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Chapter 1

Introduction

1.1 Introduction to the study

Very few learners have exposure to aquaria (Evans, 1997:239), especially in South Africa. This may then relate to the low status of marine environmental conservation. Evans (1997:239) stipulates that one cannot value a particular species or habitat if one is not aware of it, just as one cannot alter environmentally poor behaviour if it is not perceived as a threat to the environment.

Environmental education (EE) is based on a personal understanding of natural processes and human activities and their effect on the environment (Yeung, 2004, 101). Consequently, if learners cannot make a connection between themselves and their environment it is unlikely that they will have any concern for the conservation of that environment. Learners need to find personal relevance in what they learn, and have shared control over their learning experience (Dart, 1999:138). Therefore, the learning programme needs to be based on a learner's local context (Athman & Monroe, 2001:39) and they need to be actively involved in the learning experience.

This study focuses on the influence of particular teaching strategies that can be used in EE, and examines how specific teaching methods influence knowledge retention and attitude change. From the researcher's experience of working in an aquarium, learners who have had the opportunity to interact with live animals or dried specimens have shown greater enthusiasm and interest towards the marine environment. Their observations appeared to stimulate interest in the ways environmental education experiences can develop and subsequently influenced the learners' environmental knowledge and their attitudes towards the marine environment.

1.2 Background to the problem

Environmental Education (EE) is a process described as one that involves teachers and learners in promoting sustainable development and improving their ability to deal with environmental problems (Coetzer, 2005:309). It can consequently be argued that environmental knowledge can be increased, encouraging a positive attitude towards the marine environment through facilitating a connection between the learners and the ocean (Kuhar, Bettinger, Lehnhardt, Townsend & Cox, 2007:161).

Anderson (1995:202) describes the importance of how one studies material, and the consequences for how that material is retained. Anderson stated that sensory memory is constructed through audio, visual and tactile experiences and these are therefore important in learning experiences (Anderson, 1995:159). Learning experiences can be thought of as acquisition of knowledge or skills (Akhtar, 2007:270), but these experiences are not only important in developing skills and knowledge, but they also allow for the acquisition of values, attitudes and emotions (Ormrod, 1990:5). Two teaching strategies that could be considered are teacher-centred instruction, and learner-centred instruction (McCown, Driscoll & Roop, 1996:293). The teacher-centered strategy employs the 'traditional' lecture style method, while the learner-centered strategy employs cooperative learning.

Costa, Van Rensburg and Rushtun (2007:214) found that the lecture style method was discouraged in favour of a more interactive teaching style, and that active participation increases the retention of factual knowledge. Vermunt and Vermitten (2004:361) describe how active involvement during the learning process affects emotions that may arise during the learning experience and result in a change of attitude or behaviour.

Active involvement in the learning process (as with cooperative learning) also provides some control over the input of information (Cohn, Atlas & Ladner, 1994:201) compared to the lecture style method where little opportunity is given to independent thinking (Yeung, 2004:102). McCown et al (1996:390) describe the active learning experience as constructing meaning through interaction with the environment. This makes learners active participants in knowledge construction, rather than passive recipients of a lecture-style presentation. When learners feel positive about their learning environment, their brain releases endorphins that stimulate the frontal lobes and therefore make the learning experience more pleasurable and successful (Sousa, 2006:83).

Sousa (2006:84) argues that more is likely to be remembered once the learners have made an emotional investment. A powerful emotional experience could result in a long lasting memory. Memory allows an individual to draw on an experience and use the power of prediction to decide how to respond in the future to a similar situation (Sousa, 2006:77). Learners who have the opportunity to interact with live marine animals or dried specimens may have a long lasting memory of their experience which could affect their attitude in future situations. Zeppel (2008:6) states that the improvement in environmental behaviour correlates with active involvement and participation, and that the type of information that learners receive appears to directly influence their behaviour. So it could be said that how the subject material is internalised has an important consequence for how much of the material is remembered (Anderson, 1995:202), and if a positive emotional memory is created, this could impact on future behaviour or attitudes towards that subject material. Knowledge is not isolated but rather interconnected and organised (Ormrod, 1990: 151), and by using the cooperative learning method to teach conservation messages learners are able to interact with their environment, create positive emotions and long-lasting memories. Such memories could later be drawn upon to create a change in a future response.

Cooperative learning is more effective at motivating learners to learn independently, and allows them to realise the relevance of the content and its connection to real-world situations (Langen & Welsh, 2006:600). Yet according to Langen and Welsh (2006:600) there is limited quantitative data to support the experiential and active learning process in terms of improving content knowledge and change in attitudes towards environmental conservation. Thus there is a need for more research on closing the gap between environmental methodology and associated knowledge retention and attitude change.

1.3 Purpose of the study

The purpose of this study is to investigate the effect of two teaching strategies and teaching methods used in the conservation educational programme of a marine education centre, on the environmental knowledge acquisition and attitudes of school learners. Hence the aim of the study is to compare the methods of the 'traditional' lecture-style method (where learners are passive) with cooperative learning, to determine their influence on learners' knowledge retention, attitude and behaviour towards marine conservation.

The following research questions frame this study:

1) Does a particular method of teaching used at a marine education centre foster greater knowledge retention among learners?

2) Is cooperative learning more effective than the 'traditional' lecture-style method in creating positive environmental attitudes and behaviour in both the short- and long-term?

1.4 Research Design

1.4.1 The quantitative approach

This study follows a quantitative research design in the form of a pre-, post- and delayed post-test control group design (Tuckman, 1999:162). Quantitative research allows for specific questions to be asked and quantifiable data to be collected. Statistics are then used to analyse that data and provide an unbiased result (Creswell, 2008:47).

A quantitative approach was chosen because the study aimed to describe trends and provide an explanation of the relationship between teaching methods, knowledge retention and attitude change. As quantitative research focuses on answering a narrow question using measurable data, the aim of this study is to explain how the variable teaching may affect knowledge and attitude.

1.4.2 Pilot study

To ensure validity of the data that was collected, the questionnaire was piloted on a group of 54 Grade 7 learners from Camperdown Primary School who were part of the Natal Portland Cement (NPC) outreach programme. These learners were of a similar age and socio-economic group as those of the sample population, and formed part of the intended test population since they were from the same area and followed the same requirements in order to be a part of the outreach programme (which will be discussed further in 3.3). They were, however, not part of the sample group that participated in the actual study.

The pilot study was conducted on 12 February 2009 at Camperdown Primary School by members of the outreach team. Learners were given a pre-test questionnaire before the lesson, and then given a post-test questionnaire after the lesson.

The questionnaire contained the four sections as described in 3.2.3. However for the pilot study section C contained 30 attitude statements instead of 10. This allowed for the possibility of removing some of the statements due to unsuitability. The lesson given at Camperdown Primary School was the same as the lesson to be conducted during the study. By presenting the same lesson, we could determine whether the questionnaire would be suitable for the actual lesson to be used in the study.

A correlation was run between the response scores obtained by each person on each item, and the scores obtained by each person across the whole scale. Increased correlation indicated a stronger relationship, so only questions with a score of 0.5 were used.

Results of the correlation allowed for the removal or change of questions that may have been poorly worded or where there may have been ambiguity. It was found that 5 of the questions from section B were unsuitable and these were re-worded. The unsuitability was mainly due to choice of words, and these were subsequently replaced by simpler words. The pilot study also indicated that 22 of the questions from Section C were unsuitable. The 20 questions with the lowest correlations were removed, and the remaining two were re-worded. There were no discrepancies found in Section D, so the questions in this section remained unaltered.

1.4.3 Sample Population

The study involved a sample of 5 schools, each with 120 Grade 7 learners, who ranged from 10 to 15 years of age. These learners were from similar socio-economic backgrounds but from different geographic areas. The schools were selected from the participants of Sea World's Natal Portland Cement (NPC) Outreach Programme. To qualify for the programme the school should serve the poorer community; have school fees of less than R1000 per year; have a large percentage of non-payment of school fees and belong to a feeding scheme. In their applications the schools also had to provide substantiation as to how they would benefit from the proposed lesson, and if the knowledge they gained would be used in the classroom.

1.4.4 Data Collection

Data was collected over 5 days with each school being brought in on a different day. The selected sample of 120 learners was divided randomly into two groups. Each group received a pre-lesson questionnaire in English, which covered specific environmental topics relating to the lesson to be given. This gave an indication of the baseline knowledge of the learners, as well as an assessment of their prior attitudes and behaviours. The learners were informed that the questionnaire did not evaluate their individual abilities, that their responses would be anonymous and that their ideas would be valued.

The questionnaire was completed in the presence of a Sea World Educator. Each learner responded individually, although the questions were read aloud to guide learners. This was designed to eliminate the possible problem of poor reading abilities.

The questionnaire had four sections:

- Section A focused on determining the demographics of the group
- Section B consisted of 10 multiple choice questions that determined knowledge
- Section C contained 10 statements that learners rated on a 5 point Likert scale to determine attitude change
- Section D consisted of two open-ended questions to determine the learners' perceptions about environmental problems.

The questions were intended to establish the learners' knowledge and attitudes about the environment as well as provide background information on the learners themselves. Each group received a lesson on marine conservation, with Group A being exposed to a teaching-centered strategy using the lecture style method. Group B was exposed to learner-centered strategy participating in co-operative learning.

Each group was then given a lesson on environmental conservation based on the South African National Curriculum Statement for Natural Sciences, focusing on Grade 7 and covered in the Learning Outcomes and Assessment Standards (Department of Education, 2002:64-65). Further details of the learning outcomes and topics appear in Chapter 3.

The lecture style method used a Powerpoint® presentation and a data projector system. The Powerpoint® presentation contained images and text, and interaction/questions were encouraged amongst the learners during this lesson. The cooperative learning lesson included the opportunity to touch live marine organisms, dry material and the learners participated in interactive group activities. All learners then participated in a guided tour of the aquarium before

completing a post-test questionnaire on returning to the Education Centre. The post-test questions covered the same questions for each category.

Three months after their visit to the Education Centre, the learners were re-visited and given a second post-lesson questionnaire. This follow-up would provide an indication of long term knowledge retention of the topic, as well as the long term effects of the lesson in terms of attitude change.

All of the lessons were conducted by the researcher, and all guiding in the aquarium was conducted by an education assistant to ensure uniformity in the style of the presentations.

1.5 The significance of the study

This study examines the effect of two teaching methods on marine conservation knowledge retention and attitude change. Its significance lies in the following areas;

- Firstly, the study will provide a link between methodology and knowledge retention and attitude in order to illustrate how these may affect knowledge retention and attitude change.
- Secondly, this study may help determine which method is most suited to promote conservation in a marine education centre.

1.6 Limitations of the study

The study is limited to learners from disadvantaged schools, so while this study will provide consistency within the study, it will only give a small representation of the comparisons of the methods for knowledge retention and attitude change for all Grade 7 learners.

The study is limited to evaluating change over a short term period (before and after the lesson) and a long term period (3 months later), and will therefore not evaluate change over an extended period of time to determine a more permanent effect.

The study also assumes that the teaching methods used by the learners' teachers in their day to day teaching will not influence the way the learners respond to the methods investigated in the study.

1.7 Organisation of the dissertation

This dissertation will be presented in five chapters.

Chapter 1 describes the scope of the study, and how the ideas for the study came about. The problem of the study is outlined, and the purpose of the study given. The research questions are identified and the significance of the study elaborated upon.

Chapter 2 reviews the consulted literature that informs and supports this study. Literature related to teaching strategies and associated methods are examined as well as literature that relates to research design, ethics, learning, knowledge retention, attitude change, and environmental education.

Chapter 3 describes and justifies the research methodology and methods. The context and outline of procedures for data collection are described as well as data analysis.

Chapter 4 presents the findings of 10 sampled groups from similar socio-economic backgrounds. Their experiences will be analysed in an attempt to illustrate how their participation in activities (or lack thereof) contributed to their environmental knowledge and attitudes.

Chapter 5 summarises the research findings, discusses the conclusions, and considers the implications of the study for the practice of environmental education. This chapter also proposes suggestions for future research and practice in marine education fields, while considering the limitations of the research design.

Chapter 2

Literature Review

2.1 Introduction

Teaching, which can be described as an action to facilitate learning, can take the form of many strategies. These strategies, along with their methods promote the acquisition and retention of knowledge. This study intends to compare two teaching and learning methods to ascertain which is more successful for knowledge retention and attitude change amongst learners when conducting an Environmental Education (EE) programme at the Ushaka Sea World Education Centre.

2.2 Teaching strategies and teaching methods

Teaching models are prescriptive teaching strategies that are designed to accomplish particular instructional goals (Eggen & Kauchak, 1996:11). Van der Horst and McDonald (2003:121) describe a teaching strategy as a broad plan of action for teaching activities with a view to achieving a particular outcome. The teaching methods are the tools or techniques that are used to carry out the strategy (Van der Horst & McDonald, 2003:121) and focus on the techniques, subject matter and teaching media used to reach the objectives. Once a teaching strategy has been decided upon, only then can a method be chosen.

Two teaching strategies (McCown et al, 1996:293) that can be considered are the following:

a) Teacher-centred instruction
b) Learner-centred instruction

Teacher-centred instruction focuses on the teacher presenting key concepts of the subject matter in the form of a lecture. If learners need any elaboration or need to ask questions they ask the teacher directly.

Learner-centred instruction focuses on the teacher organising the learners into groups and then providing them with resource material. This strategy spreads the responsibility for learning between the teacher and the learners (McCown et al, 1996:393). A learner-centred approach is also consistent with a constructive view of learning (McCown et al, 1996:405), with learning best done in real life environments, where learning concepts and ideas should be learned in diverse ways.

There are, however, a variety of teaching methods that can be associated with each of the teaching strategies. This study will specifically focus on the lecture method, which is associated with a teacher-centred strategy, and cooperative learning, which is associated with the learner-centred strategy.

The lecture method can be described as presenting information to a group for the purpose of instruction (McCown et al, 1996:395). This method assumes that all learners need the same information presented in the same way, at the same place and at the same time. The method is appropriate when presenting key information to learners who have the attention span, self discipline and motivation to benefit from this method (Westwood, 2008:18). The lecture method allows one to introduce a new topic or bring learners up to date on the most recent information, and this method is quick, concise and integrated (Westwood, 2008:19). When used in early education, the lecture method increases the opportunity for independent learning through less structured methods later on in the learners' education (Westwood, 2008:24).

However, the lecture method provides little opportunity for learners to interact with each other or with the teacher, and therefore discourages the social construct of knowledge and skills. Often lectures outlast the attention span of learners and they are frequently considered boring as learners are expected to passively receive information that is delivered to them in a particular way (Eggen & Kauchak, 1996:215). Additionally, learners tend to lack confidence to ask questions when in a large group (Westwood, 2008:21). The limitations to this method are that individual learners differ in prior knowledge, experience and motivation, and it is not possible to know whether every student has understood the lecture (Westwood, 2008:21).

Cooperative learning is an instructional technique that teams learners together to attain certain goals (McCown et al, 1996:409). This method promotes face-to-face interaction and group processing, and focuses the learners' attention on the content. Learners actively process content and this in turn allows for the construction of knowledge. Cooperative learning often incorporates a varied use of materials and resources such as visual media, experiments or the use of live/real material where possible. It thus allows learners to learn from their own active processing of information using a range of authentic resources (Westwood, 2008:35).

The advantage of cooperative learning is that learners may find this method motivating through active participation, while working hands-on with materials gives them the opportunity to make personal choices (Westwood, 2008:35). However, this method requires a resource rich learning environment and learners need to have adequate literacy, numeracy and inquiry skills (Westwood, 2008:36). Some learners may assimilate very little with this method if they lack the pre-requisite knowledge for interpreting the new information being presented.

