. Classroom teachers in the primary grades and Health and Physical Education staff in the secondary school provided developmentally appropriate Health Education Programs (HEP) to each class from Year 3 to year 10. In addition, a Nutritional Symbol System (NSS) was developed, refined and made available in the dining hall of the school. The NSS was designed to inform and guide students regarding nutritional choices. How did these two methods of educating students support their informed decision-making regarding food? To what extent did the students translate knowledge into behaviour? To answer these research questions, two students were purposively sampled from each year level from Year 3 to Year 10 (n=16). Students were interviewed using a semi-structured questionnaire designed to ascertain students’ understanding from the NSS and the HEP. Data were recorded and analysed using two methods, namely, manual coding and the Leximancer Text Mining software (Smith 2000). Results revealed that students were knowledgeable about food portions and used the nutritional symbol system appropriately. However, the data collected from these students also indicted misconceptions regarding the major categories of foods and their purposes (e.g. carbohydrates, proteins). The implications drawn from this study include the value of triangulating nutritional information through the use of readily accessible symbols and posters. The health education units taught in the classroom reinforced the Nutritional Symbol System provided at the point of food selection. Overall, coordinated developmental approaches to Health Education Programs and whole school approaches to nutrition are recommended.

INTRODUCTION

Informed decision-making about health and nutrition is a key outcome for the Health and Physical Education (HPE) curriculum in Australian schools. Nutritional information provided to school-aged children through health education programs is delivered by generalist classroom teachers in the primary grades and often by curriculum specialists in the secondary grades. The content is presented in developmentally crafted units of work, responding to classroom cohort needs and based on the relevant state syllabi under the assumption that the knowledge acquired by the students, in discrete units of work, will transfer into support for these students making informed decisions about what they choose to eat. Important features of successful health education programs include an alignment between the social milieu and the long-term outcomes of informed health-related decisions.

In much of the literature surrounding food, health, and choices that children make, there is concern for the perceived lack of transfer from knowledge to behaviour (O’Connor-Fleming & Parker, 2007) or to health practices (Mielewczyn & Willig, 2007). This issue has been central to many health practices for a range of population groups including smoking (Conner,
As with many of the outcomes of the health education curriculum in primary and secondary schools, there is a paucity of research designed to measure the effectiveness of the knowledge and any subsequent influence on, and adherence to, behavioural changes. This may be due to the multidimensional nature of health practices (Mielewczyk & Willig, 2007). In the case relevant to this study, students are choosing lunch in an all-school context. The selection and choices, therefore, may be very different if they are ‘grabbing a snack’, ‘dining with parents’ or ‘enjoying a post game meal’. In addition, the difficulty in designing methodologically appropriate studies that have the capacity to identify issues of importance to knowledge, behaviour and health-related practices (Nutbeam & Harris, 2010) is acknowledged.

In this paper, we describe how broad societal concerns over body composition and health, motivated one school community to address students’ knowledge and behaviour through a combined Health Education Program (HEP) and the implementation of a Nutritional Symbol System (NSS). Specifically, a large Anglican boarding school with a co-educational junior school, and boys-only middle and high school sections, instituted this school-wide health education initiative. This school has a total enrolment from Kindergarten to Year 12 of approximately 600 students.

**Methodology**

This study was conducted over a three-year period. During the first year, consultation with the school community informed the development and refinement of the instruments (e.g. the Health Education Program, the Nutritional Symbol System, and the interview schedule) used. The beginning of the second year witnessed the development and implementation of the Health Education Programs and the trial and refinement and instalment of the Nutritional Symbol System. The evaluation interviews reported here were conducted in August and September of the third year of the study.

**Instruments**

The development of the Health Education Program (HEP), the Nutritional Symbol System (NSS), and the evaluation interview schedule used in this study are described below.

*The Health Education Program (HEP)*

The Health Education Program was constructed with the collaboration of a group of classroom and specialist teachers in order to present a developmentally appropriate program of nutrition to each of class group. Specifically, the Health Education Programs for the primary grades (Stages 1, 2 & 3) were based on the New South Wales K-6 PDHPE syllabus content strand of *Personal Health Choices*. In addition, the Developmentally Appropriate Nutrition Education Resource for Youth Ages 6-11 (Wisconsin Nutrition Education Program, 2007) provided a robust framework. Associated learning and assessment choices were framed by the *Knowledge and*
Understanding Outcomes of the NSW curriculum in combination with decision-making outcomes from the Skills section of the syllabus. Similarly, the secondary school (Grades 7-10) Health Education programs were based on the NSW 7-10 PE syllabus for Stages 4 and 5.

