University of Alberta

Enhancing Learning Through The Use Of Graphic Organizers to Teach Science to Grade Eleven Students in Jamaica

by

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Abstract

This study investigated the effectiveness of using concept mapping via the web-based software *Inspiration* to teach grade 11 students 'Nutrition in Humans'. The sample consisted of 60 students, with an average age 16.4 years who were enrolled in a co-ed high school in western Jamaica. Three instruments were used: an observation schedule designed to determine the frequency of chorus answering for each lesson; an anxiety questionnaire consisting of 16 statements; and a Biology achievement test of 30 recall and application questions constructed by the researcher. The anxiety and biology instruments were administered before and after the 7 weeks of teaching the topics using concept mapping via the web-based software as well as by paper and pencil. The results showed that after students had been taught using the *Inspiration*, their anxiety levels decreased, the frequency of chorus answering decreased, and their biology achievement significantly improved. It was concluded that concept mapping using the web-based software *Inspiration* was effective in teaching grade 11 students 'Nutrition in Humans'.

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Chapter1: Introduction

Statement of the problem

The Reform of Secondary Education (ROSE) program aims at producing scientifically literate grade seven to grade nine students who are aware of the nature of science (Ministry of Education & Culture, 1998). Despite the well written aims of the science curriculum, some curriculum developers, principals and teachers continue to ignore the changing dynamics of the classroom, and the problems experienced by many students. These problems include: impatience with a lecture-type of instruction where everyone is expected to learn at the same rate; high anxiety levels among some students, especially females; and the high level of noise existing in classes resulting from, for example, several students blurting out answers at once (chorus responding). These perennial problems do interfere with students' learning and performance according to Naveh-Benjamin (1991) and Tobias (1985).

Background to the problem

In order to tackle these problems and effectively teach concepts as outlined in the grade eleven integrated science syllabus, the researcher consulted the writings of Ausubel (1963; 1968); de Bono (1978) and Soyibo (1994). De Bono (1978) forecasts positive changes in noise level especially "chorus answering" if students are given the opportunity for "thinking", particularly if this is done in group situations. On the other hand, Soyibo (1994), concerned with students' anxiety levels stated that science teachers ought to create anxiety-free learning environments. This, he purports, would help to lessen their students' anxiety and facilitate the effective teaching and learning of science. Such an environment he predicts would allow the teacher to deliberately pay more attention to his/her students' needs.

In creating the atmosphere for effective teaching, the teacher is required to carefully plan and select sensitive methodical instructions to help learners' master concepts. Remembering that these concepts are fundamental to thought and learning and so teaching cannot be left to chance (Lang, McBeath & Hébert, 1994).

In order to guarantee meaningful learning, it is suggested that teachers appeal to student's learning styles, where individuals are supported in the selection of relating new knowledge or relevant concepts and propositions in what they already know (Ausubel, 1968). According to Hall, Strangman and Meyer (2003), understanding is not only recall of facts, but of how the facts are organized cognitively, so discrete pieces of information can relate to one another in more inclusive, super ordinate manner so that concepts make sense to the individual.

The researcher was given the task of teaching grade 11 students the concept-nutrition, using the objectives stated by the ROSE program as a guide. These objectives state that the student should be able to appreciate that they are responsible for maintaining a healthy body and that food ingested goes through a number of processes.

After analyzing these objectives and based on the works of scholars previously mentioned, the researcher decided to use the heuristic of graphic organizers, namely concept mapping to teach students this topic.

A graphic organizer is a visual and graphic display that depicts the relationships between facts, terms, and/or ideas within a learning task. Graphic organizers are also sometimes referred to as knowledge maps, concept maps, story maps, cognitive organizers, advance organizers, or concept diagrams (Strangman, Hall & Meyer, 2003). Concept mapping is a schematic device for representing a set of concept meanings embedded in a framework of propositions (Novak & Gowin, 1984); concept maps visually present the relationship among concepts. Concept mapping specifically was invented by Gowin in 1977 and has been described by many as very useful in assisting people in understanding the structure and process of constructing knowledge. According to Cesarone (2007), concept diagrams are "chart-like graphic that describes a concept and its various relationships, with general concepts at the top, supporting concepts at the bottom, and lines showing the connections between the concepts" (p. 191). This method enables students to add new information to existing schemata. Alvarez, Risko, Waddell, Drake and Patterson (1988) have found that concept mapping aids conceptual organization by enabling students to perceive and understand their knowledge structures. Barenholz & Tamir (1992) and Pankratius (1990) established that its use leads to an overall higher achievement among students. Cesarone (2007) recommended

that concept diagrams be used with students with learning disabilities (LD), as these students encounter tremendous difficulty in expressing and linking ideas. Moreover, this technique can be used to evaluate students' understanding of information, by asking students to create their own concept diagrams. This activity would enable the teacher to see "misdirected links or wrong connections" (Inspiration Software Inc, 2011). Khan (1993), investigated and found that using concept mapping to teach Jamaican grade 11 students general proficiency mathematics examined by the Caribbean Examinations Council (CXC) was effective in improving cognitive achievement. Inspiration Software Inc (2011) elaborated that concept maps provide an "accurate, objective way to evaluate areas students have not grasped". The multiple ways that this strategy can be used to increase comprehension makes it a necessary tool in all classrooms. Jegede, Alaiyemola and Okebukola (1990) founded that concept mapping when used as a teaching tool in science classes causes a reduction in students' anxiety levels. This device as described by Schmid and Telaro (1990) is a useful instructional strategy.

Okebukola (1992) theorized that "concept maps aid meaningful learning because it help to organize incoming information and help to build mental bridges between what is already known and what is to be learned" (p. 203). Furthermore, concept diagrams allow students to focus on pivotal concepts necessary to enhance comprehension. Concept diagrams facilitate understanding of definitions, characteristics and uses of concepts (Vaughn & Edmonds, 2006). Graphic organizers allow for visual thinking, which is a learning style where the learner better understands and retains information when ideas, words and concepts are associated with images (Inspiration software Inc, 2011). According to the *Inspiration* Software Inc (2011)

> Visual learning strategies, such as graphic organizers, help students of all ages better manage learning objectives and achieve academic success. As students are required to evaluate and interpret information from a variety of sources, incorporate new knowledge with what they already have learned, and improve writing skills and think critically, visual learning tools help students meet those demands. Paired with the brain's capacity for images, visual learning strategies help students better understand and retain information. (Visual thinking and learning in education section, para. 1).

> Visual thinking and learning strategies have been shown to increase academic performance for students of all learning abilities. It is recommended for students with ADHD, autism, Asperger's, dyslexia, aphasia, and visual or auditory processing disorders; by providing multiple mediums for representation, expression and engagement. The tools in this software help students visually organize and outline ideas to structure writing and improve communication and expression-all this while learning skills that enhance and make learning fun and engaging. (Product information, para. 1).

With the *Inspiration* software's tools, students brainstorm using symbols and images to represent and sort their ideas, and create visual diagrams and graphic organizers to break complex tasks down into manageable sections. Visual learning engages students of all abilities as they work together and contribute at their individual levels (Inspiration Software Inc, 2011).

In order to engender meaningful learning, which is based on the development of thinking skills which, in turn, involves deliberate exploration directed at the learners' experience, the researcher used concept maps using the *Inspiration* Software as: a device to identify students' preconceived ideas; an instructional tool; a revision tool; and as an assessment tool.

The effectiveness of using technologically based concept mapping to teach grade eleven students was determined by its ability to reduce anxiety levels and increase cognitive achievement on the topic "Nutrition in Humans."

Purpose of the study

This study explores the effectiveness of using concept maps to teach eleven grade students the concept of "Nutrition in Humans" using the Inspiration Software.

The objectives of this study were to determine whether or not the use of concept mapping as a teaching tool:

1. Affects grade eleven students' anxiety levels.
2. Affects cognitive achievement.

3. Encourages the development of thinking skills.
4. Encourages a reduction in chorus answering and an increase in listening.
5. Creates any significant relationships among students biology achievement, their anxiety level and age.

Research Questions

1. To what extent does using concept maps reduce grade eleven students' anxiety levels in science-based classes on their pre and post test scores on the anxiety questionnaire?
2. To what extent do using concept maps improve grade eleven students' cognitive achievement in the learning of the topic "Nutrition in Humans" based on their pre and post test scores?
3. Are there any significant relationships among the students' anxiety level, age and biology achievement before and after using concept mapping?
4. To what extent does the use of concept maps reduce students' chorus answering and increase their respect for other students contributing to the lesson?

Significance of the study

This study will likely encourage biology teachers to be more informed about the use and possible usefulness of this teaching tool in their classroom. These teachers will likely also use the resources provided to enhance and incorporate e-learning in the classrooms; as we are now living in a technology driven era.

This study is likely to enlighten biology teachers to consider using concept mapping to reduce their students' anxiety and noise making during the learning process.

This study is likely to motivate students to explore their knowledge, and understanding of concepts and their relationships, and thus be engaged in meaningful learning. This will likely lead to improvements in their academic performance on this biological concept-nutrition.

After experience with using *Inspiration*, most students will be able to use this tool in learning other topics in biology and even apply its use to other subjects.

Chapter 2: Review of the Literature

The nature of the problem

The Caribbean Examinations Council (CXC) chief examiner's report indicates that the June 2011 examination in Biology at the General Proficiency level was the 37th sitting of this subject conducted by CXC. Biology examinations continue to be offered in both January and June. The biology examination is one of the more popular of the single sciences offered at the Caribbean Secondary Education Certificate (CSEC) level. This examination is marked out of a maximum of 160 points. In January 2010, the candidates' mean score for the total examination was 30.7 and in June it was 43; for January 2011 the score was better than that in 2010 and for June the mean score of 44 was slightly better than the subsequent year. The examiners complain annually that students seem knowledgeable about some of the biological facts and so can recall them, but they seem unable to apply this knowledge. The report for January 2010 elaborates on this problem thus: "it appears that candidates knew basic facts but did not understand the concepts associated with the facts nor did they know how to express it, as they supplied irrelevant information" (p. 2).