2.3 Teaching and learning

As mentioned in the introductory paragraph of this chapter, teaching is an action taken with the intent to facilitate learning (McCown et al, 1996:3) and learning is the change in thought or behaviour that modifies a person's capabilities (McCown et al, 1996:3). Therefore, teaching and learning are interconnected as a process for facilitating learning through taking certain actions in the hopes of reaching the goal of modifying a learner's capability.

2.3.1 The inter-relationship between learning, knowledge and attitudes

McCown et al (1996:390) describe learning as being actively constructed in a social context. They describe meaning as being constructed through a learner's interaction with the environment and how learners need to be active participants in their knowledge construction rather than passive recipients of lecture-style presentations (McCown et al, 1996:390).

Learning is the means, through which not only skills and knowledge are acquired, but also values, attitudes and emotions (Ormrod, 1990:5). One can therefore suggest that using an interactive learning approach would allow for a greater experience with environmental concepts and, through exposure to different stimuli, create a positive attitude towards environmental issues. Newhouse (1990:27) states that learning is a process of retaining new information or recalling previously learned information. This is often best done through direct experience, as an active approach to learning could increase environmental knowledge and create a positive attitude towards the environment (Newhouse, 1990:27).

Studies done by Aivazidis, Lazaridou, and Hellden (2006:53) showed that a direct experience of learning increased knowledge and caused a change in learners' attitudes towards the environment. A direct experience results in a greater attitude-behaviour consistency than an indirect experience, and it makes more information available thus allowing for a more positive environmental attitude. A direct experience may cause one to focus on a particular behaviour and therefore may promote an attitude towards a more positive one. Through the repetition of the more positive behaviour, the associated attitude may be more easily or accurately remembered (Newhouse, 1990:27).

Aivazidis et al. (2006:46) found that knowledge and attitude appeared to be very strong components in pro-environmental behaviour. Knowledge, beliefs, attitudes and emotions are not isolated but are associated and interconnected (Ormrod, 1990:151). Thus, there appears to be a strong connection between knowledge and attitude. Behaviour, although linked to a learner's attitude, may change randomly as the context changes. Due to expectation or the promise of external reward a learner may choose to behave in a way that does not coincide with their attitude and subsequently what a person would be willing to do is therefore based almost entirely on an emotional reaction towards the issue (Newhouse, 1990:27). An environmentally responsible behaviour would be more positively related to an individual's feelings or their feeling of obligation rather than their attitude. However, behaviour cannot be measured in terms of a learning style as there are many other factors that may determine a learner's pattern of behaviour. Consequently one cannot design an EE programme without taking knowledge, attitude and emotions into account if the programme is to be successful.

2.3.2 Learning

2.3.2.1 What is learning?

Akhtar (2007:270) describes learning as an observable change in a person's reaction to an equally observable stimulus or situation. The change in reaction can traditionally be described as being relatively permanent once it has been learned, so learning can be thought of as an acquisition of knowledge or skills from certain experiences. Pre-existing abilities, skills and context may however influence the way a person learns and this may influence the learning outcome (Akhtar, 2007:268). When designing a learning programme, the learners' background and context also need to be taken into account if the programme is to be successful.

2.3.2.2 How does learning take place?

McCown et al. (1996:390) describe how learning is actively constructed in social contexts and that the term "active learning" was first used in the late 1950s and early 1960s. Mental involvement of a learner in a task encourages learners to interact with those around them allowing them to work at their own pace. This creates a more enjoyable and controlled learning experience. This then challenges learners by allowing them to interact with a new concept through material that may be familiar to them. An example of active learning is contained in the demonstration of how the water cycle works using a cup of boiling water and a saucer to show how hot water evaporates and condenses to form water droplets when it comes in contact with a cool surface. The cup, saucer and boiling water are all familiar objects to the learner, and the materials can be actively used to demonstrate an abstract concept.

Though there is organisation of information during the process of experiential learning, a person's perception of an experience may sometimes be different from the experience itself. Piaget's cognitive development theory describes how learners construct meaning to their world at different stages of development. Learners need to find personal relevance in what they learn, share control over their learning experiences and view knowledge as ever-changing (Dart, 1999:138). They therefore need to be able to connect with the concepts that are presented to them. As children think and learn differently from adults, they cannot learn if they do not understand what they are being asked to learn. Real knowledge can only be gained when a task is useful to learn and when the learner is psychologically ready (Athman and Monroe, 2001:43)

2.3.2.3 How do we remember?

As a person is actively involved in the learning process and is in control of his or her own learning process, he or she can determine how to mentally process information (Ormrod, 1990:151). Consequently one cannot force a learner to learn the 'correct' information, but it is important to guide his or her experience in order to create positive memories.

Memory allows individuals to draw on experiences and use the power of prediction to decide how they will respond to future events (Sousa, 2006:77). If a person feels positive about his or her learning environment endorphins are released to create a feeling of euphoria and stimulate the frontal lobes of the brain, therefore making the learning experience more pleasurable and successful (Sousa, 2006:83). The result is that a person is more likely to remember content once an emotional investment has been made (Sousa, 2006:84). One can therefore say that a powerful emotional experience can cause an instantaneous and long-lasting memory of an event (Sousa, 2006:85), which provides experiences to draw upon when

encountering new learning material and consequently allows the process of learning to take place. It is thus important to study how meaning is constructed in relation to the outside world (Erstad, 2006:418). Gavin (1998:25) describes how the sensory system is the first point of connection between the internal and external world, and how the sensory information is the most important information in the perceptual process when making meaningful connections between what the learner is receiving via a stimulus and how he/she is interpreting that stimulus. If the learner encounters a positive stimulus, he/she may be able to make an emotional connection and, in turn, create a long lasting memory of the experience.

2.3.2.4 The effects of teaching and learning methods

The lecture method appears to be the least appropriate when the learning objectives relate to developing a change in feelings, emotions or attitudes (Westwood, 2008:19). Alternatively, cooperative learning allows for intense and personal involvement when participating in tasks, also encouraging open communication (Lord, 2001:32).

A study conducted by Lord (2001) found that certain elements of learning were enhanced by using cooperative learning, in that they showed an enhancement of thinking skills, reading and writing skills and the learning environment. By performing tasks in small groups learners were more comfortable asking questions and helping each other, and through this process improving their overall thinking skills (Lord, 2001:31). A cooperative learning environment thus allowed learners to be actively part of their learning experience, and working in groups encouraged learners to be more creative and adventurous, which in turn encouraged the development of their reading and writing skills as they continually reviewed each other's work (Lord, 2001:33).

It would therefore be through the use of a cooperative learning that one could heighten learners' emotional connection (via participation and engagement with their environment), thus creating a more meaningful learning experience.

2.3.3 Learning and knowledge acquisition

Concepts are learned through observation, experience and definition (Taylor, 2002:153), and children understand concepts better when they are related to other concepts that they already know (Taylor, 2002:154). From the age of eleven years, the capacity for abstract thought begins (Berk, 2003:245). It is at this age that adolescents develop the capacity for abstract and scientific thinking, and are capable of reasoning when faced with a problem or are able to evaluate the logic of verbal statements without referring to the real world circumstances (Berk, 2003:246). At this stage learners develop the ability to formulate a general theory of all possible factors that might affect the outcome and deduce from it a specific hypothesis (Berk, 2003:245).

Learners are, however, prone to perceiving objects in ways that they have learned to perceive them in the past (Ormrod, 1990:189). Association is particularly powerful when feelings or emotions are associated with the learning experience, and emotions usually have a higher priority than cognitive processes when the two are presented simultaneously (Sousa, 2006:145). The result is that a learner may choose an emotional response over a logical cognitive one in a given situation if the emotion and logical thought are conflicting. The question arises whether cooperative learning could create positive feelings towards a new learning experience?

As learners increase in age, so they become aware of their involvement and role in both the care and destruction of the environment. Emotions seem to play an important role in the acquisition of knowledge and the development of attitudes, and one can connect to learners' emotions through a hands-on approach such as cooperative learning.

2.3.4 Attitude

2.3.4.1 What is an attitude?

An attitude can be described as an enduring positive or negative feeling about some person, object or issue (Newhouse, 1990:26). The essential feature of an attitude is the readiness for response (Cushman & McPhee, 1980:2). Attitudes are complex and can be related to four entities: target, an action, temporal reference and situational reference (Newhouse, 1990:28). Because an attitude is a positive or negative feeling it needs to relate to a target and if an attitude is the readiness for response, there will be an action that will require a reference.

A "target" is the object or person to whom a learner has an emotional response. This may be an animal, something physical or another person, and will be the item that the positive or negative feelings are directed towards. The "action" will be the activity that will be carried out in response to the positive or negative feelings towards the object, in other words, what the learner would like to do with or to the object. The learner's "temporal reference" will relate to a real world experience. For example, a learner knows, through touching, that water is wet. That is a reality that cannot be changed. However, the learner's "situational reference" will link to what the learner may be experiencing at that particular time. For example, if a learner nearly drowned he or she will be afraid of water and this will influence his or her attitude towards water.

An example of how an attitude may come into play would be as follows: if a learner finds an injured bird, the bird would be the target. The response would be to want to help the bird. The learner may have a temporal reference to care for animals, and the situational reference could be that it was a rainy day which heightened the empathy towards the injured bird. This learner would then demonstrate a caring attitude towards the injured animal. If the target and the action are identical across both attitude and behaviour, a person's attitude can be predicted by his/her behaviour (Newhouse, 1990:28).

2.3.4.2 How are attitudes formed?

Attitudes generally seem to be a consequence of life experiences rather than related to any set programme (Newhouse, 1990:28), and repeated exposure to particular stimuli enhances an attitude toward an object (Newhouse, 1990:29). So a learner's attitude towards the environment will depend on experience related to an environmental stimulus. The media creates awareness about global issues through news broadcasts and magazine articles, but they seldom relate to local environmental issues and as a consequence young people may be more concerned about issues at a global level compared with those of a local nature (Yeung, 2004:101). This is of concern as it is generally at local level where individuals can make an impact. So it is important that learners can relate to or are exposed to local environmental issues, which influence their attitudes towards those particular issues.

2.3.4.3 Changing attitudes

Newhouse (1990:130) describes how, at the schooling level of Grades 5 – 8, there is an increase in cognitive and factual understanding in relation to attitudes towards animals. Therefore, if one was to introduce animal handling and observations into an environmental education (EE) programme to illustrate the importance of conservation, one could expect a positive response in the learners' attitude towards the animals and hopefully a positive response towards the conservation of those animals and their habitat. One of the objectives of EE programmes should be to try and foster awareness and compassion for animals and their natural environments.

Comparing favourable situations with something that the learner is familiar with appears to be most effective in producing attitude change, and this can be strongly linked or associated with objects or people who are respected or liked (Newhouse, 1990:30). For example, the notion of "do not litter" can be reinforced by showing well-known actors and sports stars who actively promote anti-littering campaigns, thus encouraging learners to change their attitudes towards littering.

2.4 Facilitating learning through Environmental Education (EE) programmes

2.4.1 What is environmental education?

Environmental Education (EE) is a process described as one that involves teachers and learners in promoting sustainable development and improving the capacity of people to address environmental issues. Environmentally literate learners need to know values and skills best developed though active learning, critical thinking and active involvement (Coetzer, 2005:309).

The environment can be the natural world, but also includes a particular social, economic and political setting. EE is important in teaching about how the natural environment functions and how human beings can manage their behaviours and ecosystems in order to live in a sustainable manner, thus preserving resources for future generations.

The conservation education movement began in the 1930s and covered topics mainly related to resource management and the conservation of natural resources (Athman & Monroe, 2001:38). Progressively, education started to include topics about the environment and the technique of 'learning by doing'. By the early 1970's EE had evolved (Athman & Monroe, 2001:38) as people began to realise the enormous impact human beings were having on both the natural and built environment. EE was subsequently developed as Education for the Environment and included awareness, knowledge, attitude, skills and participation (Athman & Monroe, 2001:38).The world can now be studied as the interaction between the natural environment and human beings, allowing them to grasp the extent of their impact on the environment and their role in sustainability.

2.4.2 Why EE is important?

During the development of an Environmental Education programme it is important to consider the theme of that particular programme, as learners need to be made aware of the impacts on the environment and to develop skills that can promote sustainable development. Langen and Welsh (2006:600) state that EE should inform and influence one's opinion about the impact of human activities on the environment and that through problem-solving one can appreciate the relevance of content to the real world. A person's understanding of natural processes and human activities has an effect on their surroundings (Yeung, 2004:101) and consequently

EE should include aims to understand why people act in environmentally sustainable or unsustainable ways, and further use these aims to understand and promote sustainable behaviour (Clayton & Brook, 2005:88).

The primary purpose of nature study had been to understand and appreciate the natural environment through first hand observation (Stevenson, 2007:140). The conservation movement focused on the preservation of species through sound management. However, neither nature study nor the conservation movement challenged the socio-economic or political fabric of society (Stevenson, 2007:140) and so the importance of EE was recognised. EE focuses on human involvement and the connectivity of human beings in the web of life. It is important that people understand that their choices can impact on the environment and affect sustainability.

Sustainability has been defined as development that meets the needs of the present generation without compromising those of future generations (Bak, 1995:57), but unless one's basic needs are met emotionally and physically there can be little consideration for ecological issues (Roth, 2008:211). People need to see themselves as part of the natural world and that every action has a consequence. They therefore need to learn how to think about those consequences before they take any action (Roth, 2008:212). EE programmes are vital for encouraging youth to protect resources now and in the future (Kruse & Card, 2004:34).

2.4.3 Environmental Education Programmes

The goal of any EE programme should be to increase environmental knowledge, encourage positive attitudes towards the environment and create environmentally friendly behaviour by making connections between learners and their natural environment (Kuhar, Bettinger, & Lehnhardt, 2007:161). The challenge is to

translate these ideas into practical experiences in such a way that it will allow learners to make up their own minds about what is appropriate action (O'Riordan, 1981:13). EE programmes must be factually accurate, balanced with different viewpoints and theories and, most importantly, have openness to enquiry (Athman & Monroe, 2001:41). Including these aspects inspires, provokes thought, sparks interest and relates to individual lives (Kuhar et al, 2007:161).

The role of an EE programme in an aquarium is to improve understanding of the human relationship with the non-human world, and to foster a positive attitude towards the marine environment by creating an awareness of marine animals and their natural habitats (Kruse & Card, 2004:34). Zoos and aquaria have the opportunity to teach through hands-on experience and therefore encourage participation. This may establish perceptions that could form the basis for future attitudes (Kruse & Card, 2004:34). Little substantial learning takes place without involving experience and reflection (Roth, 2008:212), and this usually involves feelings, emotions and actions.

Habitats and species cannot be valued if they are not known about, or the damaging practices affecting particular species cannot be altered if those practices are not perceived as a threat (Evans, 1997:239). The lack of awareness creates a challenge as many people seldom visit aquaria, but when they do it is vital that a lasting impression is made on them. To achieve this, EE programmes have to be learner-centred and involve cooperative learning as this would be effective and motivate performance (Athman & Monroe, 2001:44).

Barney, Mintzes, and Yen (2005:42) describe how EE programmes encourage attitudes and behaviour that are environmentally responsible with a view towards conservation of natural resources and the preservation and protection of diversity of life in a variety of habitats. While knowledge and attitude do not help or harm

the environment, human behaviour does. Thus behaviour that is supported by knowledge and attitude can make a difference (Athman & Monroe, 2001:40), since having a good understanding of environmental problems and a positive attitude towards the environment may alter behaviour.