In accordance with the organisation of the school, students enrolled in Year three to Year five (eight to ten years of age) received the unit on nutrition from their generalist primary classroom teacher. At the same time, specialist PDHPE teachers delivered their HEP to students in Years 6 to 10 (eleven to sixteen years of age).

The Nutritional Symbol System (NSS)

Across a twelve-month period, the Nutritional Symbol System was conceptualised, developed, and refined by School staff members in consultation with a range of ‘experts’. These included a nutritionist from the New England Area Health Service, the school chef, members of the Australian Institute of Sport, and academics and consultants from The University of New England (UNE).

Following this broad consultation the NSS was initially trialled for the first year. After this time, feedback and input from students, teachers and parents was sought. The NSS was then further refined through stronger links with the newly established Student Food Committee, which included membership from students on campus and a parents’ on-line forum.

The Nutritional Symbol System (NSS) was the key instrument used in this project to inform students’ food choices in a range of settings. The implementation strategy included the prominent display of several posters that conveyed information to students about the relative percentages of protein (30%); carbohydrates (40%); and, vegetables (30%) that they should aim to eat for a balanced diet (See Figure 1).

![Figure 1: The Nutritional Symbol System (NSS)](image)

The following specific information was linked to the Nutritional Symbol System on the posters displayed in the school’s dining hall and canteen. Each
poster indicated that, “Carbohydrates are the critical source of energy for exercising the body’s muscles. Proteins are derived from amino acids, which provide the building blocks for the growth and repair of the body. Vegetables and Salads are important to a balanced diet. A balance of 5 fruits/salads everyday is the key to a healthy body and the prevention of many diseases. Using the coloured plate (see Figure 2) as a guide, select your meal using healthy choices.”

Figure 2: Dining Hall Plate

A Physical Education specialist designed the school-based NSS using ‘expert’ advice from the Australian Institute of Sport. The NSS was implemented in a dining hall and canteen that catered for boarding and day students enrolled from Kindergarten to Year 12. All students were initially provided with explanations of the Nutritional Symbol System. Posters located in the dining hall, classrooms and canteen areas provided later reinforcement of the system and prompted the use of this information to make optimally healthy food choices. Parents were involved in school meetings regarding the NSS, with information also shared through the school newsletter and website.

Classroom teachers and PE specialists implemented the associated Health Education Programs. Content covered included basic nutritional needs, healthy food choices and the essential food groups. After three school terms of experience with the NSS and HEP programs, interviews were conducted in order to provide a diversity of students’ views on the perceived impact of the initiative.

PARTICIPANTS
Two students from each year group from Years 3 to 10 were interviewed (n=16). These students were selected based on two criteria: (1) that parental permission was granted for the student to participate; and (2) that the students were from diverse points on the achievement continuum as identified by their classroom teachers. The gender balance of participants reflected that of the larger school population with 10 boys interviewed and 6 girls. The junior school is co-educational, however, the middle and high school sections cater for male students only.

**Interviews**

The interview instrument was based on that used to evaluate the Wisconsin Nutrition Education Program. Students were asked in age-appropriate language what foods were examples of carbohydrates, proteins, fats and how much of these foods as a proportion of their plate would usually choose to eat. In addition, students were asked to give examples and explain the rationale behind the labelling of ‘sometimes’ and ‘everyday’ foods. The information provided was considered procedural, so opportunities for the application of knowledge to behaviours were then provided. This latter step involved an individualised methodology that required recapping and then probing some of the students’ specific answers to previous questions.

**Data Analysis**

Interview data were recorded, transcribed, coded manually and subsequently analysed using the Leximancer text mining software (Smith, 2000). The interview data were first coded manually for trends within and between participants’ responses across the same questions before being analysed using the Leximancer text analysis software (Smith, 2000). These two forms of analysis provided complementary perspectives on students’ understanding of the key outcomes related to the Health Education Program and the NSS.