This is a problem that needs to be dealt with urgently, given the consistently inferior test scores. One way this problem could be tackled is in the use of a teaching methodology where thinking and independent learning by students is the main emphasis. Using a teaching technique that enhances the acquisition of 'meaningful learning' ought to be the quest of Jamaican educators. The Ministry of Education seems to have concurred with this idea as it announced the reform of secondary education (ROSE) curriculum.

According to Minister of Education in 1998- Hon. Burchell Whiteman, the Ministry of Education embarked on the ROSE curriculum for grades 7-9 in order to address the issues of inequality in the educational system, both in terms of access and quality. The chief education officer, Wesley Barnett, stated that the major thrust of the ROSE program is to enhance the teaching/learning environment that will result in higher students' gain in cognitive knowledge, skills and values. The classroom will then be characterized by a curious questioning atmosphere where the place of reading

information, sharing and discussion assumes prominence. Each student will be empowered to realize his/her potential and so be ready for the next stage of education (Ministry of Education & Culture, 1998).

The ROSE curriculum emphasizes more of a child-centered approach, and less of teacher dominance. The curriculum developers of the ROSE program require the teacher to be knowledgeable of the current changes to methodology. The grades 7-9 science curriculum seeks to provide for all students a basic understanding in science that will serve as a foundation for further learning, as well as assist them to become functionally literate in science (Ministry of Education & Culture, 1998).

Among the aims of the ROSE science curriculum is the development of critical thinking and process skills. Thinking is a mental activity directed at experience in order to explore and enlarge understanding. De Bono (1978) describes thinking as the "deliberate exploration of experience for a purpose- understanding, planning, and decision making" (p.33). The acquisition of thinking skills ought not to be left to chance but should be formally taught. Effective teaching of concepts requires careful planning and sensitive methodical instruction to help learners' master concepts (de Bono, 1978).

Novak and Gowin (1984) claim that a student's power to better control his/her later experience is grounded not so much in the teacher's authority as in the student's understanding of how educational materials enhance and enlarge the range of experience. The teacher's responsibility is to see that what the student takes from the educational materials does in fact help the student in this increased understanding.

The teaching of science is a rather challenging task for many teachers (Sorgo, 2006). This is so for many reasons. First, science is a subject with lots of interrelated abstract concepts, units of measurements, graphs, experiments, application of ideas and practical activities. Learning isolated facts, therefore, does not equip students with the skills necessary to be successful. Because concepts are interrelated, content may seem overwhelming to students, especially those with learning disabilities. Second, many students enter the science classroom with preconceived notions of what things are and how they work. Science is all around us and so this frequent encounter of concepts leads to the development of many misconceptions. These misconceptions are based on

cultural beliefs, commercials, personal interpretations and religious beliefs. Third, science textbooks contain difficult vocabulary and puzzling explanations of concepts that make them problematic to comprehend (Kinniburg & Shaw, 2007). One way teachers can combat these problems is through the use of graphic organizers.

Concept mapping is a teaching tool that teaches thinking skills and encourages meaningful learning by acquainting the student with 'learning how to learn'. Concept mapping promotes meaningful learning as opposed to rote learning. Concept mapping according to the ROSE curriculum is one of the many strategies for effective science teaching as it helps to give meaning to learning (Ministry of Education & Culture, 1998).

Mintzes, Wandersee, and Novak (2005), points to a drawback in this methodology when he highlights the fact that while some teachers master this technique because it in their teacher's manual, they are completely unaware of its use, that concept mapping is not just another 'study strategy'. In other words, they fail to see the advantages of this technique in building students' confidence and relating classroom experience to the realities of life in the wider world. Ausubel's (1968) theory states that to learn meaningfully, individuals must choose to relate new knowledge to relevant concepts and propositions they already know.

The seemingly absence of meaningful learning in most classrooms, and thus the development of lower order cognitive skills by rote learning seems to account for the low achievement of students in doing the CXC biology examination. In addition, as students face examination they grow more anxious about success. This may also account for their low achievement as according to Naveh-Benjamin (1991) and Tobias (1985), anxiety can block school performance in many ways. Anxious students may have difficulty learning, difficulty using or transferring knowledge they have and they may have difficulty demonstrating their knowledge in tests. So the lack of higher order cognitive skill and the presence of anxiety may be factors affecting students' biology achievement. Slavin (1997), states that low achievers are particularly likely to feel anxious in school but they are by no means the only ones to experience this anxiety.

Soyibo (1994) describes the low achievement trend as a 'depressing situation' and one which must be confronted. He calls upon science teachers to be more aware of their

students' anxiety levels towards science. He also hopes that such awareness would sensitize teachers to the need to create anxiety free-atmosphere during science lessons, which would be conducive to the promotion of effective science learning and achievement.

Anxiety in the classroom

It has been revealed that anxiety exerts immense influence on students' classroom functioning and achievement on important cognitive and affective domains (Fraser, Nash & Fisher, 1983; Phillips, 1978; Spielberger, 1966; Tobias, 1979). Cameron (1982) and McKnight (1985) however, found that anxiety did not have any significant effect on academic performances among grade 11 Jamaican students. Soyibo (1994) engaging similar students reported that the less anxious students significantly outscored the highly anxious ones on a biology test. Jegede, Alaiyemola and Okebukola (1990) investigated the effect of concept mapping on 51 grade 10 students' anxiety and achievement in biology. Using the Zuckerman Affect Adjective checklist, it was found that the use of such a tool reduced the students' anxiety level towards the learning of biology (Viswanathan, 2005; Salkind & Rasmussen, 2007). Using 50 multiple choice questions developed from the West African Examination Council, they found that concept mapping enhanced achievement in biology.

There are different types of anxiety: normal, neurotic, situational and trait. Normal anxiety often induces caution in performing tasks. It is apprehension that most people experience in certain situations (Lindgren, 1976). Normal anxiety becomes neurotic when the arousal is so intense that it deactivates higher mental processes that in turn hinders decisive action and focuses on the discomfort experienced rather than the problem (Soyibo, 1994). Anxiety may be situational, that is, only occurring in clearly defined circumstances, for example, when sitting an examination; or trait, which appears as a part of an individual's innate personality, so that the stimuli that provokes it are numerous and diverse (Fraser, Nash, & Fisher 1983; Spielberger, 1972; 2010).

Anxiety is an experience of dread and foreboding based on some diffuse or specific expectation of harm rather than on an obvious external threat (Okebukola, 1992). Anxiety is also defined as an emotional state that includes feelings of apprehension,

tension, nervousness, and worry accompanied by physiological arousal (Spielberger, 2010). Science anxiety is the uncomfortable feeling students experience when faced with or thinking of science, due to the expectation that something unpleasant will happen during their exposure to school science.

Concept mapping

Concepts are fundamental labels and names given to particular object or events. Concept mapping is a schematic device for representing a set of concept meanings embedded in a framework of propositions (Novak & Gowin, 1984). Concept mapping is a structured, visual means of representing concepts and their inter-relationships (Lehman, Carter & Kahle, 1985). Concept mapping assumes that concepts do not exist in isolation. Each concept depends upon its relationship to other concepts for meaning (Okebukola & Jegede, 1988). Concept mapping incorporates ideas from constructivism, which views the learner as constructing knowledge in accordance with their prior knowledge (Novak & Gowin, 1984). In contrast to behaviourism that views knowledge as a transmission from the teacher to learner; new concept meanings can be acquired through assimilation into existing propositional frameworks (Santrock, 2011). Concept mapping serves as a tool to help learners organize their cognitive frameworks into more powerful integrated patterns. Concept mapping serves as a meta-knowledge and meta-cognitive tool. This brings one back to the fundamental assumption of Ausubel's (1963; 1968) assimilation theory of cognitive learning:

> *If I had to reduce all of educational psychology to just one principle, I would say this is the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly. (p.18)*

Novak (1990) using this theory as his foundation refuted Piaget's belief that children would not be able to understand abstract concepts because of their low cognitive operational capacity but alluded this observation to the limitation of the quantity of their prior knowledge acquired through experience and instruction (Novak, 1990).

Concept mapping therefore relates directly to theoretical principles such as prior knowledge, assumption, progressive differentiation, cognitive bridging and reconciliation (Mintzes, Wandersee, & Novak, 2005). Concept mapping is a procedure

for assisting learners to recognize concepts and to order information about the properties of objects, events or processes into meaningful entities. Willerman and Harg (1991) stated that through concept mapping humans are better able to absorb and retain information through meaningful learning than through rote learning.

For concept mapping, the words associated with the concept are listed and arranged in a hierarchical order, with the most general, abstract and inclusive concept being at the top. Lines are then used to link concepts. These lines ought to be labeled with linking words, which may be literally a word or a short phrase that accurately represents the learner's understanding between the two concepts. At the end of each branch on the concept map usually is placed an example of the terminal concept. Concept mapping helps the learner to organize information and build mental bridges between what is already known and what is to be learned (Okebukola, 1992). Concept maps are intended to 'tap' into a learner's cognitive structure and to externalize it, for both the learner and the teacher to see, what the learner already knows (Novak & Gowin, 1984).

Concept mapping is a useful tool for the learner and teacher- irrespective of age, educational experience or cognitive ability. Alvarez, Risko, Waddell, Drake, and Patterson (1988) helped first grade students to engage in meaningful learning of science concepts. These maps have been used by Beyerbach and Smith (1990) to assess teachers' knowledge of 'effective teaching'. Mohammed-Wafaie (1997) purports that these maps provide students with a means to learn the language patterns of science and to construct scientific knowledge. Many researchers on concept mapping demonstrate that meaningful learning results came from its use in science classrooms (Novak & Gowin, 1984; Okebukola & Jegede, 1988).