Research done by Dimopoulos, Paraskevopoulos, and Pantis (2008:48) has shown that EE programmes can significantly increase knowledge and establish a positive attitude change compared to regular classroom lessons. Further to this, if the content of the EE programme is embedded in a local context, it would be even more effective. Learners will then begin to experience and become part of their own education (Athman & Monroe, 2001:39).

People are active processors of information and are actively involved in learning and interpretation of events around them. Rather than just responding to stimuli, people tend to act on stimuli and then observe effects of their actions (Ormrod, 1990:138). How the material is studied impacts on how much of that material is retained (Anderson, 1995:202). A teacher-centred strategy that uses lectures (Horner, Jeng, & Lindell, 2007:162) is not as powerful as the student-centred strategy that can realise changes in feelings, emotions or attitudes (Westwood, 2008:19). As mentioned previously, it is the involvement of emotions and feelings that have an influence on attitudes and possible behaviour.

It is, however, necessary to keep in mind that it is not sufficient to have an experience alone without any reflection, otherwise the experience may be lost or forgotten (Gibbs, 1988:9). Reflection plays an important role in providing a bridge between experience and theoretical conceptualisation (Gibbs, 1988:10). By experiencing feelings (through actions) and having thoughts about those feelings (reflection), new knowledge and concepts are generated. Cognitive development results from interaction between an individual with his or her physical and social

environment (Ormrod, 1990:139). Therefore lectures are discouraged in favour of a more interactive teaching and learning style (Caspi, Gorsky, & Privman, 2005:214), as theoretical concepts will become part of the learners frame of reference only if they have experienced something at a meaningful and emotional level and have then been allowed to think about their experience and consider any feelings related to that experience. Increased active participation will increase enjoyment, stimulate questioning and thinking and therefore promote the retention of factual knowledge (Costa et al, 2007:214).

Edutainment, which can be described as a process of entertaining an individual while providing an educational experience, is advantageous in that an individual can learn while having fun (Mitsuhara, Hirakawa, Kanenishi, & Yano, 2007:527). So if EE programmes follow a cooperative learning method where learners are able to produce part of their own learning materials or experiences (Killi, 2006:22); actively involve emotion (Vermunt & Vermetten, 2004:361); and are presented with visual aids that are simple and clear (Ham, 1992) then through this well-structured and presented information (Caspi et al, 2005:33) learners should acquire the ability to think more abstractly. Edutainment may allow learners to think about activities or experiences that they encounter and consider ways in which they may respond to those situations. By allowing learners to discuss and understand the activity they are involved in, they may be able to create a broader and more meaningful connection, and thus increase knowledge and develop a positive attitude towards the environment.

2.4.4 How EE programmes affect learning and knowledge

EE programmes that are hands-on allow people to develop skills that will enable them to identify problems, how to think, providing those with the skills to collect and analyse information and then make informed decisions (Athman & Monroe, 2001:41). As mentioned in the previous section EE programmes should have a stronger, more lasting effect on learners than classroom lessons alone as these programmes provide a combination of first-hand experience, participatory interaction and reinforcement (Smith-Sebasto & Cavern, 2006:45). When learners are allowed to explore things for themselves they assimilate new knowledge more easily (Smith-Sebasto & Cavern, 2006:14). This in turn fosters a sense of love for the natural environment and sensitises them to the impact of human practice (Newhouse, 1990:27).Through sensitisation one can hope that learners will then make more environmentally positive choices that will lead to the care and protection of the environment.

EE has much to offer formal education through a hands-on approach (Athman & Monroe, 2001:41). At the Sea World Education Centre there is an opportunity to introduce the learners to live animals and a variety of dried specimens, and this may in turn make the education centre's EE programme more effective.

2.4.5 How EE programmes may affect attitudes

According to Newhouse (1990:26) the root of environmental problems is human behaviour, which may be associated with environmental attitudes. The learners' attitudes towards environmental issues are therefore important to consider, as attitudes are acquired at a young age and may be carried into adulthood (Kruse & Card, 2004: 34). A study by Kruse and Card (2004:35) has shown that the incorporation of animal handling into an EE programme increased the level of

knowledge, created positive attitudes and allowed for an increase in commitment to act in an environmentally responsible manner. It was then further stated that hands-on learning affects environmental knowledge, attitude and behaviour. Through follow-up sessions a learner's knowledge may be increased, and attitude and behaviour may be altered even further. Zeppel (2008:6) concurs with the link between active involvement and participation in a programme. The role of cooperative learning in creating empathy and challenging environmental attitudes is very important. Not only does this increase knowledge about environmental issues, it can alter environmental attitudes through emotional connections with the environment and therefore may influence behaviour too.

When an EE programme is developed it is important to look at the prior knowledge and beliefs of learners as this may lead to a conflict in interpretation (Hofer, 2001: 372). Prior skills of learners may affect their ability to interpret concepts and should therefore also be taken into account (Moore & Dwyer, 1994: 236).

2.5 Concluding remarks

An environmental education programme needs an effective teaching strategy, as well as associated teaching and learning methods to enhance knowledge retention and attitude change. Teaching intends to facilitate learning, and from the preceding literature overview, it appears that learning is best achieved through cooperative learning. This overview has tried to show the importance of active involvement to encourage an observable change in a person's reaction to a particular situation, while still incorporating emotional connections and participation. Through positive environmental stimuli, positive memories may be created so that in the future one is able to draw on those positive experiences, and be more likely to remember the associated context.

The development of an attitude also relates to experience. A learner-centred teaching strategy along with cooperative learning encourages interaction between learners and the material.

The link between teaching strategies and methods were highlighted in order to illustrate how these may affect knowledge retention and attitude change. The following chapter (Chapter 3) will look at the methodology used to compare a teacher-centred lesson (using a lecture) with a learner-centred lesson (using cooperative learning) in an attempt to determine which method would be more successful in increasing knowledge retention and attitude change when conducting EE programmes for younger primary school learners in the context of the marine environment at the Ushaka Sea World Education Centre.

Chapter 3

Methodology

3.1 Introduction

This investigation attempted to determine the effect of teaching Grade 7 learners by means of the teacher-centred strategy using lectures, and the learner-centred strategy using cooperative learning. The learners were from five schools in the peri-urban and urban areas of KwaZulu Natal. The comparison between a traditional lecture and participation in a cooperative learning lesson is made to determine the contribution of each to promote knowledge retention and attitude change.

3.2 Research Design

3.2.1 The quantitative approach

This study followed a quantitative research design in the form of a pre-, post- and delayed post-test control group design (Tuckman, 1999:162). Quantitative research allows for specific questions to be asked and collects quantifiable data. It then uses statistics to analyse that data and provide an unbiased result (Creswell, 2008:47)

A quantitative approach was chosen because the study aimed to describe trends and provide an explanation of the relationship between teaching methods, knowledge retention and attitude change. Because quantitative research focuses on answering a narrow question using measurable data, the aim of this study is to explain how the variable teaching may affect knowledge and attitude.

3.2.2 The two treatments

Two groups were employed in the design: One group was exposed to co-operative learning while the other group was not. Both groups were given a pre-test and a post-test evaluation, and both groups were exposed to the same experiences, with the exception of the differential treatment described above. Three months after the initial study the schools were re-visited and the learners were given a delayed post-test questionnaire.

3.2.3 The research instrument

Data was collected using a questionnaire (Appendix I) which allowed for the investigation of the effect of two teaching strategies and teaching methods aimed at determining if cooperative learning is more effective than using the 'traditional' lecture method for creating positive environmental attitudes and knowledge retention in both the short and long-term periods. The questions designed for the purpose of the study, were chosen to suit the intellectual and environmental background of the learners, and were relevant to the lesson that was presented.

The questionnaire has four sections:

Section A:

The first section focused on demographics, which included gender, age, number of people in their home, tap location, where their food was sourced and if they are taught environmental education at school.

Section B

Section B contained a knowledge scale consisting of 10 multiple choice questions.

Section C

An attitude scale consisting of 10 statements rated on a 5 point interval (Likert) scale (1=Strongly agree; 2=Agree; 3=Undecided; 4=Disagree; 5=Strongly disagree) comprised Section C.

Section D

The last section consisted of two open-ended questions about what learners perceived as environmental problems and what they could do to solve these problems.

Section A allowed for a summary of the background of the learners who participated in the study. This was thought to be relevant in terms of comparing their social standing with their environmental knowledge.

Section B contained 10 knowledge-based questions that were designed specifically for the content presented during the study period, and covered ecological links and human impact on the environment. This section aimed to determine the learners' level of knowledge related to the content before and after the lessons.

Section C contained an attitude scale that consisted of 10 statements to which learners had to provide a response on a 5 point Likert-type scale (1= strongly agree; 2=Agree; 3=Undecided; 4=Disagree; 5=Strongly Disagree). All questions were phrased in such ways that "strongly agree" showed a favourable response and "strongly disagree" suggested a negative response. This scale was used to measure the learners' attitudes towards environmental issues that were covered by the lesson. These issues included water usage, food resources and the food web, biodiversity, human impact, litter and pollution, and how people can make a difference.

Section D was used to determine the perception of what an environmental problem is, whether learners perceived problems to be in a local, national or global context, and if the learners believe that they could do something to solve environmental problems.

3.2.4 The pilot study

To ensure validity of the data that was collected, the questionnaire was piloted on a group of 54 Grade 7 learners from Camperdown Primary School who also formed part of a Natal Portland Cement (NPC) outreach programme. These learners were of a similar age and socioeconomic background as those of the sample population. This group also formed part of the intended test population, as they were from the same area and followed the same requirements in order to be a part of the outreach programme (which will be discussed further in 3.3). They were, however, not part of the sample group that participated in the actual study.

The pilot study was conducted on 12 February 2009 at Camperdown Primary School by members of the outreach team. Learners were given a pre-test questionnaire before the lesson was conducted, and then given a post test questionnaire following the lesson.

The questionnaire contained the four sections outlined in 3.2.3. However, Section C had 30 attitude statements instead of 10. This allowed for the possibility of removing some of the statements due to unsuitability. The lesson conducted at Camperdown Primary School was the same as the lesson to be conducted during the study. By presenting the same lesson, we would be able to determine whether the questionnaire would be suitable for the actual study lesson.

A correlation was run between the response scores obtained by each person on each item, and the scores obtained by each person across the whole scale. Increased correlation indicated a stronger relationship, so only questions with a score of 0.5 were used.

Results of the correlation allowed for the removal or change of questions that may have been poorly worded or where there may have been ambiguity. It was found that five of the questions from Section B were unsuitable and these were re-worded. The unsuitability was found to be mainly due to choice of words, and subsequently simpler words were used instead. The pilot study also indicated that 22 of the questions from Section C were unsuitable due to a weak correlation. The 20 questions with the lowest correlations were removed, and the remaining two were re-worded. A second pilot test was not conducted as the questions were reviewed for clarity and distribution by Princess Msomi, the Outreach Coordinator, who visits many of these schools within this area, and has an understanding of the learners' language capabilities. There were no discrepancies found in Section D, so the questions in this section remained unaltered.

3.3 Sample Population

Sample selection focused on the target population from the eThekwini Municipal area, and a simple random sampling technique was used to select the schools. This sample selection would assume that each school in the sample carried the same weight, and it could therefore be said to be a self-weighted design as each school had an equal chance of being selected for the sample. The area was divided into five regions: a central area, a northern area, a southern area, an inland area and a coastal area (see Figure 1).

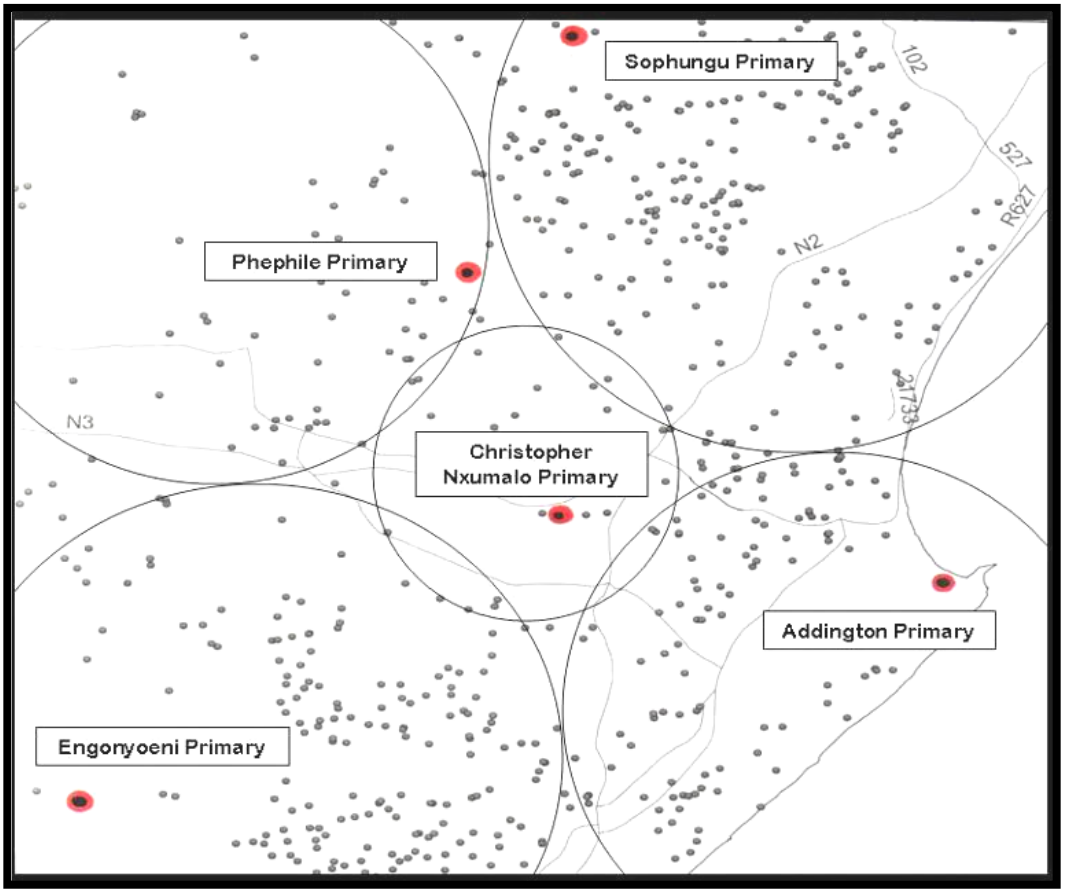

Figure 1: Sample Selection area within the greater Durban area

One of the Sea World Natal Portland Cement (NPC) Outreach Programme Schools was then randomly selected from within each of these areas. By choosing schools from each area, the sample would be representative of the entire eThekwini Municipal area.

The population for the investigation included the five schools, each with around 120 Grade 7 learners, who ranged from 10 – 15 years in age. The learners were from similar socio-economic backgrounds but from different geographical areas within KwaZulu-Natal. Four of the schools are peri-urban schools, and one a city-central school. As stated previously, to be a part of the outreach programme each school had to submit a form providing more information about the school.

As mentioned in Chapter 1, a school that qualifies for the programme should serve the poorer community; have school fees of less than R1000 per year; have a large percentage of non-payment of school fees and belong to a feeding scheme. In their applications the schools also had to provide substantiation on how they would benefit from the proposed lesson, and if the knowledge they gained would be used in the classroom. English is not the home language of the pupils, but the chosen schools teach in English and so the questionnaire was constructed in English. The schools that were chosen for the study are Engonyaeni Primary, Christopher Nxuamlo Primary, Phephile Primary, Addington Primary and Sophungu Primary. The total sample population for the study was 504 learners (n=504).