Leximancer (Smith, 2000) is a software text-analysing tool that is used to identify “emergent concept groups that are referred to as themes” (Smith & Humphreys, 2006, p.264). The use of this software allowed for the further detailed coding of major themes and concepts. As defined by the Leximancer manual (Smith, 2008), concepts are considered to be “collections of words that generally travel together throughout the text” (p. 28). Themes that emerge from the Leximancer software are identified within a “concept list” and presented in hierarchical order from most associated to least associated. The strength of the themes can be determined using the “absolute count” tool which refers to the number of times concepts are found in the text.

Leximancer also generates data in the form of graphs that show concepts that occur together in clusters. These clusters are represented as circles, which are referred to as “theme circles.” The size, colour and “nearness” of theme circles to other circles, indicates the semantic patterning derived from the data. For example, the brighter the colour around the concept on the graph, the more frequently it appears in interview responses. This use of Leximancer software compliments manual coding and provides a method of triangulating the findings from the initial coding of the data.
RESULTS
Structured interviews with 16 students were conducted to ascertain individual’s levels of understanding related to the knowledge imparted through the HEP and use of the NSS to make informed nutritional choices. The content of the Health Education Programs (HEP) implemented in each class informed the development of the interview questions. General comments about students’ responses followed by a discussion of their knowledge of different types of food will be presented in the following sections.

General Comments
During the interview process, all students were able to recall and discuss the information included on the posters used in relation to the Nutritional Symbol System. In addition, the coloured wheel symbol, with carbohydrate (yellow), protein (red) and fruit/vegetable (green) portions, was memorable to the students who were all able to recall what the colours signified and where the posters were displayed in the school. The high visibility and mnemonic function of these posters was a key factor underlying the success of the NSS program.

‘Sometimes’ Food
The majority of students (n=12/16) could recall and provide examples of foods that were categorised as ‘sometimes’ foods. Most students’ responses provided evidence of a basic understanding of the term. When provided with a prompt from the interviewer, about foods being categorised into ‘sometimes’ or ‘everyday’ foods, the students could then provide examples of different types of foods (e.g., chocolate and chips) that are to be consumed infrequently.

Regarding the reason for the term ‘sometimes’ foods, the majority of participants (13/16) indicated that eating these types of foods each day would mean that they would get “fat”, or that their tastebuds would become “collapsed and boring”, and that if they “had the same thing over again and again you would get fat” (female student, Yr 4) – or you would “get heaps of acne” (male student, Yr 8).

Fast foods were commonly identified as ‘sometimes’ foods with many offerings from fast food outlets named (15/16). Chips, burgers, fat, chocolate, soft drinks, sweets and chocolate biscuits were all named as ‘sometimes’ foods. Financial cost, dental caries, gaining weight, being unhealthy, cholesterol and stroke were all named as the physical consequences of having too much of these types of foods.

Some students (n=8) provided in-depth descriptions of the long-term health implications related to eating too much fat from meat, chips and fast foods. However, a small number of students (n = 2) also erroneously provided examples of ‘everyday’ foods such as vegetables as being deleterious to health (male student, Year 5).

‘Everyday’ Food
All students (16/16) could identify what everyday foods were and why they were termed such. Students provided examples of healthy everyday choices.
that were aligned with the nutritional guidelines provided by the NSS.
Example responses include:
“Apples, bananas and vegetables are everyday foods” (male student, Year 3)
“Fruits and vegetables – healthy things” (female student, Yr 5)
“Red meat, vegetables such as peas and broccoli” (male student, Year 6)
“Tomatoes and vegetables” (male student, Year 6)
“Meat, vegetables and fruit” (male student, Yr 7)

Overall the questions about ‘everyday’ foods were answered the most accurately of all the nutritional knowledge questions. Students also provided accurate rationales for eating these foods and explanations about why everyday foods are important. A representative response to the request to give a rationale for eating everyday foods was that, “Parents force you to eat them, so you get used to them”. (male student, Year 6)

Identification of Specific Food Groups
Across the age groups there were some students who gave inconsistent and erroneous examples of types of foods or failed to provide accurate examples of the three main NSS categories. For example, when students were asked to tell the interviewer about the foods that were representative of specific groupings, they made the most errors for the category of ‘Carbohydrates’. Students were more accurate for ‘Protein’ foods, and most accurate in giving examples of ‘Vegetables and Fruit’. Specific results are discussed below:

Carbohydrates
Students’ knowledge of this food group was the most inaccurate. Student providing accurate answers to this question were in the minority (n=4/16). For example, students below Year 6 level could not define carbohydrates at all. Most correct answers came from the older students who provided correct examples such as: “pasta, rice” (male student, Year 7); “nutrigrain, bread, snacks, milo and shapes (crackers)” (male student, Year 8); “Bread fibre and stuff” (male student, Year 9); and “Bread and pasta” (male student, Year 10).