Both mathematics and science teachers favour the use of this tool as a meta-learning device because of its enhancement of meaningful learning and a reduction in students' anxiety levels (Jedege, Alaiyemola & Okebukola, 1990). Khan (1993) used it to successfully teach CXC Mathematics to Jamaican students. Concept maps are useful tools to represent knowledge in any discipline by aiding the organizing and understanding of new subject matter. Pankratius (1990) found concept mapping to be a diverse teaching tool to greatly improve science achievement prior to, during and subsequent to instruction.

This tool helps teachers to chart their course of teaching a lesson. It aids the teacher with information on students' prior knowledge, inclusive of misconceptions. Its continuous use empowers the teacher to supervise and teach for conceptual change among his students, hence encouraging meaningful learning.

Concept learning is useful in guiding students to identify key concepts of a lesson and the relations between them. Concept maps help students focus and so interpret events and objects, for example, when doing a lab or conducting activities on a field trip. Concept mapping used during lessons enables the student to visualize new knowledge as it relates to previous experiences and knowledge.

Concept mapping can be used as an assessment tool. Novak (1990) has developed a format for marking such strategy. Meaningful and valid propositions are scored as 1 point; 5 points for each valid level of hierarchy; 10 points for each cross link that is both valid and significant and 1 point for each example.

Many psychometricians battle with the idea of finding the types of tests that assess Bloom's taxonomy in its totality. Odom and Kelly (1998) state that the construction of concept maps requires a student to operate in all six levels (knowledge, comprehension, application, analysis, synthesis and application) of the cognitive domain of Bloom's taxonomy. The second domain, the affective, of Bloom's theory advocates structure and sequence for developing attitude and beliefs. This domain has five levels: receive, respond, value, organize values and internalize values (Santrock, 2011). The third domain, the psychomotor, was established to address skills development relating to manual tasks and physical movement. This domain has five levels: imitation, manipulation, precision, articulation and naturalization (Santrock, 2011). Concept mapping can be used as a diagnostic tool: to modify instruction, present a schematic summary of what has been learned and as an assessment tool.

Concept mapping can be used while reading books, magazines, newspapers; during pre-instruction; while writing reports or preparing for presentations and developing curriculum (Odom & Kelly, 1998). Through concept mapping the student engages in meaningful learning by learning how to learn and controlling such process by the employing and developing critical thinking skills.

The development of critical thinking skills is even enhanced by organizing students in groups. Von Glasersfeld (1989) emphasizes the importance of social interaction in generating discrepancies that promote conceptual change. He suggests that this is why many constructivist teachers of science and mathematics have been promoting group learning. Concept mapping, according to Soyibo (1991), when used with different modes of social interactions- cooperative (CP), cooperative-competitive (CP-CM) and individualistic (IW) significantly improved grade 10 students' performance in genetics. All the experimental groups of students exposed to this heuristic achieved significantly better grades in genetics than in the lecture method.

Concept mapping though being highlighted in a perfect manner by the researcher does have limitations. Concept mapping may cause the teacher to be side tracked from the objectives that were originally set out to fulfill a given lesson. Additionally, concept mapping is very time consuming and requires the teacher to continuously assess its construction.

Reducing chorus answering

Choral response occurs when there is only one possible correct answer and is done by many students in the class in unison (Hunter, 1982; Rosenshine & Stevens, 1986; Hunter, 2004). In the Jamaican situation, however, this construct method of answering rarely occurs. Students tend to answer spontaneously without any regard for their fellow students. This may have very negative effects where students' answers are often not heard by the teacher and so are unedited. This most certainly will cause longevity of misconceptions. Unfortunately, not much has been documented on noise level or choral answering in the Jamaican context.

The researcher believes that the noise level of a class especially the occurrence and frequency of chorus answering are issues that detract from the attainment of meaningful learning for all in the classroom. Often times the teacher has to take time from valuable and often insufficient teaching time to reprimand students.

Teaching critical thinking according to de Bono (1978) as a skill will result in more listening to other people and less talking across people, less giggling and or whispering, less abuse and shouting down and more tolerance of others views. These changes are

possible if students are given the opportunity to think and discuss in groups (de Bono, 1978).

The increasing prevalence of obesity and the decline in physical fitness among school-age children is of great concern to many physicians and parents' according to the National Diary Council. Despite being a North American observation it would not be surprising if a similar problem existed, or is developing in Jamaica. Senator Hugh Dawes, the then State Minister in the Ministry of Education stated that the rationale for the formal introduction of nutritional education was for learning to be used as a means of changing home and community nutrition related practices and so enhance the nutritional development of our people.

It is by considering all of the above that the researcher investigated the effect of using concept mapping to teach the topic 'Nutrition in Humans' on anxiety levels and academic performance among grade 11 students.

Chapter 3: Methodology

The School

The sample was selected from a co-ed, government high school. The chosen school is located in Trelawny, Jamaica and was founded in 2004. This institution provides tuition for 968 students from grades 7 to 12. A full complement of 48 permanently employed teachers staff this school. Of this number, only 11 form the science department.

There were 158 students in grade 11 grouped into 6 streams of classes. Streaming was done according to the results of the students' end of year examinations at the end of grade 9. The 60 lowest performing students are randomly assigned by the school to one of two streams. The researcher worked with these streams.

The Sample

The researcher taught both groups for seven weeks. One group was taught using traditional pen and paper concept mapping (the control group) and the other group was taught using the *Inspiration* software (the experimental group). The control group had a total of 29 students, 11 girls and 18 boys; and the experimental group had a total of 31 students, 8 girls and 23 boys. The control group took their lessons in the biology lab while the experimental group had all their lessons in the information technology (IT) lab. Both rooms are spacious and well ventilated, however the IT lab is also air conditioned, likely because computers add heat to the room. This study was approved by the University of Alberta ethics board. The researcher had the permission and cooperation from the school board and principal.

Topics Taught

The study carried out centered on the topic "Nutrition in Humans" taught over a period of seven weeks. Fourteen lessons were taught by the researcher over this period. There were two lessons per week on Thursdays and Fridays. Each lesson lasted for 70 minutes.

The topic, "Nutrition in Humans", is part of the ROSE curriculum guide (1998), units 9 and 10. The sub-unit 10.1 "Food and Health" were taught for four lessons before sub-unit 9.3. The general objective for sub-unit 10.1 is 'for students to become aware of the

importance of a balanced diet'. From unit 9 "Energy flow through Living Systems", the sub-unit 9.3 "Food intake, digestion and absorption in animals" were taught for five lessons. The general objective being that ' students understand that the food which animals eat, goes through a number of processes before reaching the cells, and the energy from the food gives energy to the cells.

In considering these objectives the researcher carefully organized and planned interesting and interactive lessons. The researcher introduced the heuristic tool, concept maps, during week 1 and 2. This introduction took the form of lectures and discussions on the components of and the procedure in constructing concept maps, using pen and paper and the web-based software *Inspiration*. For week 3 to 7 students were given ample practice in constructing concept maps individually and in groups during class time. The students, after displaying mastery of this technique, were instructed to draw a concept map representing their understanding of the concept 'food'.

From these concept maps, students' preconceived ideas were identified by the teacher, who then developed strategies to clarify misconceptions where present. The topic "Nutrition in Humans" was broken into nine sub-topics and taught over five weeks, as shown below.

Table 1

Teaching Schedule for weeks 1 – 7

WEEK	SUB-TOPICS	TIME (mins)
1-2	Introducing concept mapping	210
3	Food and Health	70
3	Nutrients- Carbohydrates & Vitamins	70
4	Nutrients- Proteins	70
4	Nutrients- Fats, Minerals & Water	70
5	Making foods useful to our bodies	70
5	Digestion in the mouth	70
6	Digestion in the mouth and stomach	70
6	Digestion in the stomach & duodenum	70

7	Digestion in the small intestine	70

The 'Food and Health' lesson took the form of a discussion where students revealed their ideas regarding terms such as 'nutrition', 'malnutrition', 'healthy', and 'balanced diet' just to list a few. The teacher used this opportunity to define these terms as well as to clarify misconceptions where necessary. The subsequent three lessons focussed on nutrients, their components, sources, forms, functions, associated deficiency diseases and their confirmative tests (food tests). A written test was administered at the end of these lessons to see if the students grasped the concept of 'nutrients', and thus will be ready for the next sub-topic of ‘digestion’. The students were first introduced to the structure of the human digestive system, the names of each structure along with its functions. The following five lessons were aimed at familiarizing students with the processes occurring in the digestive tract, and this was done with the aid of videos. From this exposure it was hoped that students would be better able to understand prevent and care for digestive malfunctions of the human body, prevalent in their community.

All lessons were taught using PowerPoint as the main medium for providing information. Worksheets were given to students to complete as culminating activities, or they were asked to create their own concept map to illustrate what they learnt. Charts were often used for culminating activities for displaying information continuously on the walls of the classroom.

Instrument

The instrument that was used to measure the effect of using concept mapping to teach human nutrition included:

1. a biology achievement pre- test and post-test which is aimed at assessing students’ cognitive ability on the topic ‘Nutrition in Humans’.

2. an anxiety questionnaire adopted from Zuckerman’s Affective Adjective Checklist containing 16 statements which is aimed at assessing students’ anxiety towards science.

3. an observation schedule constructed and completed by the researcher after each lesson which is aimed at identifying the occurrence of chorus answering.

Assignments in the form of worksheets for culminating activities and also creating concept maps on the main ideas introduced during the lessons complemented the teaching program and were also used to evaluate students' progress.

Pre and Post test

The anxiety and biology instruments were administered before teaching commenced and will be called the pre test. In week 7, when the teaching ends, these instruments were again administered and were called the post test.