3.4 Data Collection

3.4.1 Procedure for data collection

The data was collected over five days. Each of the five schools was brought in on a different day: Monday – Engonyameni Primary, Tuesday – Christopher Nxumalo, Wednesday – Phephile Primary, Thursday – Addington Primary and Friday – Sophunga Primary. On each day approximately 120 learners arrived from each school and were randomly divided into two groups (Group A and Group B). Each group received a pre-test questionnaire in English, which covered specific environmental topics related to learners' life style choices and their impact on the environment, and reliance on the balance of nature to survive.

This served as a baseline to learners' existing knowledge about their environment as well as their initial attitudes. The questionnaire was completed in the presence of a Sea World Educator. Each learner was asked to respond individually, although questions were read aloud to guide learners and to facilitate comprehension.

Each group was then given a lesson on environmental conservation, with the lecture method being used with Group A and cooperative learning method with Group B. The lessons were based on the South African National Curriculum Statement for Natural Sciences (focusing on Grade 7) and covered the following Learning Outcomes and Assessment Standards (Department of Education, 2002:64-65):

LO 2: Constructing Scientific Knowledge

Assessment Standard 2 – Categorising information and looking for patterns

Assessment Standard 3 – Interpretation of information

Assessment Standard 4 – Applying knowledge to problems not explicitly taught

LO 3: Science, Society and the Environment

Assessment Standard 2 – Understanding sustainable use of the earth's resources.

The topic for the lessons was linked with the Natural Science Curriculum Core Knowledge Concepts of 'Life and Living' and, more specifically, the interaction in the environment focusing on the following:

1. An ecosystem maintains numerous food webs, and there is competition amongst organisms for food among different individuals and populations within this web. South Africa has certain ecosystems of exceptional biodiversity. All use of these areas must be based on principles of sustainable utilisation.
2. Pollution interferes with natural processes that maintain the interdependence and diversity of an ecosystem.

A Powerpoint® presentation was used during the lecture, and followed the theme of resources that are used by humans. The presentation portrayed the idea that

people need these resources to survive, and that the choices they make impact on these resources and on the environment. The presentation also looked at steps individuals can take to help solve the problem at hand. There were a total of 39 slides. The opening slide had the question – "what do you need to survive?" This immediately led to a slide with pictures of vegetables, a t-shirt, a bicycle, a house, a sofa, a loaf of bread, a chocolate bar, a pair of jeans, eggs, a glass of water, fruit and a can of coke. The learners were then asked which of these items were essential in order to be able to survive (the correct answer being water and food). They were then asked what would happen if they did not get food and water, and the desired response was that they would die. The learners were then asked where water comes from, and three slides representing the sea, estuaries and fresh water, as well as the water cycle and the earth being covered by 70% of water, were shown. A further nine slides showed where food comes from, the links in food chains and food webs and of human impact on food webs. One slide showed a variety of plants and animals, and the concept of biodiversity was discussed before showing ten slides on how humans impact on biodiversity and the natural environment. The last eight slides used pictures that were pair-matches to explain ways in which the learners could make a difference (Appendix II). All learners then participated in a standard guided tour of the aquarium before completing a post-test questionnaire at the education centre.

The cooperative learning group was then divided into sub-groups of ten learners each where each learner was responsible for a portion of the work, and each sub-group had the individual attention of a Sea World Volunteer Education Officer to guide the learners toward the solution. All officers had been trained to conduct the lesson in exactly the same way.

The cooperative learning lesson was based on the same topic as the lecture, however the presentation of the material differed. The cooperative learning lesson

used picture cards (Appendix III) to identify the resources that humans use to survive. The learners were presented with twelve cards with pictures of the following: vegetables, a t-shirt, a bicycle, a house, a sofa, a loaf of bread, a chocolate bar, a pair of jeans, eggs, a glass of water, fruit and a can of coke. Each learner was given a card and was asked to group these items into two groups: items that are essential to survive (water and food) and those that are non-essential for survival. What is really needed to survive was discussed and that items such as chocolate or coke, are not essential items. Learners were then asked what would happen if they did not get water and food, again with the desired response being that they would die. Learners were then asked where water comes from and a globe of the earth and a glass of hot water with a saucer as a lid were used to explain the concept of the water cycle. The globe gave a visual representation that 70% of the earth is covered by water. The mug with the hot water demonstrated evaporation and condensation, and this was linked to a picture diagram of the water cycle.

A separate set of picture cards (Appendix IV) were used to create a food web. These cards included pictures of the sun, grass, an antelope, lion and man to represent the food chains found on land. These were discussed first, and then learners were each given a card and asked to create food chains. Then pictures of a predator fish, sea urchin, shark, seaweed, sea cucumber, mussel, crab, rock lobster, octopus, eel, limpet, urchin, plankton, man and the sun were used to represent food chains in the ocean. Bowls containing sea cucumbers and sea urchins were given to each group so that when each of the animals was discussed, the learners had the opportunity to see live specimens and were able to touch them. The relationship between these animals and their importance to man was emphasised. Biodiversity was also discussed referring to the number of different plant and animal species found in an ecosystem.

Learners then played the "who dirtied the water" game to form a concept of the impact of the human choices on the environment. These choices include farming practices, choices of household chemicals, littering etc. In this game a bowl with clean water was placed in the middle of the table. Each learner was given a small named container with a substance such as wood chips, shells, oil or sand. A story was read of new settlers moving to a pristine island that had not been inhabited before. As the story progressed and each container's name is mentioned, the learners add the container's contents to the water. Consequently the water gets progressively dirtier. At the end, the learners are asked who dirtied the water and who should be responsible for cleaning it up.

Lastly, the learners played a "match the cards" game, where they needed to match up different effects/impacts with the solutions to those effects/impacts (Appendix II). This activity was designed to provide learners with possible solutions to environmental problems and options available to them.

All learners then participated in the standard guided tour of the aquarium before completing a post-test questionnaire back at the education centre. The post-test questionnaire covered the same questions for each category.

3.4.2 The follow-up visit and questionnaire

Three months after their visit to the Education Centre, the learners were visited and given a second post-test questionnaire to assess the long term effects of the lesson. This was conducted over a two week period by the Outreach Team. They initially conducted the survey followed by a lesson that was not related to their original experience.

3.5 Data Analysis

3.5.1 Scoring the data

The data from Section A was used to give an outline of the demographics of the sample population as well as the ratio of males to females, in order to determine if there would be any bias. The information collected from the question pertaining to the tap location provided an understanding of what was the learners' value of water, while the question about food acquisition served to provide information about the emphasis learners placed on where food was sourced. Asking learners if they are taught about environmental education at school would have given some background to their understanding of what constituted environmental education, as environmental education is included in the National Curriculum. These interpretations could then provide insight into results from Sections B to D.

The multiple choice questions from Section B had four possible answers but only one correct answer, and were designed to cover the full scope of the course. A learner would obtain a single knowledge score on the basis of the number of questions answered correctly with a minimum score of 0 and a maximum score of 10.

The sum of the responses for each individual for Section C was the attitude score that fell between a minimum of 10 and a maximum of 50. The minimum score learners could attain was 10 (1x10 questions), which would be favourable as all responses would 'strongly agree'. The maximum score a learner could get would be 50 (5x10 questions), which would be unfavourable as all responses would 'strongly disagree'. A score of more than 30 would mean that more than half of the

responses would be unfavourable and any score of 30 or below would correspondingly be favourable. This served to get an insight into whether learners had a favourable or unfavourable attitude towards the environment.

Section D contained 2 open ended questions which were scored according to pre-coded answers in terms of being a local problem (1), a national problem (2) or a social problem (3). This was done by the researcher for uniformity, and each answer was categorised as being either a problem that related to social issues like violence or theft; a local environmental problem like litter; or a national or global problem such as climate change or energy crisis.

3.5.2 Statistical program and data input

Microsoft Excel and Statistica were used to perform parametric statistical analysis on the data collected. The pre-test and post-test questions and statement responses, and the coded open-ended question responses were typed into an Excel worksheet and then transformed into a Statistica worksheet and variables named.

3.5.3 Statistical testing

Analysis included the measurement of the raw data to determine the average, distribution and spread of the data sets. A normality test was done to determine if the frequency distribution of values from the different ranges of the variables were symmetrical, therefore indicating a normal distribution of data. A Levene's test was then done to determine the absolute deviations of values from the respective group means, therefore indicating that the variances in the different groups are equal. If this is the case in both instances, the assumption can be made that the data is normally distributed and parametric tests can be applied.

A paired t-test (Tuckman, 1999:300) was performed to compare the differences in the means between the pre- and post-test scores of learners as well as the pre- and delayed post-test scores of the learners for both groups. An analysis of variance using ANOVA was then used to compare the results of the two methods. The tests for knowledge scores and attitude scores were conducted separately. The tests were also done collectively for all data and then individually for each participating school.

3.6 Ethical Considerations

3.6.1 What are ethical considerations?

Ethical considerations make sure that the study is in accordance with the rules or standards for the right conduct or practice of a particular profession. Because this study deals with learners, it was important to ensure that full consent to participate was given by the learners, their parents and the school principal (who liaised with the Education Department), and that all parties were informed of the processes that took place during the study.

According to Tuckman (1999:262) the following should be adhered to:

1. Give an explanation of the purpose of the research to the participants, with an expected duration and description of procedure.
2. A description of all possible discomforts should be given.
3. A description of all possible benefits should be given.
4. There should be a statement of confidentiality.
5. It should be stipulated that it is a voluntary process.
6. A statement should be included that approximates the number of subjects that will be participating.

It is important to remember that each learner has the right to privacy, the right to remain anonymous and the right to confidentiality.

3.6.2 Why are ethical considerations important?

In any study personal questions may be asked, and a learner answering a questionnaire may be providing personal information about themselves. As stated in 3.6.1, learners have the right to privacy, and not mention things that they do not wish to reveal. They also have the right to confidentiality, to know that the way that they have responded to questions will not be divulged to anyone else in any way that would reveal their identity. They further have the right to remain anonymous and not be singled out from within a group. Learners, therefore, were not requested to write their names on their questionnaires.

3.6.3 The ethical considerations that were implemented during this research

Each of the participating schools was contacted in January 2009, informed about the process and asked if they would be willing to participate in the study. Details of what would be expected during the research and a description of the procedures (Appendix V) was given to each school. Each school was also given a written letter (Appendix VI) outlining the points of ethical consideration.

The staff from the schools were informed about the benefit of the free visit to Sea World (if they were willing to participate) and were assured that a curriculum-based lesson would be given at Sea World, followed by another three months later at their school. They were also informed that there would be no cost to them, as all costs for buses and entrance fees would be paid for by the NPC Sea World Education Centre.

Each school was informed of every learner's right to privacy in terms of non-invasive questions, and that there would be a limit to the number of personal questions. Learners would have the right to remain anonymous, and it was explained that all the data would be pooled and individual learners would be given numbers rather than named. Each learner would have the right to confidentiality in terms of rostering all data by number and not name, and that all original questionnaires would be destroyed once the study was complete.

3.7 Validity

3.7.1 What is validity?

Validity ensures that individual scores from an instrument make sense and are meaningful, to enable the researcher to draw a good conclusion for the sample of population under study (Creswell, 2008:171). A study may become invalid if it is poorly designed, the participants are fatigued or stressed, misunderstand the questions, or when the information has little use and application (Creswell, 2008:171)

3.7.2 How validity is determined

Validity may be determined by examining the information about the objectives of the instrument, content areas and the level of difficulty of the questions. This may be done by asking experts in the field to peruse all the questions (Creswell, 2008:172). Validity may also be determined by correlating scores, with the higher the correlation indicating the great validity of the questions.

3.7.3 The validity of this research

The validity of this research was done through both a correlation on the pilot study data (to compare scores of the questions in Section B and Section C) and through examining the questions for understanding and grammar. This was done by Princess Msomi (Outreach Coordinator) and Jone Porter (Director of the Education Centre) who checked for grammatical errors and the level of understanding of each question in relation to the age of the participating learners.

3.8 Reliability

3.8.1 What is reliability?

Reliability indicates that the scores from the questionnaire are stable and consistent (Creswell, 2008:169). Scores should closely parallel one another when a questionnaire is administered a number of times and on different occasions, thus highlighting consistency. A study can be unreliable when questions are ambiguous or unclear, when procedures of the questionnaire administration are varied and not standardised or when participants are fatigued, nervous or misinterpret the questions (Creswell, 2008:169).

3.8.2 Why reliability is addressed

Reliability is important to determine that learners are answering the questions in a similar way, and to ensure that the results of the study are of value and can be used to make recommendations.

3.8.3 Determining the reliability of the questionnaire used in this research

All questions from Section B and C of the pilot study were correlated to determine which questions were reliable. As a further measure to ensure reliability, all lessons were conducted by the researcher and all guiding through the aquarium by a Sea World Education Officer to ensure uniformity in the style of the presentation.

3.9 Summary

This chapter gave a description of the research design followed during the investigation. It indicated the methodology, and how the researcher tried to ensure reliability and validity of the results obtained. The following chapter describes and discusses the data obtained from the above design.

Chapter 4

Results, interpretation and discussion of results

4.1 Introduction

The pre-, post- and delayed post-test questionnaires were applied and completed by the population group. All collected data was encoded and statistically analysed as described in Chapter 3. Chapter 4 reports on data analyses, interpretation and discussion of the results.

4.2 Results

4.2.1 Demography and general information (Questionnaire Section A)

The questions discussed in Chapter 3 and detailed in Appendix I were given to each learner in the sample group. The results for the questions in Section A are as follows:

The sample group had been divided into two groups: Group A and Group B. Group A were the learners that participated in a lesson that used the lecture method, while Group B were learners whose lesson was structured using cooperative learning. This section looks at the learners collectively, but the histograms do show results for each of the two groups. The average age of the 504 learners that took part in the study was 13 years, with 46% (n=232) male and 54% (n=272) female. This provided a more or less even representation of male to female learners.