When asked for the rationale for eating foods from this food group, responses included, “No idea” (male student, Yr 8); “Gives you the most energy and proteins” (male student, Yr 10); “If you eat an apple it is not well, as it can keep you up all night, Grandma said” (male student, Year 3); “I’m not sure what it means – I have learned about it in Year 3 though” (male student, Year 4); “Not much – depends on how much” (male student, Year 4); “I am not sure” (male student, Year 6); and “Need them for energy and if you eat too much you will get too fat (male student, Year 4).

Proteins
The knowledge of this food group was inconsistent across the interviewees, with the younger children confusing proteins with other more well-known food groups, and the older students seeming more confident of their answers (n=10/16). When asked for examples of proteins, students made responses such as those provided below:
“bananas, apples, pears and vegetables” (male student, Year 3)
“Not sure” (male student, Year 5)
“Fish, meat and eggs, maybe cheese” (male student, Year 6)
“Nutrigrain” (male student, Year 8)
“Fruits have protein and milk and things like that” (male student, Year 10)
This level of confusion about what constitutes protein foods was concerning and indicated limitations to the Health Education programs delivered to students.

**Fat**
When asked about foods that have fat in them, students (n=11/16) were consistent in knowing that it is preferable if fat on meat is cut off and not eaten. Some of the interviewed students’ responses included:
“Chips, burgers, smoothies, coffee and lots of other foods have fat” (male student, Year 3)
“Pies, fatty foods, bacon, fried foods, chocolate and fast foods are fatty” (male student, Year 5)
“Sugary foods and normal meals, like at restaurants” (male student, Year 10)

When asked about the implications of eating these foods, responses included:
“It isn’t good for you to eat too much fat – because it is bad for your body” (male student, Yr 3)
“It is not good for you and you shouldn’t eat too much of it” (female student, Yr 7)

**Vitamins**
Students in classes lower than Year 8 were unsure what vitamins were and generally did not know where they came from. A number of students (n=6/16) noted that vitamins were “good for you” and one student said they “come from sunshine (Vitamin D)” and that they also came from “tablets - Vitamin E and Vitamin C”. A Year 10 male student said that, “Vitamins come from fruit like oranges. They are supplements. Most foods have some type of vitamins in them”.

**Drinks**
Twelve of the sixteen students indicated that water was their preferred drink. Four of the older male students talked of soft drinks and twelve of the boys who were boarders at the school reported drinking warm milk with 4Milo as an evening drink. Five boys also reported the consumption of juice with meals. Most of these boys played sport for the school or were members of the swimming team.

**Informed Decision-Making**
Students were also asked interview questions designed to address their ability to apply the nutritional symbol system to food choices made within the school dining hall and canteen. Although, as the previous answers indicate, some students’ knowledge was limited when asked about categories of food, all 16 interviewees showed accurate recognition of the NSS information and understood the percentages and proportions of foods that they should choose

4 Milo is a malt based chocolate tasting additive usually mixed with hot or cold milk.
for optimal health. Specifically, all students understood the use of percentages apportioned to foods in the NSS and why these were different across the food groups, i.e., 40% for Green (Vegetables and Salad)/30% for Red (Protein)/30% for Yellow (Carbohydrates).

When asked how they used the plate guide (see Appendix A), students could identify which foods went into each part of the plate. They tended to report using the percentages of food choices suggested by the Nutritional Symbol System rather than using the proportions printed on the melamine dining hall plate. This was an indication that the NSS was a more powerful informational tool than the plate itself.

When students were asked how the NSS and classroom HEP program, plus the use of special plates in the dining hall, affected their food choices many replied that their behaviour had changed over the course of the program. All sixteen students reported that they followed the guidelines closely at the beginning of the program, but eighteen months later six students reported that they now thought less about the NSS because they had developed good habits and now consistently chose healthy options.