The anxiety test consists of twenty statements and students were asked to agree or disagree with each statement, according to the feelings they possessed towards science. Each statement contained a word taken from Zuckerman's Affect Adjective Checklist used by Salkind & Rasmussen (2007) and Viswanathan (2005). Soyibo (1994) used this checklist to measure anxiety among Jamaican high school students as related to the learning of science. Only 16 of the 20 statements were scored. If a student disagreed with a statement designated negative (-), he/she scored one (1), while if he/she agreed the score was zero (0). For statements designated positive (+), a score of 1 was given for agreeing while 0 was given for disagreeing. The total anxiety score was obtained by adding the scores. The maximum possible value is 16 while the minimum is 0. Therefore, a high score indicates high anxiety while a low score indicates relatively low anxiety.

For the cognitive achievement test the domains knowledge and application were measured for the topics 'nutrients' and 'digestion', using 30 multiple-choice items, each having four choices.

The following table of specification shows the percentage weightings for this instrument.

Table 2

Table of specification for biology achievement test

TOPIC	KNOWLEDGE	APPLICATION	TOTAL

Nutrients	30	15	45
Digestion	40	15	55
	70	30	100

The topic 'nutrients' and 'digestion' were further divided into sub-topics and the marks distributed as per the following table:

Table 3

Distribution of biology test items according to each domain and sub-topic

TOPIC	KNOWLEDGE		APPLICATION		TOTAL
	Number of items to be asked	Question number on the cognitive test	Number of items to be asked	Question number on cognitive test	
NUTRIENTS					
Function	**1**	10	**1**	15	**2**
Source	**2**	9; 24	**1**	3	**3**
Deficiency	**3**	2; 17; 23	**2**	7; 13	**5**
Food test	**2**	1; 8	**0**	-	**2**
Balanced diet	**0**	-	**1**	25	**1**
TOTAL	**8**		**5**		**13**

DIGESTION					
Physiology	**5**	16; 19; 21; 22; 26	**1**	5	**6**
Anatomy	**5**	14; 27; 28; 29; 30	**0**	-	**5**
Enzymes	**3**	4; 6; 12	**3**	11; 18; 20	**6**
TOTAL	**13**		**4**		**17**

An observation schedule was completed by the teacher to assess the incidence of chorus answering and the number of times the teacher had to interrupt classes to address this problem. The teacher had to rate five items according to the criteria suggested. Four of the items focus on chorus answering and the other on students' listening while their fellow students contributed to the lesson whether by making a point, sharing an experience and or asking/answering a question.

Teaching Materials

The teaching materials used over this 7-week period included charts, worksheets and the web-based software *Inspiration.* All the lessons were taught using PowerPoint as the main medium for providing information. Charts were used for culminating activities, and for displaying information continuously on the walls of the classroom.

In order to gain insight into the students' ideas on the topic 'Nutrition in Humans', students in the control group were asked to draw a concept map with the word 'food' as the main concept, while the students in the experimental group were asked to create the same concept map using *Inspiration.* These maps were analyzed by the teacher and objectives formulated to tackle the misconceptions held by the students and revealed by the activity.

Worksheets which ask students to complete given concept maps were used as culminating activities. The teacher used concept maps as revision tools and on one occasion as an assessment tool.

Data Analysis

The pre and post test scores were tabulated for each student for each item, in both the control and experimental group. These data were then imported into the SPSS program to determine: frequency; average (mean); standard deviation; t-value and correlation coefficients.

The number of students answering each item along with their choices were used to generate a frequency table which was then used to generate graphs. The mean and standard deviation for each domain and set of sub-topics was then calculated for both the pre and post test. The scores on both tests were then compared and significance determined by a two-tailed t-test.

After tabulating and calculating individual anxiety level scores, the teacher categorized students as displaying anxiety level above or below the mean value of the class. Using a t-test analysis these categories were compared against the biology achievement and age for both the pre and post test.

Using correlation, the researcher ascertained if the relationships between biology achievement, anxiety levels and being taught using concept mapping via the web-based software *Inspiration* are statistically significant.

The relationship between the biology achievement and students' anxiety level and age was also analyzed.

Chapter 4: Results and Discussion

The sample consisted of 60 grade 11 students, 41 boys and 19 girls, who were taught by the researcher during the weeks of intervention. The students in this sample had the lowest average in science among the grade 11 students. This group was randomly divided into 2 groups (streams) by the institution with one being was designated the experimental while the other designated the control. The age of the students ranged from 15 years to 17 years with the average being 16.4 years. Majority of the students were from Trelawny, with a few from the neighbouring parish of St. James.

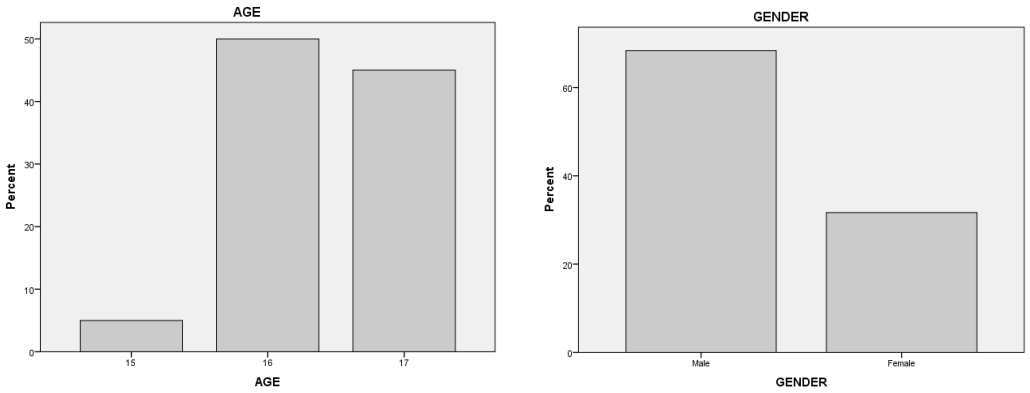
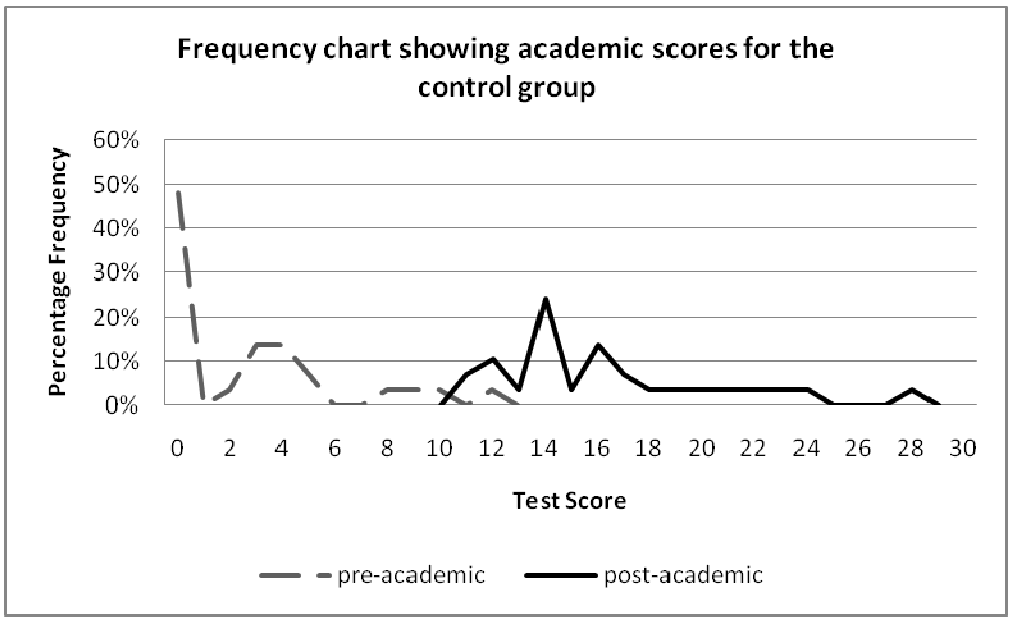


Figure 1. Age and gender distribution of the sample.

The minimum score on both the pre and post academic test was 0; the maximum was 12 and 30 respectively with means of 2.78 and 20.92. The pre academic test had small spread (standard deviation of 2.98) and a strong positive skew with majority of the participants (30%) receiving a score of 0. However, on the post academic test the scores were more widely spread (standard deviation 6.45) with a slight negative skew indicating that there were more high scores than low scores as illustrated in figure 2.

On the anxiety test, the maximum score reached was 16 on the pre test and 14 on the post; the minimum was 7 and 0 respectively. On the pre anxiety test the average score was 12.68 with a negative skew. While on the post anxiety test the average score improved to 7.43 with a virtually symmetric distribution.