The location of the tap for each learner's household (Figure 2), was as follows:

A. Inside the home	67% (n=338)
B. Outside the home	24% (n=121)
C. Near the home	6% (n=30)
D. Need to collect river water	3% (n=15)
Total 504	

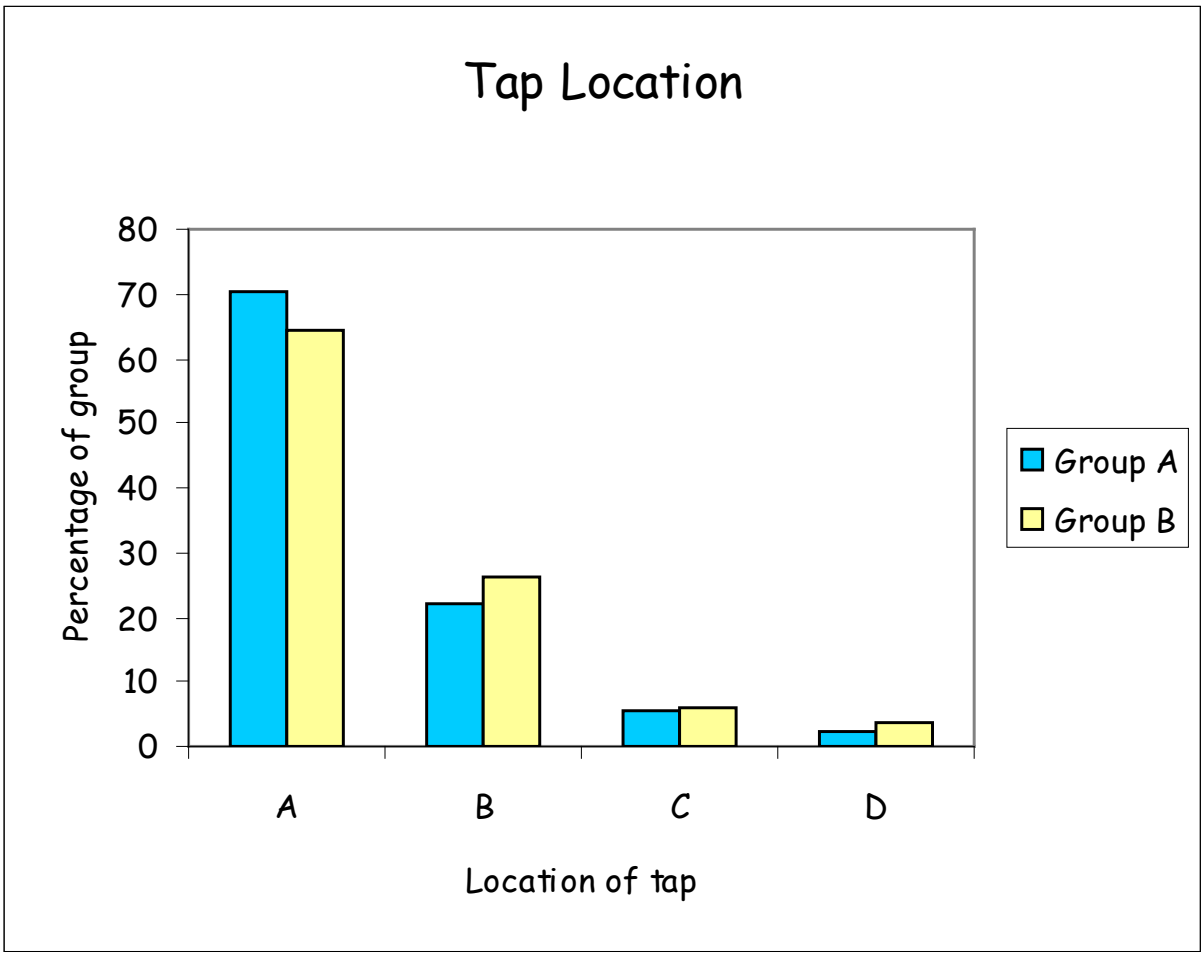

Figure 2: Tap location in each of the sampled learners' households

This showed that most learners had access to running water either in their home or on their household property. Very few learners needed to travel from home to collect water. This information may be important in understanding the learners' value of water. Learners who have easy access to running water may be less likely to appreciate the resource compared to learners who needed to travel long

distances to collect water for home usage. While conducting the lessons, water was highlighted as a very important resource. Learners were shown how human activities may have detrimental effects on water as a resource and therefore ultimately on human beings. The more 'privileged' learners may never have been exposed to such impacts as they have access to water from a tap, and therefore may be less concerned about environmental impacts on water bodies.

Similarly, when looking at where learners obtained their food (Figure 3) one can see that the learners' source of food was represented as follows:

A. Obtained from a supermarket or shop	91% (n=459)
B. Obtained from friends or family	3% (n=15)
C. Grow their own food	6% (n=30)

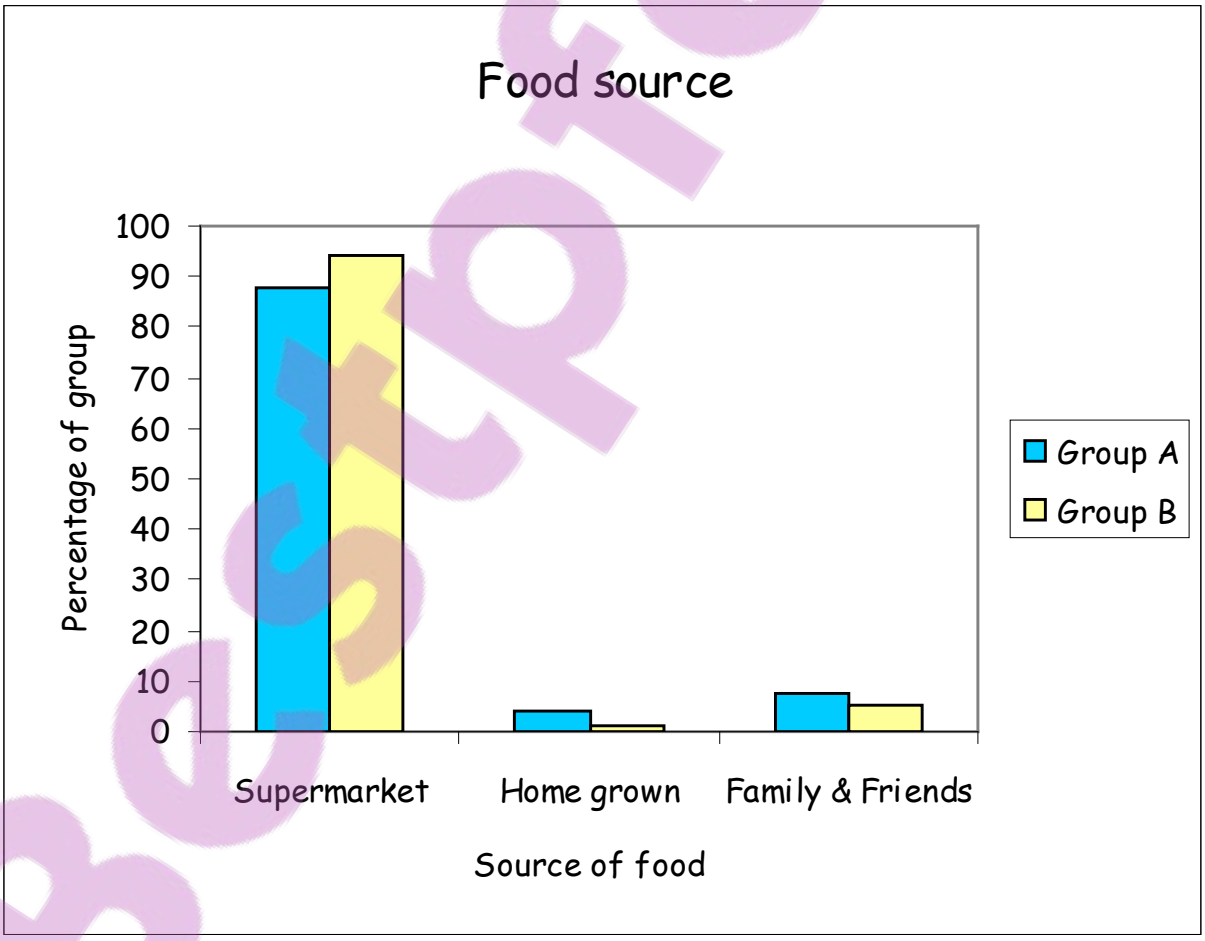

Figure 3: Learners' food sources

The majority of the learners and their families obtained food from supermarkets, with only a small percentage either growing their own food or receiving goods from family and friends.

This may indicate that learners are accustomed to packaged food and may not always be aware of where food originates. This further suggests that learners may be unaware of the impact human beings have on the environment and therefore on food stocks. Learners are less likely to be aware of over fishing and the impacts of bad fishing practices on both the environment and food stocks in general.

Of the learners surveyed, 90% (n=454) indicated that they were taught about environmental matters in the classroom, while 10% (n=50) indicated that they were not (Figure 4). This suggests that learners are being exposed to environmental education at school.

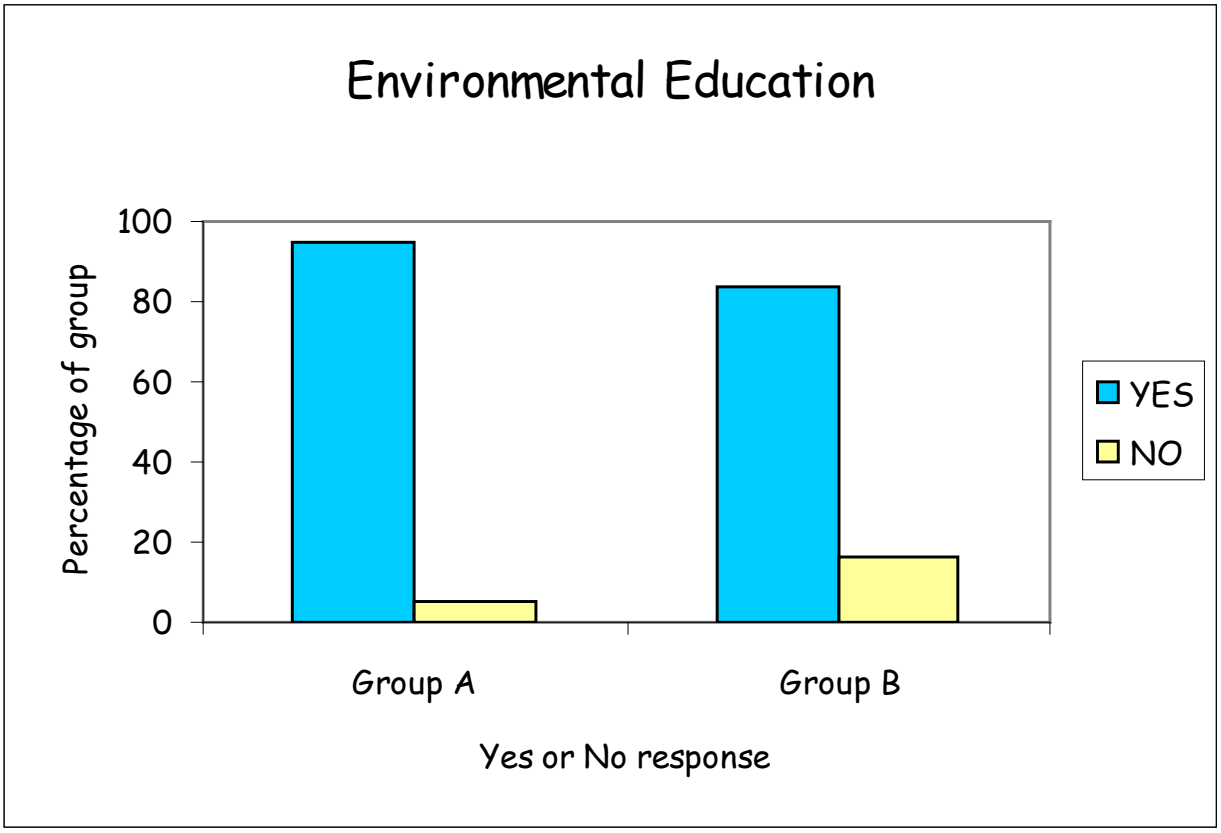

Figure 4: Percentage of learners who believe whether or not they were taught about environmental issues.

By asking learners this question one could ascertain whether or not learners were being exposed to environmental issues at school. These results indicate that learners are being taught environmentally related topics, and that they should have some basic knowledge about the environment.

The information from these three questions may be able to provide some answer to the interpretation of the results from the knowledge and attitudes sections, as the questions from these sections were related to water and food as resources and how a range of environmental impacts may affect these resources.

4.2.2 Knowledge (Questionnaire Section B)

The learners' knowledge of the environment and environmental issues was tested with ten multiple choice questions relating to the topics covered in the lessons.

4.2.2.1 Frequency distributions for pre-, post- and delayed post-test scores for knowledge

Preliminary inspection of the data using a normality test showed that parametric tests, used as the sample test scores for knowledge, followed a normal distribution. The Levens test indicated that the variances in the groups were equal, as shown in Table 1. This means that one can consider the two groups as being equal to one another before any tests were conducted, therefore eliminating any prior biases.

Table 1: The p values and skewness scores for the pre-, post- and delayed post-test scores for normal distribution.

Data Group	P Value	Skewness
Pre Score	0.00000	0.037341
Post Score	0.00000	-0.314528
Delayed Score	0.00000	-0.344080

4.2.2.2 Statistical analysis of the collected pre-, post- and delayed post-test data

(a) T-test comparisons between means of the pre-test and post-test scores, as well as the pre-test and delayed post-test scores for method one (lecture) and method two (cooperative learning).

The t-test was used to determine if there were any differences between the pre- and post-tests, as well as between the different methods. This was important to show if any changes had occurred between the pre-test and the post-test or the pre-test and the delayed test. When comparing method one with method two, the pre-test comparison would show if there were any initial differences in the group of learners, and one could look at the comparative result of the post- and delayed tests to see if there were any differences between the two methods.

- Method 1

Table 2 shows the comparison of the means of the pre- and post-test scores for method one, and the result shows a significant difference (p=0.00000) between the pre-test and post-test score for the total group. This indicates that the learners' knowledge did increase after the lesson using method one. A similar trend was indicated by each individual school, with the exception of school 4, where

knowledge levels did not change significantly between the pre- and post-testing. This may be due to the fact that school 4 already had a strong understanding of the concepts presented during the lesson, and therefore the amount of new knowledge gained after the lesson would be limited.

Table 2: Comparison of the learners knowledge scores from the paired sample t-test for pre-test and post-test for method one.

		Pre-Test		Post-Test			
Group	n	Mean	Standard deviation	Mean	Standard deviation	t (1)	P
Total	251	5.29	1.98	6.37	1.58	-7.24	0.00000**
School 1	36	4.28	1.91	6.19	1.28	-4.71	0.00003**
School 2	50	5.56	1.59	6.68	1.56	-3.54	0.00080**
School 3	52	4.87	1.58	6.19	1.22	-4.42	0.00005**
School 4	54	7.09	1.78	7.35	1.51	-0.77	0.44180
School 5	59	4.41	1.66	5.46	1.56	-3.52	0.00080**

Mean: Possible knowledge score range from 0-10 *p<0.05 **p<0.001

Method 1 Table 2 n=251 Method 2 Table 4 n=253. This totals 504.

Method one therefore appears to be successful in enabling learners to retain knowledge after the lesson had been conducted.

When comparing the scores for method one, there was an overall significant difference (p=0.00011) between the pre-test and delayed test scores.

Table 3: Comparison of the learners' knowledge scores from the paired sample t-test for pre-test and delayed test scores for method one.

		Pre-Test		Delayed-Test			
Group	n	Mean	Standard deviation	Mean	Standard deviation	t (1)	P
Total	251	5.29	1.98	5.84	1.86	-3.93	0.00011**
School 1	36	4.28	1.91	5.28	1.72	-2.45	0.01950*
School 2	50	5.56	1.59	6.24	1.51	-2.53	0.01460*
School 3	52	4.87	1.58	5.75	1.66	-2.87	0.00590*
School 4	54	7.09	1.78	7.29	1.28	-0.67	0.50590
School 5	59	4.41	1.66	4.61	1.85	-0.67	0.50430

Mean: Possible knowledge score range from 0-10 *$p<0.05$ **$p<0.001$

This indicates that the level of knowledge retained three months after the study was still significantly higher than the pre-test knowledge for method one. When considering the schools individually, schools 1, 2, and 3 showed a significant difference when comparing the pre-test scores with the delayed test scores, while schools 4 and 5 showed no significant differences between the two test scores. This may indicate that the lesson had no long term effects on schools 4 and 5. School 4 showed no significant difference between pre- and post testing either. Therefore it is possible that the method was not successful in this instance or that the topic had been covered by the teacher at the school. School 5 showed a significant difference between pre- and post testing, but not between pre- and delayed testing, suggesting that this method was not successful in creating long term knowledge retention in learners from school 5. It could therefore be deduced that overall, method one is an effective method for knowledge retention in learners for both short term and long term (three month) periods.

- Method 2

The comparison of learners' knowledge scores from the paired t-test for pre- and post-test, and the pre- and delayed post test for method two (the cooperative learning method) are provided in Table 4.

Table 4: Comparison of the learners' knowledge scores from the paired sample t-test for pre- and post-test for method two.