**Overall Comments**
Based on the manual coding of the interview data, there is evidence that students applied the knowledge gained from their Health Education Programs to understand and use the Nutritional Symbol System in ways that were both effective and promoted healthy choices. These results will now be examined using Leximancer to examine what concepts occurred together in the interview transcripts.

**Results from Leximancer**

When all the interview data for this research were analysed using the Leximancer software, the following concept map (Figure 2) resulted. In interpreting Figure 2 it is important to remember that circles represent the most common concepts evident in the interview data. Concepts are clustered on the map based on their contextual ‘nearness’. That is, the concepts that appear together frequently in the text settle close together. With the Visible Concepts slider set at 10% and the Theme size at 30%, the following concepts were identified as important: food/s, things, vitamins, sugar, drink, night, dinner and hall. The size and clustering of the circles indicate their importance and their relationship to each other. As such, the larger circles containing the concepts foods, and food are the dominant concepts, closely aligned with vitamins, day, things, and night on the Leximancer concept map.
Further exploration of dominant themes, which appear within the Leximancer circles, was also undertaken. Leximancer software identifies the strength of association between the words that have been coded manually, as well as providing confirmatory analysis of the ranked concepts. Therefore, from the thematic summary, the most heavily weighted concept is food and foods. ‘Food’ is associated with other concepts namely protein, hall, fruit, day, drink, dinner, remember, vitamins and energy. Further mining of the concepts allows for other associations to be explored. For example, given the interest in the students’ discussions of the dining hall, this concept was further explored by examining the Leximancer output.

When the concept of ‘hall’ is explored in terms of themes, the relative ordering of associated words (in descending order) is: dining, plate, posters, bad, wheel, eating, and remember. All of these words adhere to the theme of (dining) ‘hall’. As the hall is the location of the NSS, these themes seem reasonable given students’ experiences of interpreting the NSS and applying its principles in order to make informed ‘healthy’ food choices.

For the concept of ‘healthy’, the thematic distribution of other words includes eating, breakfast, food, everyday, bad, types, different, body, vegetable, carbohydrate, salad, and plate. This outcome confirms the students’ exploration of what they consider to be optimal food choices from everyday
foods, including vegetables, carbohydrates and salads, as guided by the cue of the school dining hall plate.

As a further example, the largest concept cluster of food/foods is associated with themes such as everyday, carbohydrates, types, protein, different, healthy, bread, fat, breakfast, meat, stuff, bad, and, vegetables. The students’ use of these key words in the interview transcripts further confirms the impact of the school’s Health Education Programs and the transfer of this information to the dining hall setting.

CONCLUSION AND RECOMMENDATIONS
The nexus of knowledge and behaviour is a key point of interest for this paper. As such, the following results are evident. The Health Education Program provided inconsistent results across all year levels in terms of students’ knowledge and understanding of nutrition. From this study it seems clear that students in the Junior School require more opportunities to gain a holistic view of the physical and health implications of eating a balanced diet. These students also need a greater focus on differentiating and defining carbohydrates and proteins to clarify their understandings about these types of foods. Accuracy of knowledge must be considered a precursor to informed decision-making.

The NSS successfully informed students and staff of the recommended percentages of different food groups for a healthy diet: 40% of the total of Vegetables and Salad; 30% of the total Protein; and 30% for Carbohydrates. There was strong evidence that the dining hall became a place where students applied their knowledge of the NSS and the HEP, assisted by the prompt of the specially designed dining hall plates. However, there were also indications that a ‘saturation point’ may have been reached by the students who became habituated to NSS resources over time. Also a closer alignment between the percentages of different foods suggested on the NSS and the divisions indicated on the plate is highly recommended to support the seamless implementation of the NSS system. As noted earlier, the donated plate may have represented a ‘false economy’ as it could have confused students and detracted from the overall effectiveness of the NSS.

In conclusion, based on the research findings outlined here, there is evidence that many students attending the project school applied the knowledge gained from the Health Education Programs and Nutritional Symbol System in order to make informed healthy choices. Teachers would benefit from the feedback gained through this research in order to inform their Health Education Programs and increase their effectiveness.

REFERENCES


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