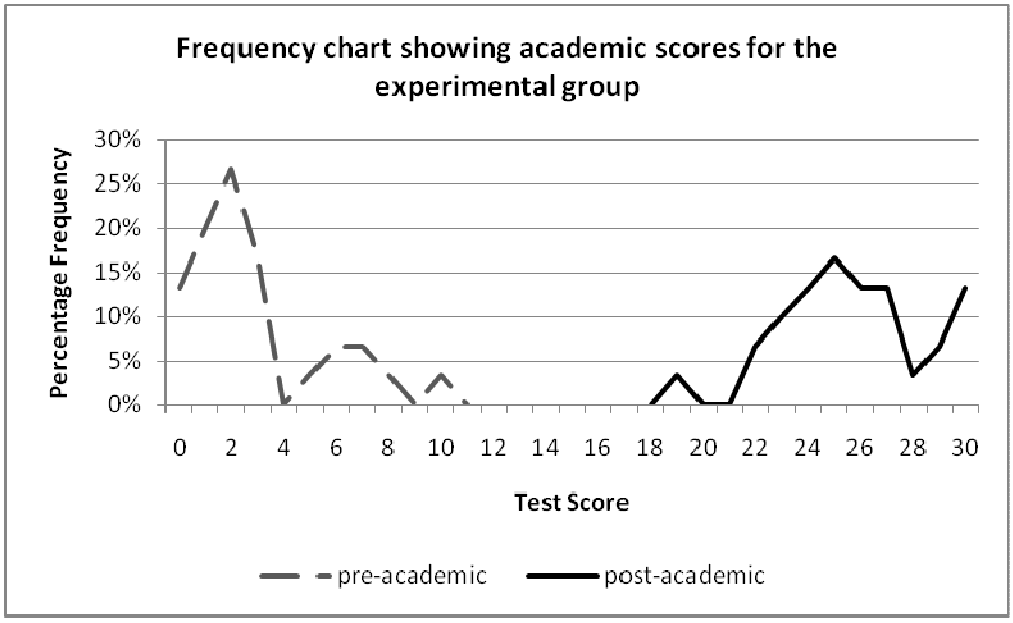
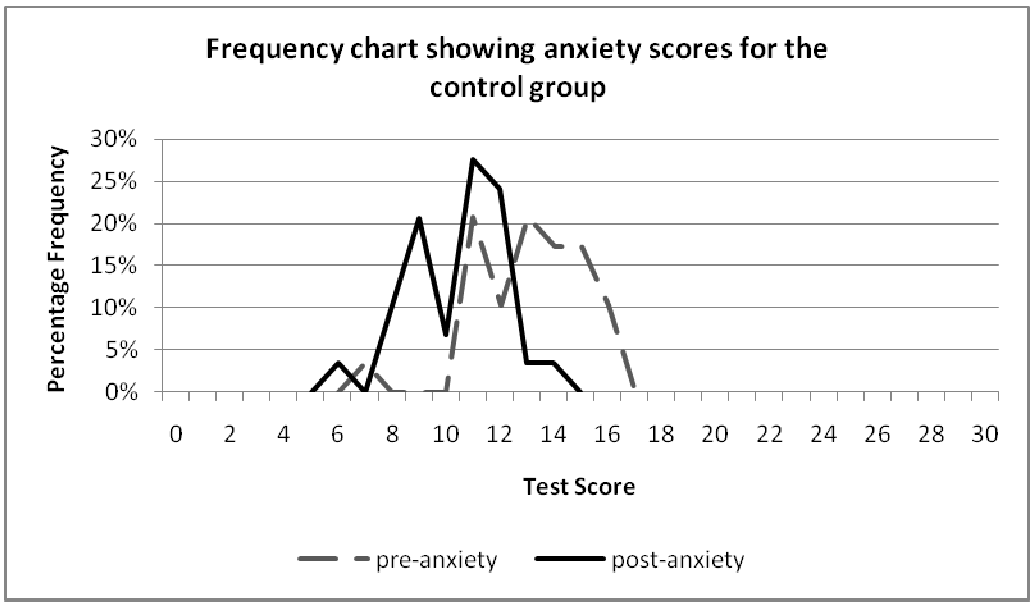


Figure 2. Academic scores on the pre and post tests. This figure illustrates that the post test scores were noticeably higher than those of the pre test especially for the experimental group.



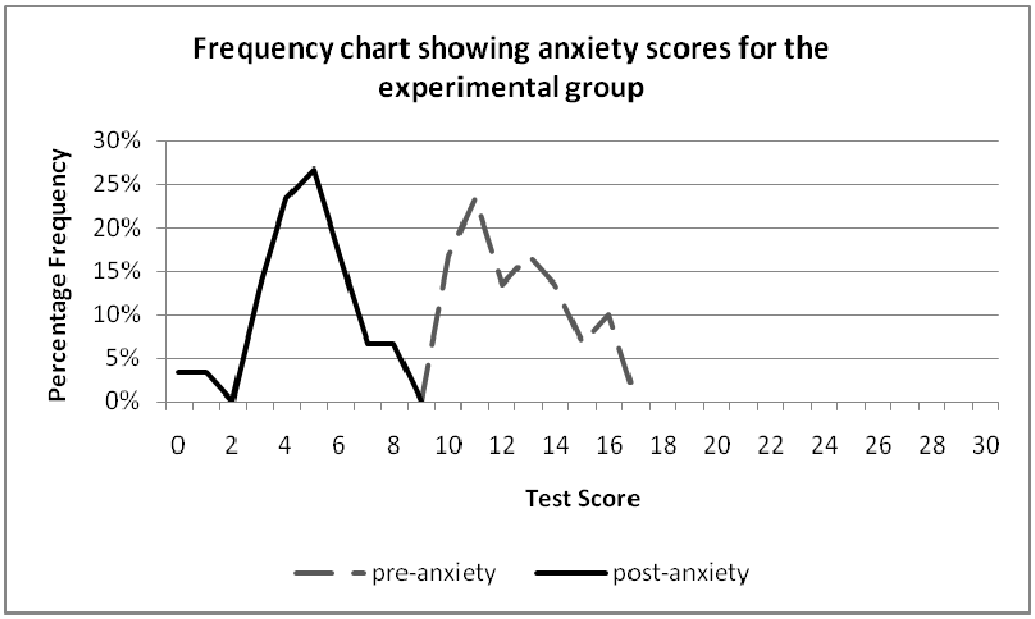


Figure 3. Anxiety scores on the pre and post tests. This figure illustrates that the post test scores were noticeably lower than those of the pre test.

Table 4
Descriptive Statistics for the Academic and Anxiety Tests

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
PRE ACADEMIC	60	0	12	2.78	2.981	1.250	.309
POST ACADEMIC	60	0	30	20.92	6.445	-.651	.309
PRE ANXIETY	60	7	16	12.68	2.103	-.379	.309
POST ANXIETY	60	0	14	7.43	3.441	-.025	.309

To what extent does using concept mapping with the Inspiration software reduce grade 11 students' anxiety levels in science based classes on their pre and post test scores on the anxiety questionnaire?

To answer this research question the results from the anxiety questionnaires were analyzed. As previously stated, a high value on this instrument indicates a high anxiety level and vice versa. Sixteen, the maximum possible anxiety total indicates that the student is very anxious, while zero, the minimum indicates that the student is not anxious.

The students' mean anxiety level was lower in the post test for both the control and experimental group. The mean anxiety scores on the pre test were 13.10 for the control group and 12.29 for the experimental group. Test of significance at a 0.05 level revealed no statistical difference between these scores. The mean scores improved in the post anxiety test to 10.45 and 4.61 for the control and experimental group respectively. These scores indicated a significant statistical difference in the performance of the groups on the post test. This is an indication that the intervention using concept maps was effective to reduce students' anxiety levels.

To what extent does using concept mapping with the Inspiration software improve grade 11 students' cognitive achievement in the learning of the topic "Nutrition in Humans" based on their pre and post test scores?

A look at the biology achievement pre and post tests revealed an overall increase of 60% on the upper range in the post test. That is, where the highest possible mark on the test was 30, the range on the total marks for both the control and experimental groups was 0 to 12 on the pre-test and 0-30 on the post-test.

Biology achievement on the pre test for the control group showed a mean of 2.72, and for the experimental 2.84. While for the post test the mean for the control group was 15.76 and 25.74 for the experimental group. Both groups registered statistically significant improvements in their performance between the pre and post tests at the 0.05 level of significance.

It was also found that there was no significant difference between the control and experimental group in the pre tests; however, there was significant difference in the post test. This indicates that the intervention using concept maps was effective to improve students' cognitive achievement in learning the topic *"Nutrition in Humans".* It also indicates that when the *Inspiration* software is used the improvement is even greater.

Are there any significant relationships among the students' anxiety level, age and biology achievement before and after using concept mapping with the Inspiration software?

The researcher used correlation analysis to identify the existence of relationships among the factors. There is a statistically significant relationship ($\rho>0.05$) between pre anxiety scores and pre academic scores. These two factors are inversely related, meaning that the higher the academic achievement the lower the anxiety levels; this is showed by a correlation of -0.281. This is a weak to moderate relationship, so while the relationship may be significant, the fact that someone is poor academically it does not mean that they will automatically have a high anxiety level. No other significant relationship was identified among the other factors.

When separated into control and experimental groupings, the same significant inverse relationship between pre-anxiety and pre-academic scores emerged. In addition the

experimental group showed a significant very strong direct relationship (0.700) between the pre and post academic test scores and a significant moderate to strong inverse relationship (-0.472) between pre academic and post anxiety test scores. This could be interpreted as meaning students with a stronger foundation will perform better when they and are less anxious on an academic test.

To what extent does the use of concept mapping with the Inspiration software reduce students' chorus answering and increase their respect for other students contributing to the lesson?

The observation schedule was used to answer this question. Classroom protocol within any class states that the students should listen while others are speaking and students should wait to be acknowledged before answering. These expectations in the Jamaican situation are often made clear to students on the first day of each term but its reinforcement seemingly decreases with time. When most classes in a school are engaged in these unacceptable 'minor' misbehaviours it creates a noisy environment for all.

Table 5

Results of observation schedules for the 7 weeks of teaching for the control group

Lesson	Observation Question 1	Observation Question 2	Observation Question 3	Observation Question 4	Observation Question 5	Average Noise Level
1	4	4	4	4	4	4.00
2	4	4	4	4	4	4.00
3	4	4	4	4	4	4.00
4	4	4	4	4	4	4.00
5	4	4	4	4	4	4.00
6	4	4	4	4	4	4.00
7	3	4	4	4	4	3.80
8	3	3	3	4	4	3.40
9	3	3	3	4	4	3.40

10	3	3	3	4	3	3.20
11	3	3	3	4	3	3.20
12	3	3	3	3	3	3.00
13	3	3	3	3	3	3.00
14	2	3	3	3	3	2.80

Table 6

Results of observation schedules for the 7 weeks of teaching for the experimental group

Lesson	Observation Question 1	Observation Question 2	Observation Question 3	Observation Question 4	Observation Question 5	Average Noise Level
1	4	3	4	3	3	3.40
2	4	4	4	4	3	3.80
3	4	4	3	3	3	3.40
4	3	3	2	2	2	2.40
5	4	4	3	4	2	3.40
6	2	2	1	1	1	1.40
7	2	1	1	1	1	1.20
8	2	1	1	1	1	1.20
9	2	1	1	1	1	1.20
10	1	1	1	1	1	1.00
11	1	1	1	1	1	1.00
12	1	1	2	1	1	1.20
13	1	1	1	1	1	1.00
14	1	1	1	1	1	1.00

In the control group, the average for the 5 questions for each lesson indicates that there was a lot of chorus answering and high noise levels during the teaching experience.