		Pre-Test		Post-Test			
Group	n	Mean	Standard deviation	Mean	Standard deviation	t (1)	p
Total	253	5.07	2.04	5.87	1.99	-5.25	0.00000**
School 1	47	4.11	1.48	5.24	1.76	-3.06	0.00370*
School 2	53	4.89	1.49	5.91	1.55	-3.46	0.00110*
School 3	55	4.93	1.82	5.56	1.87	-1.76	0.08420
School 4	47	7.59	1.36	8.06	1.09	-1.74	0.08800
School 5	51	3.96	1.75	4.73	1.89	-1.94	0.05830

Mean: Possible knowledge score range from 0-10 *p<0.05 **p<0.001

When comparing the means of the pre- and post-test scores for method two, it was found that overall the total group showed a significant difference (p=0.00000) between the two scores. This indicated that learners' knowledge had increased between the pre- and post-tests after the lesson had been conducted. A similar trend was shown by schools 1 and 2, who have a relatively small number of learners within the entire school, compared to schools 3, 4 and 5 who showed no significant difference between scores. Schools 3, 4 and 5 all have very large numbers of learners per grade and therefore per class within the entire school, and are therefore much larger schools. Schools 3 and 5 are schools that do not have access to many resources and when combined with large numbers per class, group work

may be an unfamiliar method for these learners. Consequently, they may find it difficult to participate in group work because they are not use to it. Therefore, being taught using a method with which the learners are unfamiliar may have impacted on their knowledge retention. School 4 may be more familiar with this method of teaching as their educator indicated that this method is practised in their school. However, similar to the situation of method one, the learners may already have had a good background knowledge of the subject material and therefore their knowledge may not have increased significantly.

Method two appears to be successful in facilitating knowledge retention in learners, as their knowledge had increased significantly between the pre- and post-tests although only for two of the schools. When one looks at the pre-test and delayed test scores a similar significant difference is found. Therefore although method two also allows for short term and especially long term (three months) knowledge retention, it would not appear to be as effective as method one.

Table 5 shows the comparison of learners' knowledge scores from the paired t-test for pre- test and delayed test scores for method two, the cooperative learning method, the following results were obtained:

The means for the pre- and delayed test scores showed a significant difference ($p=0.00000$) for the total group, and similarly for schools 1, 2 and 5 individually, while schools 3 and 4 showed no significant differences. This suggests that the total groups' knowledge, for both methods, increased from the time of taking the pre-test to the time of completing the post-test and that knowledge had increased from the time of the pre-test to the time of completing the delayed post-test.

Table 5: Comparison of the learners' knowledge scores from the paired sample t-test for pre-test and delayed test scores for method two.

		Pre-Test		Delayed-Test			
Group	n	Mean	Standard deviation	Mean	Standard deviation	t (1)	p
Total	253	5.07	2.04	5.72	1.82	-4.59	0.00000**
School 1	47	4.11	1.48	5.19	1.59	-3.44	0.00130*
School 2	53	4.89	1.49	6.30	1.45	-5.19	0.00000**
School 3	55	4.93	1.82	4.91	1.76	0.05	0.95860
School 4	47	7.59	1.36	7.49	1.12	0.41	0.68050
School 5	51	3.96	1.75	4.66	1.67	-2.70	0.00943*

Mean: Possible knowledge score range from 0-10 *p<0.05 **p<0.001

Where individual schools have shown no significant differences between the pre- and post-tests and pre- and delayed tests, it may indicate strong pre-knowledge. Learners may already have had a strong understanding of the concepts that were taught in the lessons and, as no new information was presented, there may not have been any room for improvement in knowledge gained. Alternatively, the learners may not have had any background knowledge or basic understanding of the subject matter and therefore the questions or concepts discussed were foreign to the learners. Even after the lesson they still had no real understanding of what they had been taught.

Thus, in comparing the two methods on the basis of long-term knowledge retention, it would appear that both methods are equally successful.

(b) T-test knowledge scores between methods for all data, school 1; school 2; school 3; school 4; school 5

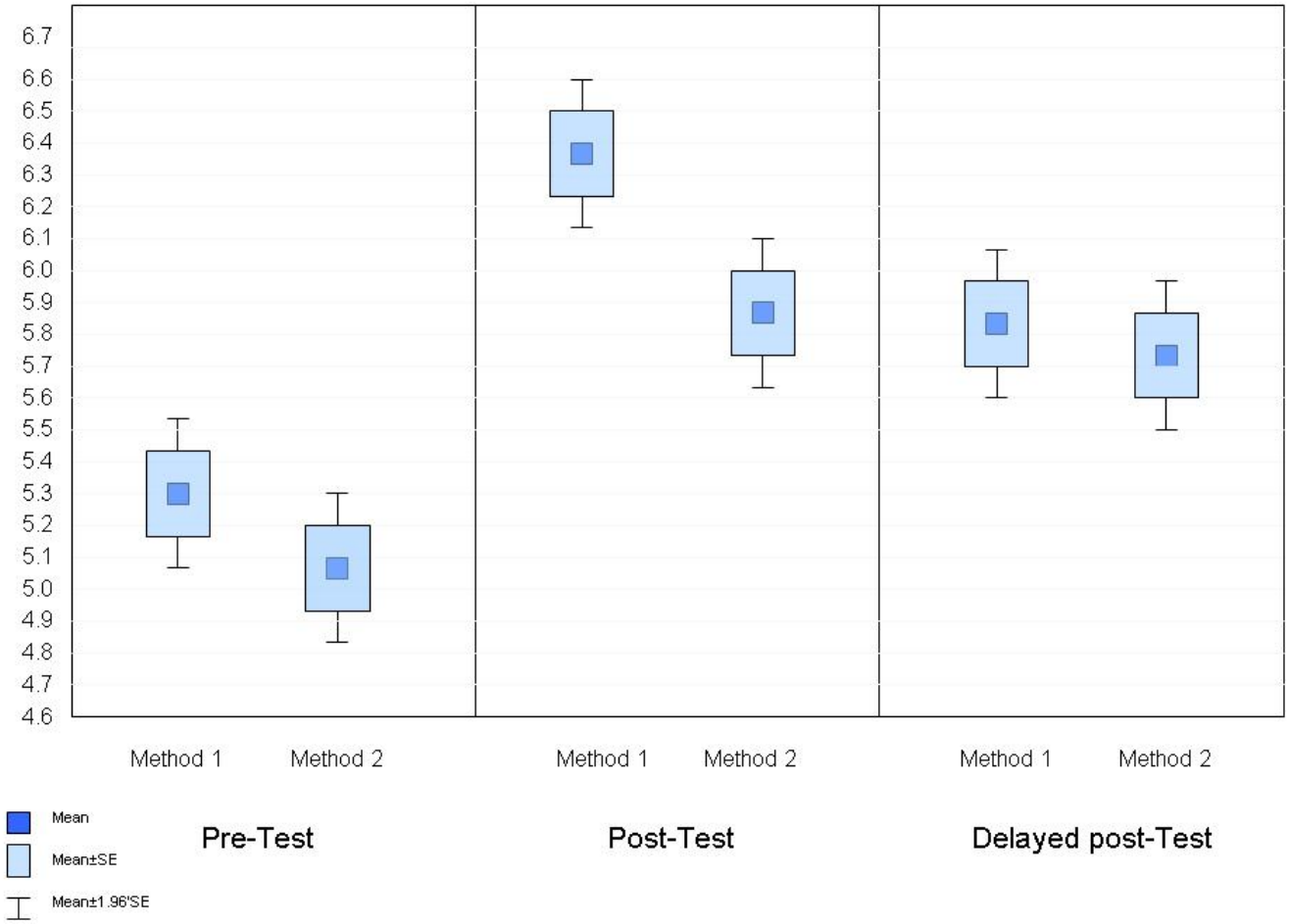

Figure 5: Box and whisker plots for a comparison between the two methods for knowledge scores for pre-, post- and delayed post-test.

Figure 5 shows a comparison between method one and method two for the pre-test, post-test and delayed test knowledge scores. The pre-test values show no significant differences, which is to be expected as this indicates that all learners had the same knowledge base when they started the programme. The post-test scores show a significant difference, which indicates that there was a significant difference between method one and method two when comparing the post-test knowledge scores, and that method one may be a more effective method than

method two for the overall group. There was no significant difference between the two methods for the delayed test for the total group, indicating that neither method was more effective than the other.

Table 6: Comparison of p value for the learners' knowledge scores from the paired sample t-test for pre-test, post-test and delayed test scores between the two methods.

Group	Pre-test score	Post-test score	Delayed test score
Total	0.212	0.002*	0.460
School 1	0.646	0.007*	0.814
School 2	0.088	0.013*	0.832
School 3	0.852	0.044*	0.012*
School 4	0.118	0.008*	0.426
School 5	0.174	0.028*	0.457

Mean: Possible knowledge score range from 0-10 *p<0.05 **p<0.001

Table 6 shows a comparison of p values between method one and method two for the pre-test, post-test and delayed test knowledge scores. The pre-test values show no significant differences, which is to be expected as again this indicates that all learners had the same knowledge base when they started the programme. The post-test scores show a significant difference (p=0.002) for the total group, as well as for each school individually, indicating that there was a significant difference between method one and method two when comparing the post-test knowledge scores. Overall, method one had a higher mean than method two. Similar results were found when comparing post-test scores for schools 1, 2, 3 and 5. This indicated that, overall, method one was a more successful method for knowledge retention in the short term. There was no significant difference between the two methods for the delayed test for the total group and for schools 1, 2, 3 and 5. However, school 4 showed a significant difference in favour of method two when

comparing the means for the two methods for the post-test and delayed test results. This may suggest that the learners from school 4 gained more knowledge in both the short-term and long-term periods when participating in an interactive lesson as compared to a lecture style lesson. This may be due to the fact that out of the five schools, school 4 is the only school that practises cooperative learning on a consistent basis in the classroom. It is also possible that as learners are taught using this method, they are more familiar with it and therefore this may allow for greater knowledge retention.

4.2.3 Attitude (Questionnaire Section C)

The learners' attitude towards the environment and environmental issues was tested with 10 questions rated on a Lickert scale of 1 to 5. These statements related to the topics covered in the lesson.

4.2.3.1 Frequency distributions for pre-, post- and delayed post-test scores for attitude

Preliminary inspection of the data using a normality test showed that parametric tests, used as the sample test scores for attitude, followed a normal distribution and the Levens test indicated that the variances in the groups was equal (Table 7). This means that one may consider the two groups as being equal to one another before any tests were conducted, therefore eliminating any prior biases.

Table 7: The p values and skewness scores for the pre-, post- and delayed post-test scores for normal distribution

Data Group	p Value	Skewness
Pre Score	0.31321	-0.039399
Post Score	0.04174	0.175996
Delayed Score	0.00000	0.867102

4.2.3.2 Statistical analysis of the collected pre-, post- and delayed post-test data

(a) T-test comparison between means of the pre-test and post-test scores, as well as the pre-test and delayed post test scores for both method one and method two.

Table 8: Comparison of the learners attitude scores from the paired sample t-test for pre-test and post-test for method one.

		Pre-Test		Post-Test			
Group	N	Mean	Standard deviation	Mean	Standard deviation	t (1)	p
Total	251	23.78	6.69	21.43	6.11	5.59	0.00000**
School 1	36	24.50	5.26	24.94	4.60	-0.50	0.622
School 2	50	23.58	7.02	21.50	6.01	1.90	0.062
School 3	52	26.33	5.54	22.85	5.56	4.00	0.000204**
School 4	54	16.62	4.73	15.51	3.86	1.26	0.2135
School 5	59	27.83	4.06	23.41	5.54	5.49	0.000001**

Mean: Possible knowledge score range from 0-10 *p<0.05 **p<0.001

In Table 8 there is a significant difference (p=0.00000) between the pre-test and post-test score for the total group for method one. This indicates that the average mean of the attitude score decreases significantly showing that there was a positive change in attitude between the pre- and post-test for method one. This suggests that method one had a positive influence on the learners who participated in the lesson and that their attitudes became more environmentally friendly over the short-term period. A similar trend was picked up with schools 3 and 5, while schools 1 and 2 showed no significant difference between the pre- and post-testing. School 1 is a deep rural school and may not be heavily affected by environmental impacts. School 1's attitudes towards the environment may already be of a good standard as they have limited resources available and are therefore more conscious of those resources that they do possess. School 2 is a peri-urban school and learners in this school may also be more conscious of their environmental resources. Both of these schools have fewer numbers of learners compared to schools 3, 4 and 5.

Table 9: Comparison of the learners' attitude scores from the paired sample t-test for pre-test and delayed test scores for method one.

		Pre-Test		Delayed-Test			
Group	n	Mean	Standard deviation	Mean	Standard deviation	t (1)	p
Total	251	23.78	6.69	22.29	6.48	2.67	0.00815*
School 1	36	24.50	5.26	23.25	5.11	0.92	0.365
School 2	50	23.58	7.02	22.04	6.04	1.29	0.204
School 3	52	26.32	5.54	21.23	4.71	4.94	0.000009**
School 4	54	16.63	4.73	20.06	9.23	-2.31	0.024705*
School 5	59	27.83	4.06	24.90	4.87	3.35	0.001437*

Mean: Possible knowledge score range from 0-10 *p<0.05 **p<0.001

School 4 also showed no significant difference for the pre- and post test, which may suggest a lack of empathy for the environment, as these learners live in the heart of the city.

When comparing the means of the pre- and delayed test scores for method one (Table 9), there was an overall significant difference (p=0.00815) between the pre-test and delayed test scores. This indicates that there was still a significant change in attitude three months after the study was completed as there was a drop in the mean attitude score. As the attitude score was measured with a Likert scale rating, with one measuring a positive environmental response and five a negative environmental response, a low score or a decrease in the mean attitude score suggests that a more positive attitude score was obtained. When considering individual schools, schools 3 and 5 showed significant difference for the pre- and delayed test scores, while schools 1 and 2 showed no significant differences between the pre- and delayed test scores. This again may be due to the fact that these two schools are not heavily impacted upon by environmental consequences such as litter and water pollution, and many of these learners live in communities that grow their own food. According to Section A of the questionnaire, the majority of respondents who grew their own food or received food from family or friends came from schools 1 and 2. This would suggest they are more conscious of where there food comes from and may therefore have a stronger environmental awareness.

An increase in the mean attitude value from the pre-test to the delayed test shows a significant decrease in positive environmental attitude. In other words, the environmental attitude of the learners from school 4 actually became poorer three months after the lecture using method one.

Table 10: Comparison of the learners' attitude scores from the paired sample t-test for pre-test and post-test for method two.

		Pre-Test		Post-Test			
Group	n	Mean	Standard deviation	Mean	Standard deviation	t (1)	p
Total	253	23.71	5.76	22.51	6.20	2.71	0.00729*
School 1	47	25.57	3.14	25.30	4.05	0.36	0.717
School 2	53	24.43	5.05	22.38	5.09	2.39	0.0206*
School 3	55	25.31	6.03	24.20	6.58	0.90	0.374
School 4	47	17.40	4.85	15.44	4.12	1.99	0.0525
School 5	51	25.31	4.91	24.75	5.20	0.57	0.5699

Mean: Possible knowledge score range from 0-10 *$p<0.05$ **$p<0.001$

Table 10 shows that when comparing the means of the pre- and post test scores for method two, it was found that overall the total group showed a significant difference ($p=0.00729$) between the two scores with a lower than average mean. This suggests a positive change in environmental attitudes. One may therefore deduce that over a short-term period, participating in an interactive lesson can increase learners' environmental awareness enough to change their environmental attitudes in a more positive way. A similar trend was shown by school 2, but there was no significant difference between scores for schools 1, 3, 4 and 5.

Table 11: Comparison of the learners' attitude scores from the paired sample t-test for pre-test and delayed test scores for method two.