In the experimental group, the average for questions 1;2;3 and 5 for each lesson indicates that there was more chorus answering at the beginning of the teaching experience. The noise level decreased drastically for lesson 4 where concept mapping using the web-based software was introduced. This was probably due to the high interest that students' seemed to have had in finding out what this software had to offer.

The noise level in lesson 5 increased probably because it was focused on 'food and health', a topic that was familiar to them and coupled with the fact that the lesson took the form of a discussion.

There was a strong positive significant difference (0.770) between the average noise level for the control and experimental group over the teaching experience. Students' in the experimental group chorus answering and their respect to each other by listening changed for the better over the 7 weeks. So it can be concluded that the use of concept mapping using the *Inspiration* software reduces chorus answering and increases their respect for others then they are speaking.

Chapter 5: Conclusions and Recommendations

Conclusions

From this study on the use of the web-based software *Inspiration* to teach grade 11 students 'Nutrition in Humans' the following conclusions are drawn. Using concept mapping as a teaching tool:

1. improved students' biology achievement especially in the area of developing the students' ability to apply knowledge learned to new situations
2. decreased the students' anxiety levels especially among the younger ones
3. reduced the frequency of chorus answering by students
4. increased the patience of students to listen to their fellow students' contribution to class discussions or their questions being asked

Recommendations

The findings of this study indicate that the learning environment can be improved in a number of ways. The following are some recommendations that are based on the findings.

1. The education officers (E.O.) ought to promote the use of concept mapping using *Inspiration* software as a teaching or learning tool for both teachers and students. This may be done by organizing workshops and publishing teaching manuals that focus on introducing and instructing teachers on this versatile teaching tool. It is through the development of meta-cognitive skills that students will build confidence in applying knowledge learned in the classroom to examination questions and possibly everyday experiences.
2. In their preparation teachers must be encouraged to plan lessons using concept maps. In so doing they will be able to see in a holistic manner the concepts to be taught and so delivering it in this manner. This will likely assist the teacher in quickly recognizing ways of integrating students' experiences to the content being taught.

3. Teachers must assess their students' content and knowledge more often in non-threatening environments in a bid to reduce anxiety due to fear of failure. Teachers should increase the focus on students' learning rather than on the outcome. As the more anxious students are, the less they will be able to pay attention. Concept mapping will facilitate reducing anxiety related to subject area learning.

4. Teachers must pay more attention to providing an environment conducive to learning for all. The teacher along with his/her students should establish clear, reasonable and consistently enforced rules to reduce chorus answering and promote listening in the classroom.

5. Students must be encouraged to use concept mapping via the *Inspiration* software as a brainstorming tool, an organizer or planning device and a studying tool that provides familiarity with learning how to learn thereby building understanding.

6. The strategy of concept mapping using the *Inspiration* software should be used more often in the classrooms, as it provides students with visual opportunities to self-evaluate their understanding and foster conceptual change where necessary.

Limitations

The study was constrained by the following problems.

1. Teaching time was shortened because many times devotion was not completed within the scheduled time. Thus the 8:30am class that was suppose to last for 70 minutes quite often only lasted less than an hour. Time was also lost because students had to be excused for taking pictures for the school magazine or for sports day preparations. On a few occasions the teachers had meetings so school was dismissed early, also school was on break due to mid-term and public holidays so the 10:50-2:00pm class sometimes was not held.

2. Study results may be limited in their generalizability. The present study was conducted in a single city in western Jamaica. Thus the extent to which results

apply to other cities over the island is not known. The students were all from similar backgrounds and socio-economic status (middle to low). Future research should include students from various backgrounds, cities and socio-economic statuses.

3. This study had a sample of 60 students, mostly boys (n=41). Hence, one cannot actually conclude that this software was as effective for girls as it was for boys. Future research should include a larger sample size and/ or one with mostly girls.

Suggestions for future studies

1. An investigation to reveal the relationship between anxiety and the use of concept mapping using the web-based software as a tool for other topics in biology or in other subject areas.

2. An investigation into the extent to which anxiety is affected by the use of concept mapping via the web-based software but using another method of sampling and/ or instrument. For e.g. interviewing students on their reactions to given scenarios that usually induce anxiety.

3. Further exploration of concept mapping software and its application to instruction.

References

Alvarez, M.C., Risko, V.J., Waddell, J., Drake, J., & Patterson, A. (1988). Concept maps and Vee diagrams: Strategies to deal with the dilemma of the restricted curriculum. In D. Lumpkin, M. Harshbarger, P, Ransom & J. Williams (Eds.), *The dilemmas of teaching reading, American Reading Forum, 8*, 10-17.

Ausubel, D. P. (1963). *The psychology of meaningful verbal learning.* Oxford, England: Grune & Stratton.

Ausubel, D.P. (1968). *Educational psychology: a cognitive view.* New York: Holt, Rinehart and Winston.

Barenholz, H., & Tamir, P. (1992). A Comprehensive Use of Concept Mapping in Design Instruction and Assessment. *Research in Science & Technological Education, 10(1),* 37-52. doi:10.1080/0263514920100104

Beyerbach, B., & Smith, J. (1990). Using a computerized concept mapping program to assess preservice teachers' thinking about effective teaching. *Journal of Research in Science Teaching, 27,(10),* 961-971.

Cameron, R. (1982). *School anxiety and academic achievement in a sample of Jamaican students.* (Unpublished masters' thesis). University of the West Indies, Kingston, Jamaica.

Caribbean Examinations Council (2010a). Report on candidates' work in the secondary education certificate examination: general proficiency examination- biology. St. Michael, Barbados: Caribbean Examinations Council. Retrieved from http://www.cxc.org/SiteAssets/2010SchoolReports/2010_Jan_Biology_SubjectReport.pdf

Caribbean Examinations Council (2010b). Report on candidates' work in the secondary education certificate examination: general proficiency examination- biology. St. Michael, Barbados: Caribbean Examinations Council. Retrieved from

http://www.cxc.org/SiteAssets/2010SchoolReports/CSEC_2010_Jun_Biology_SR.pdf

Caribbean Examinations Council (2011a). Report on candidates' work in the secondary education certificate examination: general proficiency examination- biology. St. Michael, Barbados: Caribbean Examinations Counci.Retrieved from http://www.cxc.org/SiteAssets/2011SchoolReports/CSEC_Jan_2011_Biology_SR.pdf

Caribbean Examinations Council (2011b). Report on candidates' work in the secondary education certificate examination: general proficiency examination- biology. St. Michael, Barbados: Caribbean Examinations Council. Retrieved from http://www.cxc.org/SiteAssets/2011SchoolReports/CSEC_MayJune2011_Biology.SR.pdf

Cesarone, B. (2007). Concept mapping in early childhood and primary education. *Childhood Education*, *83(3),* 191-192.

de Bono, E. (1978). *Teaching thinking.* Harmondsworth, England: Penguin Books.

Fraser, B.J., Nash, R., & Fisher, D.L. (1983). Anxiety in science classrooms: its measurement and relationship to classroom environment. *Research in Science and Technological Education, 1(2),* 201-208. doi:10.1080/0263514830010208

Hall, T., Strangman, N., & Meyer, A. (2003). *Differentiated instruction and implications for UDL implementation.* Wakefield, MA: National Center on Accessing the General Curriculum. Retrieved from http://aim.cast.org/learn/historyarchive/backgroundpapers/differentiated_instruction_udl

Hunter, M. (1982). *Mastery teaching (*1st ed.). El Segundo, CA : TIP Publications.

Hunter, R. (2004). Madeline Hunter's mastery teaching :increasing instructional effectiveness in elementary and secondary schools. Thousand Oaks, Calif. : Corwin Press.

Inspiration Software, Inc. (2011). Retrieved from http://www.inspiration.com

Jegede,O.J., Alaiyemola, F.F, & Okebukola, P.A. (1990).The effect of concept mapping on students' anxiety and achievement in biology. *Journal of Research in Science Teaching, 27(10),* 951-960. doi: 10.1002/tea.3660271004

Khan, M. (1993). *Concept mapping as a strategy for teaching and developing the Caribbean Examinations Council (CXC) Mathematics curriculum in Secondary School.* (Unpublished doctoral dissertation). University of the West Indies, Kingston, Jamaica.

Kinniburg, L. & Shaw, E. (2007). Building fluency in elementary science through readers' theatre. *Science Activities 44(1)*, 16-22. doi:10.3200/SATS.44.1.16-22

Lang, H.R., McBeath, A., & Hébert, J. (1994). *Teaching: strategies and methods for student-centered instruction.* Toronto: Harcourt Brace.

Lehman, J.D., Carter, C. & Kahle, J.B. (1985). Concept mapping and achievement: Results of a field study with black high school students. *Journal of Research in Science Teaching,* 22(7), 663 -674.

Lindgren, H. (1976).Educational psychology in the classroom (5th ed.). New York: Wiley.

McKnight, F. (1985). Anxiety in grade eleven students as it relates to their achievement. (Unpublished masters' thesis). University of the West Indies, Kingston, Jamaica.

Ministry of Education and Culture. (1998). *Reform of secondary education: curriculum guide for grades 7-9. Kingston, Jamaica.*

Mintzes,J. J., Wandersee, J.H., & Novak, J.D. (2005). *Assessing science understanding: a human constructivist view.* Burlington, MA: Elsevier Academic Press.

Mohammed-Wafaie, A. (1997). The use of concept mapping in learning science subjects by Arab students. *Educational Research, 39(3).*

Naveh-Benjamin, M. (1991). A comparison of training programs intended for different types of test-anxious students: further support for an information-processing model. *Journal of Educational Psychology, 83(1),* 134-139. doi: 10.1037/0022-0663.83.1.134

Novak, J.D. (1990). Concept mapping: a useful tool for science education. *Journal of Research in Science Teaching, 27(10),* 937-949.

Novak, J., & Gowin, D. (1984). *Learning how to learn.* New York: Cambridge University Press.

Odom, A.L., & Kelly, P.V. (1998).Making learning meaningful. *Science Teacher, 65 (4).*

Okebukola, P.A. (1992). Attitude of teachers towards concept mapping and vee diagramming as metalearning tools in science and mathematics. *Educational Research, 34(3),* 201-213. doi:10.1080/0013188920340304

Okebukola, P. & Jegede, O. (1988). Cognitive preference and learning mode as determined of meaningful learning through concept mapping. *Science Education, 72(4),* 489-500.

Pankratius, W.J. (1990). Building an organized knowledge base: Concept mapping and achievement in secondary school physics. *Journal of Research in Science Teaching,27(4),* 315-333. doi: 10.1002/tea.3660270404

Phillips, B.N. (1978). School stress and anxiety: Theory, research, and intervention. Oxford, England: Human Sciences Press.

Rosenshine, B.V. & Stevens, R.(1986). Teaching Functions . In M. Wittrock (Ed.), *Handbook of research on teaching*. New York : Macmillan.

Salkind, N.K. & Rasmussen, K. (2007). Multiple Affect Adjective Checklist–Revised Marvin Zuckerman. In *Encyclopedia of Measurement and Statistics.* doi:10.4135/9781412952644

Santrock, J.W. (2011). *Educational psychology* (5th ed.). New York : McGraw-Hill.

Schmid, R.F., & Telaro, G. (1990). Concept mapping as an instructional strategy for high school biology. *The Journal of Educational Research, 84(2),* 78-85.

Slavin, R. (1997). *Educational psychology: theory and practice* (10th ed.). Boston: Pearson.

Sorgo, A. (2006). Dichotomous identification keys: A ladder to higher order knowledge about the human body. *Science Activities, 43(3)*, 17-20.

Soyibo, K. (1991). Impacts of concept and vee mappings and three modes of class interaction on students' performance in genetics. *Educational Research, 33(2),* 113-120.

Soyibo,K. (1994). Measurement of some Jamaican high school students' levels of anxiety towards science. *Caribbean Curriculum 4(6).*

Spielberger, C. (1966). The effects of anxiety on complex learning and academic achievement. In C. D. Spielberger (Ed.), Anxiety and behavior. New York : Academic Press.

Spielberger, C. D. (1972). *Anxiety: Current trends in theory and research*. Oxford, England: Academic Press.

Spielberger, C. D. (2010). State-Trait Anxiety Inventory. In *Corsini Encyclopedia of Psychology*. New York: John Wiley & Sons, Inc.

Strangman, N., Hall, T., & Meyer, A. (2003). Graphic organizers with UDL. Wakefield, MA : National Center on Accessing the General Curriculum.

Tobias, S. (1979). Anxiety research in educational psychology. *Journal of Educational Psychology,71(5),* 573-582. doi:10.1037/0022-0663.71.5.573

Tobias, S. (1985). Test anxiety: interference, defective skills and cognitive capacity. *Educational Psychologist, 20(3), 135*-142. doi: 10.1207/s15326985ep2003_3

Vaughn, S. & Edmonds, M. (2006). Reading comprehension for older readers. *Intervention in School and Clinic*, *41(3)*, 131-137. doi: 10.1177/10534512060410030101

Viswanathan, M. (2005). What Are Examples of Measures and Measurement Across Various Disciplines? In *Measurement error and research design.* Thousand Oaks: Sage Publications.

von Glaserfeld, E. (1989). Cognition, construction of knowledge and teaching. *Synthese, 80(1),* 121-140.

Willerman, M., & Harg, R. (1991). The concept map as an advance organizer. *Journal of Research in Science Teaching, 28(8),* 705-711.

Appendix A

Samples of the instruments used

Observation Schedule

The procedure is designed and to be carried out during each lesson. This schedule was designed to answer ***'to what extent does using the Inspiration Software to create concept maps reduce students' chorus answering and increase their listening span during the teaching of 'Nutrition in Humans'***.

A. Fill in the following details:

   Date:

   Grade:

   Sub-Topic:

   Lesson:

   Duration:

B. During your observation please record the number of incidences that are related to each behaviour being studied.

Question	Behaviour	Number of incidences
1	When teacher asks questions, students answer in unison	
2	When students work in groups, they were tardy in completing given task in a timely fashion	
3	During classroom discussions, there is excessive noise in the room as everyone is talking at once	
4	Teacher had to remind students to raise their hands and wait to be acknowledged	
5	Students did not listen to fellow students when they are contributing to the lesson	

Research Number: _____ Grade: _____Date: _____

The statements below could describe how you feel about school science. Read each statement and tick (√) whether you AGREE that is correctly describes your feeling or DISAGREE if it does not correctly describe your feeling towards science.

STATEMENTS	AGREE	DISAGREE
1. I feel contented when learning science		
2. I am terrified to learn science		
3. I am nervous about learning science		
4. I feel tense when learning science		
5. I feel confused when learning science		
6. Science is a hopeless subject		
7. I feel challenged to learn science		
8. I love learning science		
9. I feel comfortable when learning science		
10. I get panicky when learning science		
11. I am afraid to learn science		
12. I am worried about learning science		
13. I feel secure when learning science		
14. When learning science I feel cheerful		
15. Learning science makes me feel happy		
16. I feel calm when learning about science		
17. I feel upset about learning science		
18. Learning science makes me feel joyful		
19. I learn steady in science		
20. I get shaky when learning science		

Research Number: _____ Grade: _____ Date: _____

Instructions: Answer **ALL** questions by **CIRCLING** the correct answer

1. Which of the following tests is used for testing proteins?

    A. Biuret

    B. Benedict's

    C. Flame

    D. Growth

2. What does a deficiency in Vitamin A cause?

    A. Night blindness

    B. Beri-beri

    C. Rickets

    D. Pellagra

3. Which constituent of beans provide a good source of amino acids?

    A. Carbohydrate

    B. Protein

    C. Fat

    D. Fibre

4. Which one of the following digestive enzymes works best at a pH of 2?

    A. Amylase

    B. Lipase

    C. Maltase

    D. Pepsin

5. Which end products of digestion would be found in largest proportion in the small intestine of a person who has eaten fish and white rice?

    A. Amino acids and glycerol

    B. Amino acids and monosaccharides

    C. Monosaccharides and glycerol

    D. Monosaccharides and fatty acids

6. The enzyme pepsin works best in:

    A. An alkaline medium

    B. A salty medium

    C. A neutral medium

    D. An acidic medium

7. Which of the following food is rich in a nutrient which will reduce the risk of anaemia?

    A. Citrus

    B. Fish

    C. Liver

    D. Milk

8. The result of testing a liquid food substance showed:

    1) A positive iodine test for starch

    2) A negative Benedict's test for reducing sugar

    What colours would have been seen at the end of these tests?

    Iodine Test **Benedict's Test**

A. Black blue

B. Black red

C. Brown red

D. Brown blue

9. Which nutrient is NOT in milk?

   A. Calcium

   B. Iron

   C. Vitamin A

   D. Vitamin D

10. Which food sample contains the most energy?

    A. 100g of bread

    B. 100g of butter

    C. 100g of oranges

    D. 100g of green vegetables

11. When iodine solution was added to a raw potato, small blue-black particles were observed. When iodine solution was added to a boiled potato a darker, blue-black colour was then observed.
    How is this best explained?

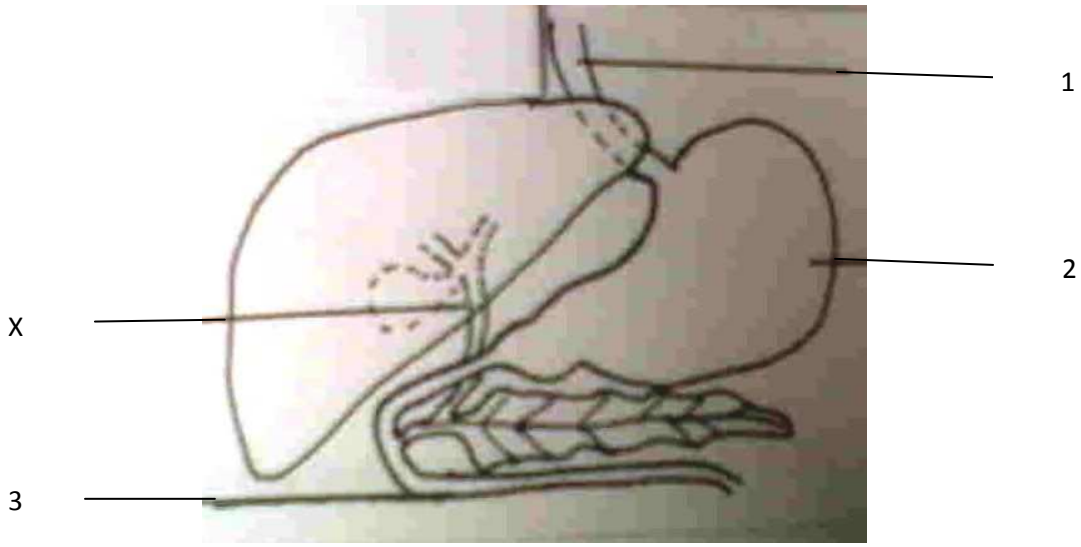
    A. Boiling causes more starch to be made

    B. Boiling changes sugars to starch

    C. Boiling damages the cells resulting in the release of starch

    D. Boiling stops respiration, resulting in the release of starch

Use the diagram below to answer questions 12 and 13.