		Pre-Test		Delayed-Test			
Group	n	Mean	Standard deviation	Mean	Standard deviation	t (1)	p
Total	253	23.71	5.76	23.77	5.04	-0.15	0.884
School 1	47	25.57	3.14	25.47	4.70	0.13	0.893
School 2	53	24.43	5.05	22.64	4.20	1.93	0.0597
School 3	55	25.31	6.03	24.00	4.72	1.32	0.192
School 4	47	17.40	4.85	22.15	6.01	-4.12	0.000155**
School 5	51	25.31	4.91	24.65	4.95	0.65	0.518

Mean: Possible knowledge score range from 0-10 *p<0.05 **p<0.001

When looking at the long-term effects, it appears as though method two has no impact on the long-term effects of learners' attitudes towards environmental issues.

Table 11 shows the means for the pre- and delayed test scores showed no significant difference (p=0.884) for the total group, and similarly for schools 1, 2, 3 and 5 individually.

School 4 did, however, show a significant difference between the pre- and delayed test scores with p=0.000155, but the average mean for school 4 was higher in the delayed test score compared to the pre-test score, which implies that environmental attitudes had become weaker compared to the pre-test evaluation. This suggests that before the learners participated in the cooperative lesson, they had a more positive attitude towards the environment compared to after they had participated in the lesson.

These results indicate that with method one, for the total group of learners, there is a positive change in environmental attitudes from the time of taking the pre-test to completing the post-test and the delayed test. Method two, by comparison, shows only a positive change in environmental attitudes from the time of taking the pre-test to completing the post-test. There is also no significant difference in attitude change when comparing the pre– and delayed test results, which means that method two has no long-term effects, either positive or negative, on the attitude change of learners.

When comparing the two methods evaluation of the data shows that there is only a significant difference for the delayed post-tests.

(b) T-test attitude scores between methods for all data: school 1, school 2, school 3, school 4, school 5

Figure 6 below shows the box and whisker plots for a comparison between method one and method two for the pre-test, post-test and delayed test scores. The pre-test values show no significant differences, which is to be expected as this indicates that all learners were of the same attitude base when they started the programme. The post-test scores showed no significant difference ($p=0.051$) for the total group, which indicates that neither method was more effective than the other in creating attitude change for the short-term period. However, the results indicate that method one does promote a positive change in environmental attitudes in the long-term (after a 3 month period) as the delayed test scores showed a significant difference between the two methods for the total group

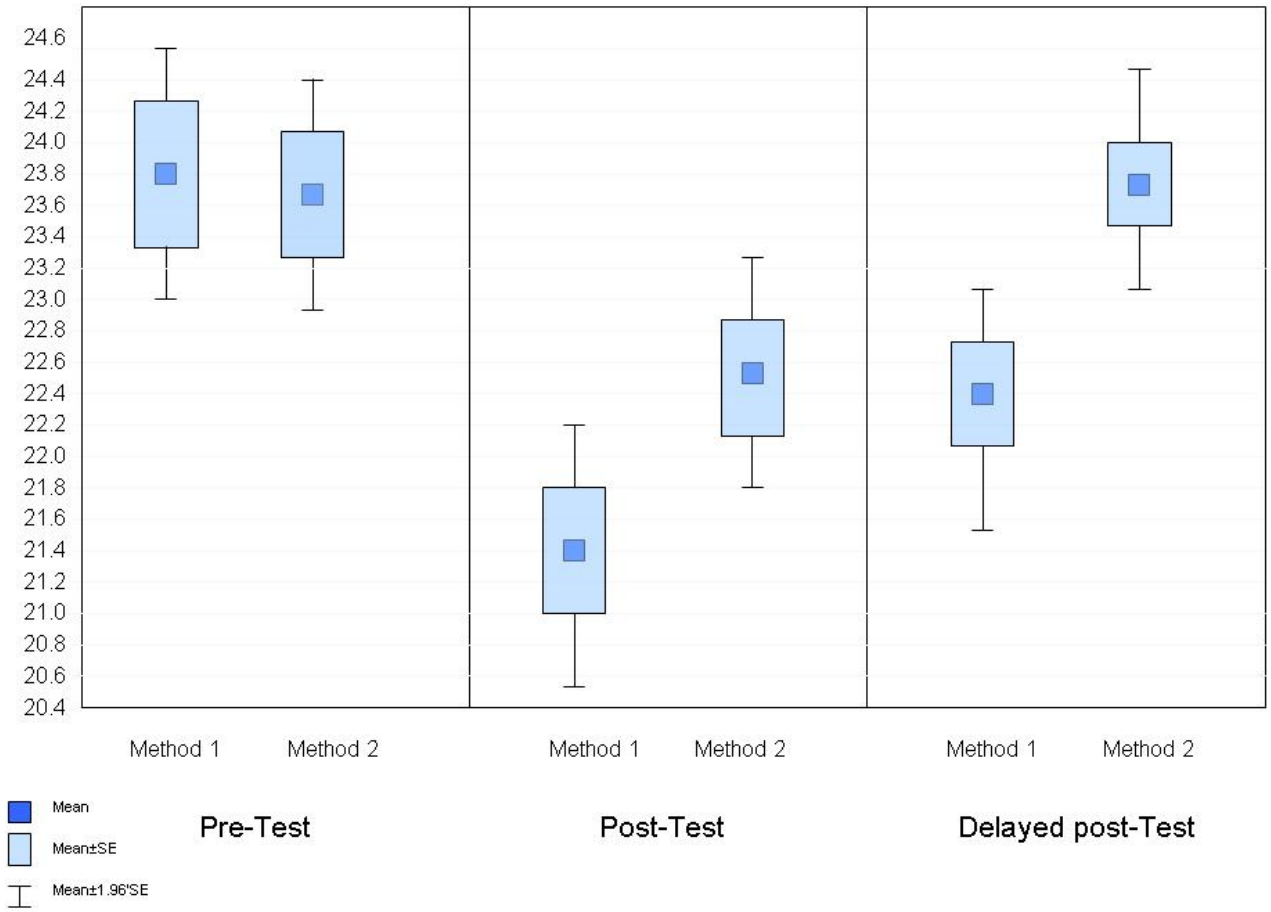

Figure 6: Box and whisker plots for a comparison between the two methods for attitude scores for pre-, post- and delayed post-test.

Table 12: Comparison of p value for the learners' attitude scores from the paired sample t-test for pre-test, post-test and delayed test scores between the two methods.

Group	Pre-test score	Post-test score	Delayed test score
Total	0.889	0.051	0.00525*
School 1	0.250	0.711	0.04356*
School 2	0.478	0.425	0.557
School 3	0.366	0.254	0.00303*
School 4	0.419	0.928	0.187
School 5	0.395	0.196	0.789

Mean: Possible knowledge score range from 0-10 *p<0.05 **p<0.001

Table 12 shows a comparison of p values between method one and method two for the pre-test, post-test and delayed test scores. The pre-test values again show no significant differences. The post-test scores show no significant difference (p=0.051) for the total group and when comparing the post-test attitude scores for each school individually there was no significant difference between method one and method two. This could mean that it does not matter which method is used, as neither is superior in changing attitudes in the short-term period. However, the results indicate that method one does promote a positive change in environmental attitudes in the long-term (after a 3 month period) as the delayed test scores showed a significant difference between the two methods for the total group, favouring method one over method two in creating more positive environmental attitudes. This trend was also shown individually by schools 1 and 3. Schools 2, 4 and 5 showed no significant difference between the two methods for the delayed test.

Generally, therefore, method one showed more evidence that it promoted a positive change in environmental attitudes both for the short-term and long-term period. Method two only showed evidence of creating a positive change in the short-term period. When comparing the two methods, neither showed a significant difference in the short-term, while method one was favoured over method two in the long-term.

4.2.4 Environmental perceptions (Questionnaire Section D)

Section D of the questionnaire asked open-ended questions related to what the learners may consider as environmental problems and how they would solve them. The responses were coded according to problems that may be at a national, or local level or be of a social nature.

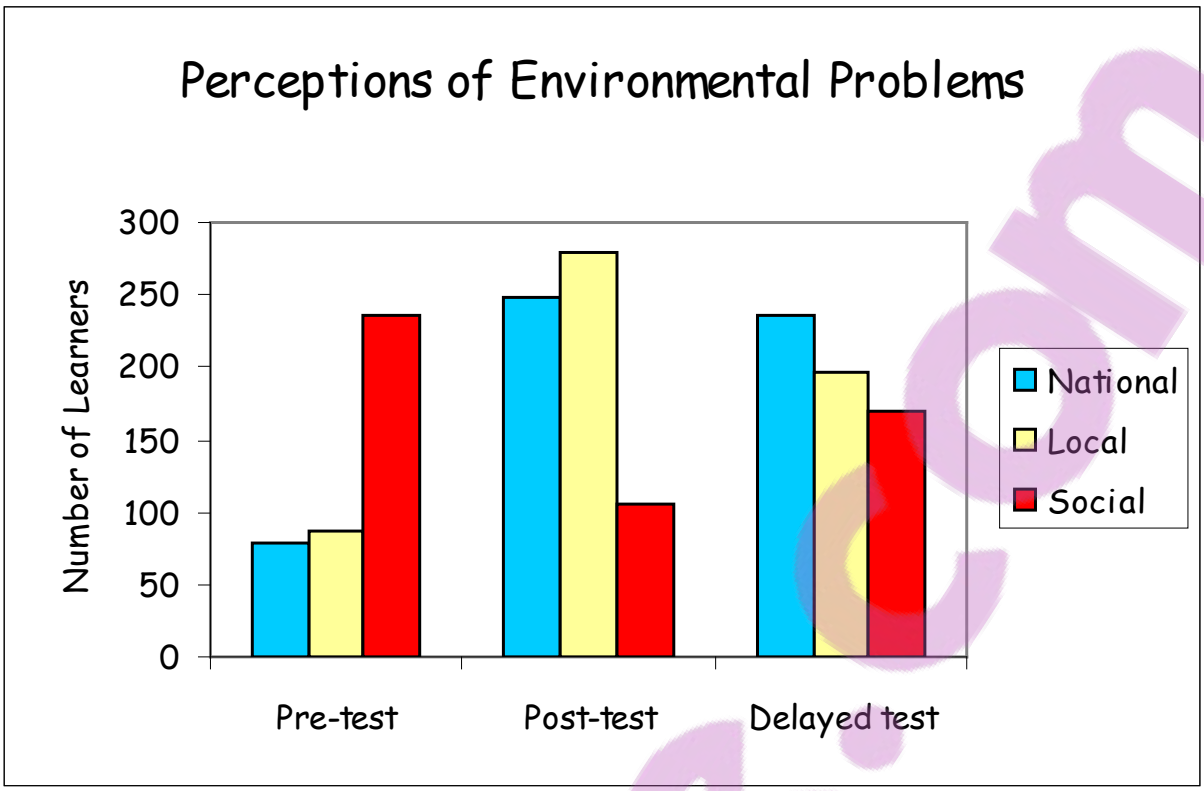

Figure 7: Responses to perceptions of environmental problems for pre-, post- and delayed post-test.

Figure 7 shows the responses to perceptions about environmental problems. The Pre-test results showed that what learners considered as environmental problems were in fact social problems, and this included issues such as abuse, drunkenness in the community and drugs. The post-test results pointed to a greater understanding of environmental problems with a focus on local issues such as litter, water pollution and damaged and dripping local taps. The delayed test indicated an increase in awareness of national environmental problems such as climate change and energy use, as well as an increase in social problems compared to the post-test. In general the learners became more aware of local and environmental issues after the lessons were conducted, and gave positive and realistic methods for solving the problems.

4.3 Summary

This chapter gave a description of the results comparing the pre-, post- and delayed post-test for each method as well as the comparison of results between the two methods. The following chapter comments on the conclusions and recommendations drawn from the above results.

Chapter 5
Conclusions and Recommendations

5.1 Introduction

This research focused on a comparison of two teaching and learning methods to ascertain which is more successful for knowledge retention and attitude change amongst learners who attend EE programmes at the Ushaka Sea World Education Centre. The information presented, interpreted and discussed in Chapter 4 gives an indication of the success of each of the two methods for both knowledge retention and attitude change, as well as a comparison of the two methods with each other relating to knowledge retention and attitude change for short term and long term effects.

5.2 Summary of the research findings

5.2.1 Knowledge

Method one, the lecture method, showed an overall increase in knowledge retention for both pre- and post tests and for pre- and delayed test. This would suggest that method one is effective in promoting both short-term and long-term knowledge retention. However, if learners in a particular school had a strong prior knowledge of the subject material, it may influence the pre- and post- and the pre- and delayed tests by showing no significant difference, as was possibly the case with school 4.

Method two, the cooperative learning method, also showed an overall increase in knowledge retention for both pre- and post-, and the pre- and delayed tests. Method two might also be considered as a successful method in promoting knowledge retention, as overall there appeared to be a significant increase in knowledge retention between pre- and post- and the pre- and delayed tests. However, individual school groups from larger schools with greater numbers of learners within each class and who lack resources did indicate no significant difference between pre- and post- and pre- and delayed tests results. This was the case with schools 3, 4 and 5.

When a comparison was made between the two methods to ascertain which method may be more effective for short-term knowledge retention, method one showed an overall significant difference compared with method two. This may imply that method one enhanced knowledge retention over the short-term period (before and after the lesson). However, method one showed no long-term (three months later) significant difference compared with method two. This could suggest that neither method is more successful than the other regarding long-term knowledge retention. When comparing the two methods within each individual school, school 4 showed that method two was more effective in both short and long-term knowledge retention when compared with method one.

5.2.2. Attitude

As far as attitude is concerned, method one induced an overall positive attitude change between pre- and post- and the pre- and delayed tests, suggesting that method one is effective in changing attitudes, both in the short and long-term. However, schools 1 and 2 showed no significant difference in attitude change. This may have been influenced by the fact that they are deep rural and peri-urban schools where learners come from families who grow their own food. Learners may

therefore have prior knowledge about the importance of resources that have influenced their attitudes in a positive way towards the environment.

Method two also showed an overall positive attitude change between the pre- and post-test suggesting that method two may be effective in changing attitude in the short term. However, there was no significant difference in attitude change between the pre- and delayed test suggesting that method two had no positive or negative effect on attitude change and is therefore not effective for long-term attitude change. School 4 was an exception with their environmental attitudes becoming more positive over the long-term period.

When a comparison was made between the two methods, to ascertain which method may be more effective towards changing environmental attitudes, both method one and method two were equal in creating attitude change for the short-term period. However, method one showed an overall significant difference in the long-term period compared with method two. It could therefore be deduced that either method could be used to influence environmental attitudes in the short-term period, but to create a long lasting effect in attitudes towards the environment, method one may be the more successful.

5.3 Conclusions

The following conclusions can be drawn from the data presented and discussed in Chapter 4. Both methods one and two can be considered effective teaching methods to increase knowledge retention and induce a positive change in environmental attitudes. However, this study suggests that the teaching method used in a particular school could affect the knowledge retention and attitude change because pre-existing abilities, skills and context may influence the way a person learns and this may influence the learning outcome (Akhtar, 2007:268).

As seen from this study learners from schools 1, 2, 3 and 5 (who participated in method one's lesson) appeared to achieve better results, having a greater increase in knowledge retention and attitude change, compared to the learners from the same schools who participated in method two's lesson. The learners from school 4, who participated in the method two lesson, showed a greater increase for both knowledge retention and attitude change compared to learners from the same school who participated in method one.