12. What pH is normally found in the parts labeled 1, 2 and 3?

	1	2	3
A.	acidic	acidic	neutral
B.	alkaline	neutral	acidic
C.	neutral	neutral	alkaline
D.	neutral	acidic	alkaline

13. What is caused by a blockage in X?

    A. Increased glycogen in the live

    B. Increased pancreatic juice in the pancreas

    C. Reduced blood supply to the liver

    D. Reduced digestion of fat

14. After eating a meal, in which vessel will an increase in the amount of amino acids first be found?

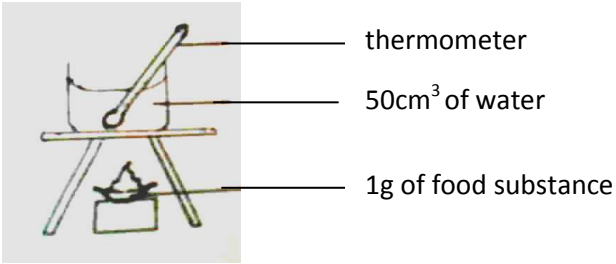
    A. Hepatic artery

B. Hepatic portal vein

C. Hepatic vein

D. Lymph lacteal

15. The apparatus shown below can be used to compare the energy values of various food substances.
Which food substance would give the greatest rise in temperature of the water if 1g was burnt?



A. fat

B. protein

C. starch

D. sugar

16. Which best describes the action of bile?

A. It neutralizes acid and emulsifies fat

A. It neutralizes acid and forms fatty acid

B. It stops acid secretion and emulsifies fat

C. It stops acid secretion and forms fatty acid

17. Which of these observations show a lack of protein in the diet of young children?

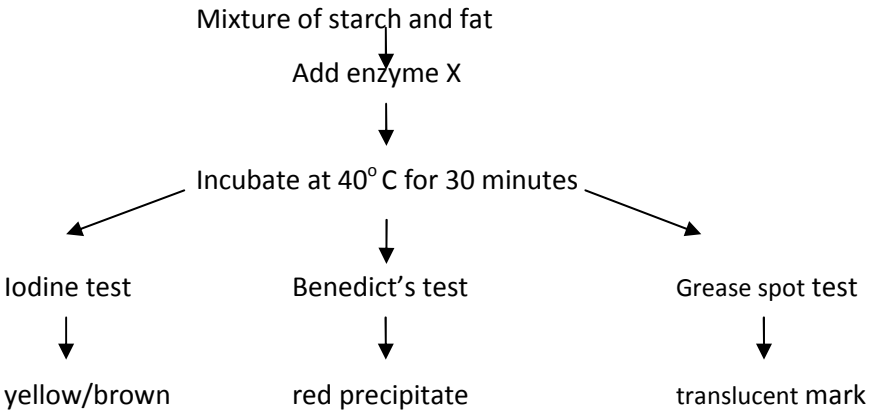
A. Being tired and irritable

B. Developing tooth decay

C. Growing more slowly than normal

D. Producing more urea in the urine

18. The flow diagram below shows an investigation carried out by a student



What is enzyme X?

A. Amylase

B. Lipase

C. Maltase

D. Protease

19. Which of the following is the end product of digestion of starch?

A. Glycerol

B. Glycerine

C. Sucrose

D. glucose

20. 10g of starch mixed with 53cm^3 of enzyme solution. After 1 hour at 15° C, 2.5g were changed to sugar. The experiment was repeated at a temperature of 25° C. How much starch was broken down in the second experiment?

A. 1.0g

B. 2.0g

C. 2.5g

D. 5.0g

21. Where is bile produced in the human body?

A. Gall bladder

B. Liver

C. Pancreas

D. Stomach

22. Roughage helps the body's

A. Metabolism

B. Deamination

C. Egestion

D. Peristalsis

23. Which of the following food items could best cure goiter?

A. Green vegetables

B. Liver

C. Iodized salt

D. milk

24. Which nutrient loses its value when boiled?

A. Protein

B. Starch

C. Vitamin C

D. Cellulose

25. Which of the following would provide the best balanced diet if available in the right proportions?

    A. bread, butter, jam, vegetables, tea and milk

    B. ice cream, eggs, cakes, fruits and milk

    C. rice, milk, fish, fruits and vegetables

    D. rice, tea, bread, fruits and vegetables

26. Which of the following terms refer to a substance which influences the body's use of glucose?

    A. Lipase

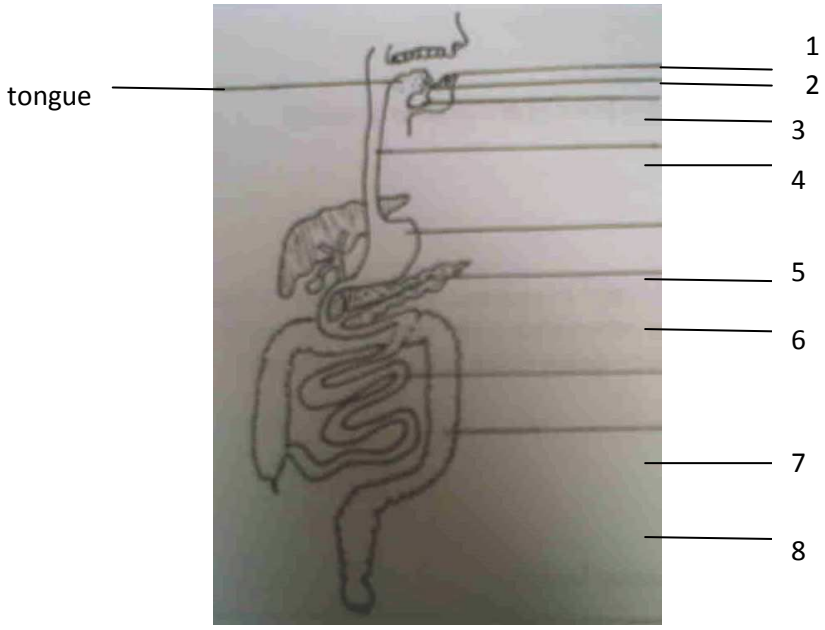
    B. Glycerol

    C. Bile

    D. Insulin

Use the diagram below to answer questions 27 to 30

Diagram showing a section of the alimentary canal



27. Which structure is the salivary duct?

    A. 1

    B. 2

    C. 3

    D. 4

28. Amylase, is produced in which structure?

    A. 5

    B. 6

    C. 7

    D. 8

29. The enzyme that is produced by the structure labeled 6 and is responsible for the digestion of fats is:

    A. pepsin

    B. amylase

    C. maltase

    D. lipase

30. The enzyme which is found in the part labeled 5 would aid in the digestion of:

    A. proteins only

    B. starches only

    C. fats only

    D. proteins, starches and fats

Worksheet on Nutrients

Name of group: _____ Date: _____

Time to be completed: 15 mins

1. Which vitamin prevents rickets?

   _____

2. Name the 3 elements making up carbohydrates.

   _____

   _____

3. Name 1 source of each of the following:

   Iron _____

   Calcium _____

   Vitamin C _____

4. Name the deficiency disease associated with a lack of:

   Vitamin A _____

   Vitamin D _____

   Iodine _____

5. State how you would test for starch.

   _____

   _____

   _____

   _____

   _____

   _____

6. State how you would test for reducing sugars.

   _____

   _____

_____

_____

_____

_____

7. Order the following persons using numbers 1 to 5, according to who needs the most energy (number 1 needs the most energy)

8 year old child……

Pregnant woman ……..

Teenage boy ……

Secretary ……

Construction worker …….

//

Research numbers of group members:

1. _____ 3. _____
2. _____ 4. _____

Test on Nutrients

Research Number: _____ Grade: _____ Date: _____

Instructions: Answer **ALL** of the following questions.

1. Name the deficiency disease associated with:

   (5 mks)

   a) Vitamin A _____
   b) Vitamin C _____
   c) Iron _____
   d) Protein _____
   e) Calcium _____

2. Below are five statements place 'T' if the statement in your estimation is TRUE or 'F' if you believe it to be FALSE.

   (5 mks)

   a) When vegetables are boiled, the vitamin C which was present in it is lost. _____
   b) Fats contain more energy per gram than carbohydrates. _____
   c) Roughage is a nutrient. _____
   d) Milk contains iron. _____
   e) The Biuret test is used to test for reducing sugars. _____

3. Fill in the blank spaces by using the name of a nutrient.

   (4mks)

   a) _____ is needed to prevent constipation.
   b) One form of _____ is monosaccharides.
   c) _____ contains two hydrogens and one oxygen.
   d) The emulsion test is used to confirm the presence of _____.

4. Excess carbohydrates cause _____ in humans.

   (1 mk)

5. State TWO functions of protein:

   (2 mks)

   a) _____

   _____

   b) _____

   _____

6. List the three forms of proteins:

   (3 mks)

   a) _____

   _____

   b) _____

   _____

   c) _____

   _____

7. Create a concept map to represent PROTEINS and attach it to this sheet of paper. This map must present mention of its forms, components, sources, functions, food test, deficiency disease.

Worksheet on Enzyme Activity

NAME OF GROUP:_____ Date: _____

Answer the questions below after discussing them as a group.

A. – starch only
B. –starch + salivary amylase
C. – starch + salivary amylase then placed in cold water
D. – starch + salivary amylase then boiled
E. – starch + salivary amylase + acid
F. – starch + pepsin

Each tube is then tested for starch.

*** Name the food test that can be used to test for the presence of starch

_____

If present:

1a. What results would you expect in tube B?

_____

1b. Give reasons for your answer in 1a.

_____

_____

_____

_____

2a. Compare the results in test tube B, C & D

_____

_____

_____

_____

2b. Give account for the results in 2b

_____

_____

_____

_____

3a. What results would you expect in test tube E?

_____

3b. Give reasons for your answer in 3a

_____

_____

_____

_____

4a. What results would you expect in test tube F?

_____

4b. Give reasons for your answer in 4a

_____

_____

_____

_____

_____

5. Name the enzyme Q

_____