While the literature may show preference towards method two in terms of the effectiveness of this teaching method, Athman and Monroe (2001:43) describe how learners cannot learn if they do not understand what is being asked of them, and that real knowledge can only occur when the task is useful to learners. When learners are presented with an unfamiliar teaching method this may influence their perceptions and understanding (Ormrod, 1990:192). Learners therefore need to be able to connect with the concepts and methods presented to them. Anderson (1995:202) suggests how the material is studied impacts on how much of that material is retained. In this study the educators from each school indicated that schools 1, 2, 3 and 5 use the same methods of teaching as method one (lecture method) while the teaching method used in school 4 resembles more closely that of method two. This may therefore indicate that in order to acquire knowledge and a positive change in environmental attitudes one needs to consider the teaching method that learners are familiar with and that is used in the classroom. Learner may learn very little when taught using the cooperative teaching method because they lack the pre-requisite knowledge to interpret the new information being presented to them (Westwood, 2008:36). Yeng (2004: 109) suggests that a combination of teaching methods would be more suitable as no teaching method is more effective than the other.

One also needs to take into account the attitudes and emotions of the learners, as well as their background and life context for the programme to be a success. Learning is a process of relating new information to previously learned information (Omrod, 1990:151), and learners understand better when concepts relate to other concepts that they know (Taylor, 2002:154). It is therefore important that the learners are familiar with the materials used in the programme, as learners need to find personal relevance to what they learn to be able to connect with the concepts presented to them. Athman and Monroe (2001:39) describe how content is more effective if conveyed when embedded in a local context, giving learners a chance to explore what is around them. The most powerful experiences in our lives are not those designed to educate, but rather life experiences (Newhouse, 1990: 27) and attitude is linked to "situational reference from life experience" (Newhouse, 1990: 28). If this is true, then it is very important to consider the learners in their life context, and that resources used should be related to the location and understanding of those learners.

The key conclusions drawn from this study for implementing a successful EE programme would be to determine which method of teaching (method one or method two) is practised in the classroom of the visiting school, and then ensure that the same method is used when offering the programme. It is also important, when designing the programme, to relate any new information to existing concepts with which the learners may be familiar. Marine education and marine species are often foreign to learners who visit the Ushaka Sea World Education Centre, so when designing a programme for these learners it would be important to link or relate new information to knowledge or species with which the learners are familiar.

5.4. Implications and Limitations

5.4.1. Implications

As either method could be effective, and the background context of the learners and their current method of teaching in the classroom are important, a number of implications may arise when designing and presenting EE programmes.

- One would need to determine the background and teaching methods used at each school that plans to visit to the Education Centre.
- While one could have a general outline for both methods (method one and method two), in order for the lesson to be effective and achieve maximum results one would still need to relate the lesson to suit the individual school in terms of the learners' background knowledge and life context.
- The resources used need to be familiar to a range of learners, or at least related to those that the learners can comprehend and recognise.

5.4.2 Limitations

5.4.2.1. Limitations of Method Two

Method two appears to provide greater limitations when compared to method one. These are as follows:

- Large numbers of learners may influence the effectiveness of method two as this method requires hands-on activities in small groups, which in turn requires greater facilitation for each group individually. In a classroom one educator may find it difficult to facilitate and control a large number of learners who would be placed in smaller groups.

- The lack of resources may influence the effectiveness of method two. Westwood (2008:36) describes how a resource rich environment is important for cooperative learning. While this may not pose a problem for the Ushaka Sea World Education Centre, this might not be the case in the majority of schools in KwaZulu Natal.
- Additionally, Method two may only be effective at the Ushaka Sea World Education Centre if used consistently in the classroom. It would therefore be necessary to ascertain which schools employ this method of teaching and which do not in order to ensure effective results.

5.4.2.2. Limitations to the study in general

A number of limitations were encounted during this study. They were as follows:

- The research was limited to learners from disadvantaged schools, so while it provides consistency within the study, it will only give a small representation of the comparisons of the methods for knowledge retention and attitude change for all Grade 7 learners.

- The study was limited to evaluating change over a short-term period (before and after the lesson) and a long-term period (3 months later), and will therefore not evaluate change over an prolonged period of time to determine a more permanent effect.

- The study assumed that the learners' present teaching method in the classroom would not influence the way the learners responded to the methods used in the study.

5.5 Recommendations

To get a more detailed understanding of the role played in the classroom teaching methods and how they might influence the choice of method used for an EE programme, it is recommended that further studies be undertaken to include a range of schools, both rural and urban, which employ either or both of the two methods within their own classrooms. The results of such a study could provide a better understanding of how the present classroom teaching method relates to the effectiveness of the method chosen for an EE programme.

The ability to reflect on an experience may influence the bridging between the experience and the theoretical concept being taught. A lack of understanding about certain marine concepts may inhibit reflection and therefore be lost or forgotten (Gibbs, 1988:9). It is therefore recommended that the visiting school be provided with some base or background information that the teacher may cover with the learners before their visit to enhance their experience.

It is also recommended that further information about the teaching methods employed by the school be acquired, prior to the school visiting the Ushaka Sea World Education Centre, to ensure that the most effective teaching method is selected for that particular group. This would enhance their experience and therefore make it more effective by increasing their knowledge retention and creating positive change in their attitudes towards the environment.

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Appendix I: Questionnaire

Masters of Education
(Specializing in Environmental Education)
Questionnaire

Please answer these questions honestly and independently. All your answers will be confidential. Remember there is no right or wrong answer, and this is not a test or exam. Respond with what you know and how you feel about the questions asked.

SECTION A

1. Gender: Male ☐ Female ☐

2. Age: | 10 | 11 | 12 | 13 | 14 | 15 | Older |

3. How many people live in your home? _____

4. Do you…
   a) have a tap inside your home?
   b) have a tap outside your home?
   c) have a tap near your Home?
   d) collect river water?

5. Where do you get your food?
   a) From a supermarket or shop
   b) From neighbours or friends
   c) We grow our own

6. Do you get taught about the environment at school? | YES | NO |

SECTION B

The following 10 questions are multiple choice questions. Read them carefully, and circle the most correct answer.

1. Water covers ____ % of the planet?

   a) 50% b) 70% c) 100% d) 30%

2. We need _____ water to live?

   a) Salt water b) Tap water c) Fresh water d) Dirty water

3. The food that we eat comes from…

   a) Plants b) Animals c) Plants & Animals d) The shops

4. Without food human beings would…

   a) Die b) Go hungry c) Starve d) Be ok

5. All plants and Animals are _____?

   a) Interconnected b) Found in the environment c) Not important d) Just there

6. Biodiversity means . . . . .?

   a) A lot of plants and animals

   b) Many different plants and animals

   c) Few plants and animals

   d) Similar plants and animals

7. Human beings have _____ impact on the environment.

   a) No b) Little c) Some d) A lot of

8. Litter should be . . . . ?

   a) Thrown in a bin b) Buried in a hole c) Left on the ground d) Ignored

9. Pollution is caused by _____?

   a) Factories b) Motor cars c) People d) a, b and c

10. If you saw a chip packet on the ground, you should _____?

    a) Leave it there.

    b) Kick it out of the way.

    c) Pretend you didn't see it

    d) Pick it up and put it in the bin.

SECTION C

There is no right or wrong answers for these questions, only the interest in how you FEEL about the statements. All the questions are statements to which we seek the Level to which you agree or disagree. Circle the following numbers for how you feel:

Strongly Agree = 1 Agree = 2 Unsure = 3 Disagree = 4 Strongly Disagree = 5

1.	Water is important and should be looked after	1 2 3 4 5
2.	The number of plants and animals are affected by things people do	1 2 3 4 5
3.	Nature can be damaged by the food choices we make	1 2 3 4 5
4.	We can determine our impact on the environment	1 2 3 4 5
5.	To pick up litter is my responsibility	1 2 3 4 5
6.	Animals are killed by litter	1 2 3 4 5
7.	Pollution is created by people	1 2 3 4 5
8.	We can stop polluting our environment	1 2 3 4 5
9.	I can make a difference by caring for the environment	1 2 3 4 5
10.	I am responsible for reporting environment problems	1 2 3 4 5

SECTION D

1. What do you think is the biggest Environmental Problem?

_____

2. How could you change or fix an Environmental Problem?

_____

_____

Thank-you  The End!

APPENDIX II: Matching Card Pairs

Cool drink tins - Recycle

Litter - Dustbin

Plastic bags – Re-usable bags

Dripping tap – Closing tap

Car – bus / public transport

Pollution – report to an official

Illegal fishing – Report to KZN Wildlife

Dumping - Recycle

Old Light bulb – Energy efficient bulb

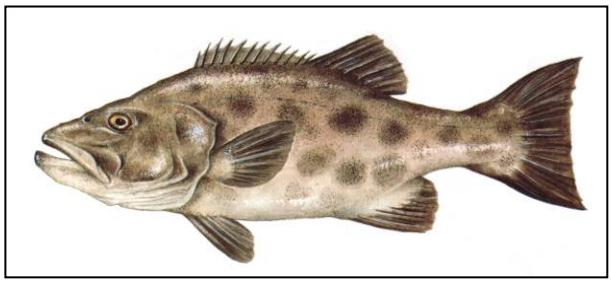
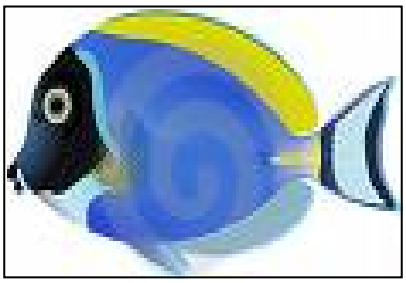
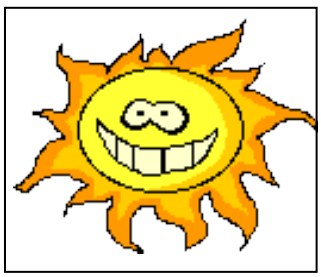
Plants – Water them

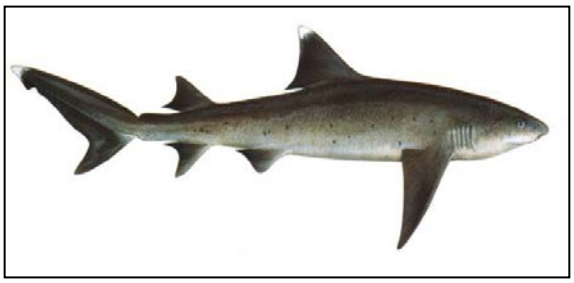
APPENDIX III: Survival Picture Cards

APPENDIX IV: Food web Picture Cards

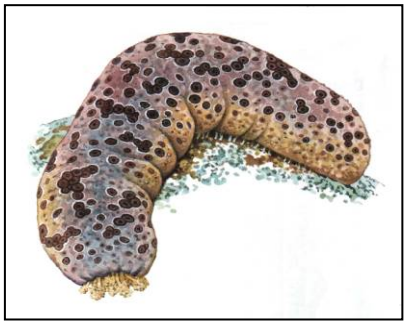


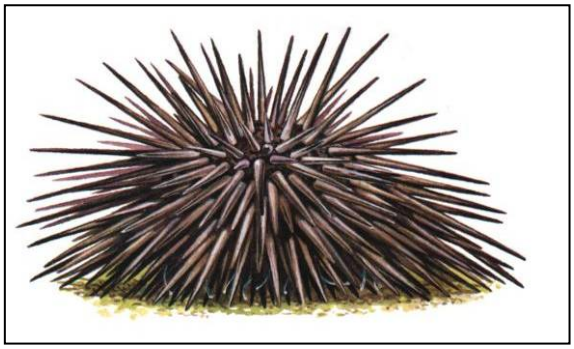


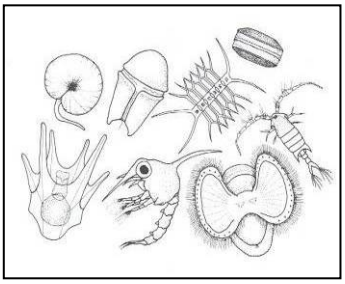
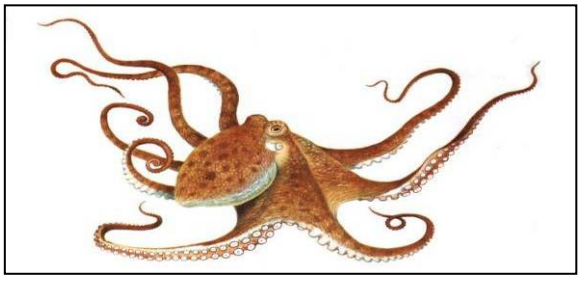













APPENDIX V: Research Procedures

RESEARCH PROCEDURES AND OUTLINE FOR YOUR SEA WORLD VISIT

We request that your school arrives at the NPC Sea World Education Centre at 8h30 on the date of your visit. Your bus will collect you from your school at 7h30 and bring you to the education centre. Once you have arrived, we will randomly divide the learners into two groups by placing a coloured sticker on each learner as they get off the bus. They will then be directed into the relevant room.

It will be explained to both groups that they will be participating in a study, and that they will be filling in questionnaires which they should do openly and honestly, and that it is not a test. The procedures of the morning will also be explained.

Group A will start with the pre-test questionnaire (15 minutes), followed by a lecture presentation (40 minutes) and then their guiding of the aquarium (1 hour). When they return from the aquarium they will fill in the post-test questionnaire (15 minutes) and have a tea break (10 minutes), where we will provide juice and biscuits. They will then be showed a 20 minute DVD on sharks.

Group B will start with the 20 minute DVD on sharks, and then do their pre-test questionnaire (15 minutes). They will then participate in a cooperative learning lesson (40 minutes), and complete a post test questionnaire (15 minutes). Group B will then have a tea break (10 minutes) where we will provide juice and biscuits, and they will then go for a guiding through the aquarium (1 hour).

Once everything has been completed learners will be greeted and thanked before they will return to the bus to head back to school. This should be at approximately 12h30.

Kind regards,

Heidi Kilian

APPENDIX VI: School letter

SAAMBR at uShaka Marine World Incorporates
Oceanographic Research Institute (ORI)
Sea World - Durban
NPC Sea World Education Centre

Reg. No. 1951/000002/08

Tel: 031 328 8195/6
Fax: 031 328 8211
Parade 4056
E-mail: Education@seaworld.org.za
KwaZulu-Natal, South Africa

P O Box 10712 Marine

26th January 2009

Dear School Principal,

EDUCATIONAL RESEARCH AT THE NPC SEA WORLD EDUCTION CENTRE

The NPC Sea World Education Centre will be conducting a study to compare two teaching strategies and their associated methods. This study will focus on the Teacher-centered strategy using a lecture, and the learner centered strategy using cooperative learning to determine if there is any difference between the two methods with regards to knowledge retention and attitude change.

We would like to invite 120 of your grade 7 learners to participate in this study on the ____ March 2009. This study will be funded by the NPC Sea World Education Centre, and we will cover all transport and entrance costs for the learners. We would request that you liaise with the Education Department in terms of the requirements for learners to attend a school outing.

The study will be conducted at the NPC Sea World Education Centre, and learners will be required to fill in a pre- and post test questionnaire on the day of their visit. This information will be strictly confidential and learners may remain anonymous. The data from the questionnaires will be captured via numbers and the questionnaires destroyed once the study has been completed. The study will be conducted by me, Heidi Simpson, the Sea World course coordinator. We also request permission to visit your school in the month of June 2009 on a date that will be suitable to you, where we will provide an additional lesson and complete a delayed post questionnaire.

Learners will be receiving a curriculum linked lesson and a guided tour of our aquarium. The follow up lesson will also be linked to the National curriculum statement for Natural Science for Grade 7. Please see the attached outline for the research procedures and details of your visit. We really appreciate your cooperation and support in this process, and without your participation we would be unable to conduct this research project which will hopefully help us in providing more meaningful educational experiences to learners that visit our facility.

Kind regards,
Heidi Kilian
Formal Education Manager and Ushaka Sea World