2013

School Project: Determining the predominant learning style from the VAK learning styles model in KS2 to enhance environmental education

Land, C.

Land, C. (2013) 'School Project: Determining the predominant learning style from the VAK learning styles model in KS2 to enhance environmental education', The Plymouth Student Scientist, 6(1), p. 332-362.
http://hdl.handle.net/10026.1/14021

The Plymouth Student Scientist
University of Plymouth

School Project: Determining the predominant learning style from the VAK learning styles model in KS2 to enhance environmental education

Connie Land

Project Advisor: David Harwood, School of Geography, Earth and Environmental Sciences, Drake Circus, Plymouth, PL4 8AA

Abstract

There is a need to improve the delivery of environmental education as it struggles to establish itself within the curriculum, it would be more beneficial if environmental issues were to become embedded in the whole curriculum rather than currently being confined to science/geography. Environmental issues such as climate change means that it is imperative that young children are effectively educated in order to develop a more ecocentric viewpoint of the world. The aim of this research was to investigate if there was a predominant learning style from the VAK (visual, auditory and kinaesthetic) model that is most effective for the teaching of environmental issues in KS2 (7-8 years of age). The three learning styles were tested by delivering three 1.5 hour lessons, each based upon one of the three learning styles. The lessons were delivered to three different classes within year three at Hyde Park primary school, Plymouth. Learning was tested through individual/class questionnaires.

Kinaesthetic learning was found to be the most effective style showing the highest retention rates of 99% and 100% respectively for short and long-term learning. Visual learning showed good short-term retention with 100% but declined to 98.25% when tested for long-term retention. Auditory learning showed improvement in short-term learning to 94.25% but long-term retention was poor with only 83%. A significant misconception was generated in the auditory lesson which was dependant on response of question time period p-value < .014. Despite poor retention the learners in the auditory lesson seemed to develop a more ecocentric viewpoint in comparison to other learning styles. The use of kinaesthetic teaching techniques should be encouraged for learners in KS2 to enable them to get the best learning experience possible. The inclusion of storytelling and visual stimulus within lessons has proved to be effective. These techniques can help implement effective environmental education with the limited time dedicated to this subject within the current national curriculum.

Acknowledgements

I would like to thank Dr Dave Harwood for his assistance and development of this research, and providing valuable insight into this subject area. I would like to thank Julian Stander (Associate Professor in Statistics and Mathematics) for his help with statistics and understanding the dataset. Thank you to Matthew Chown for providing inspiration and helping me to develop ideas throughout the entire project period. Many thanks to Hyde Park school and staff for their support and participation throughout the lessons, with particular thanks to Miss R. Cheney for allowing me to carry out the research with her year three pupils and helping me to develop the research. Finally, thank you to the pupils of year 3 because their input in the research was crucial and would not have happened without them.

Table of Contents

List of Figures

Chapter 1: Introduction

1.1 Introduction

There is a need for an improvement in the delivery of environmental education in primary schools to enhance the understanding of many issues that the world is facing now and in the future such as climate change (Ballantyne and Packer, 1996). By effectively educating children that are seven or eight years of age about environmental issues there is hope that this will stay with them and influence moral decisions throughout their adult lives (OCED, 2007). The concept of learning is to provide an expansion of knowledge leading to a change in behaviour.

1.2 Aims

- To establish if there is a predominant learning style from the VAK (visual, auditory, kinaesthetic) model that is most effective for the teaching of environmental education in KS2 (7-8 years of age)

- To help the development of effective environmental education in primary schools

"The direction in which education starts a man will determine his future life".
Plato

1.3 Objectives

- To design and deliver three lessons each constructed around one of the three VAK learning styles

- To measure the pupils' short term learning by conducting questionnaires at the beginning and end of each lesson

- To measure the pupils' long term learning by conducting questionnaires three weeks after the lesson

"I hear and I forget,
I see and I remember,
I do and I understand"
Confucius

Chapter 2: Literature Review

2.1 Environmental education

Since the early 1990's there has been increasing importance has been placed upon environmental education and this has been addressed in the UNCED and World Conservation Strategy plans and at their conferences (Tilbury, 1995). Furthermore, there has been growing importance placed upon the implementation of environmental education in schools by large NGOs and UNCED and ACA.

The main goal of environmental education is to develop a feeling of responsibility towards environmental issues and to encourage an ecocentric conception of the world (Gigliotti, 1990; Hungerford and Yolk, 1990).

The main delivery of environmental education in primary schools is through science and geography (Tilbury, 1995). Tilbury (1995) & Fossett (2008) both argue that since environmental education is not a singular subject area it has struggled to strongly establish itself as an important feature of the curriculum. Furthermore, there is the idea that secondary schools are designed to actually focus more on science and it is here that a lot of time is spent compensating for the lack of science taught in primary school.

Fossett (2008) has further noted that the amount and depth of environmental education given to young learners depends on the school, area, and teachers. Environmental education must engage pupils and enhance their understanding of the world around them, and most importantly allow them to identify themselves as a part of the solution for many environmental issues (Tilbury, 1995).

Both Fossett (2008) and Tilbury (1995) suggest that the main focus of environmental education should be structured around future sustainability. Therefore, maintaining and enhancing resources, recycling and conserving energy.

Ballantyne, Fien and Packer (2001) suggest that the implementation of environmental education is not only necessary for young learners but it also plays a very important role in reaching wider audiences through intergenerational learning; extending knowledge to families, friends and teachers (Ballantyne, Fien and Packer, 2001).

It is most effective to begin education in environmental issues at around 7-8 years of age (OCED, 2007). Early intervention is especially important before materialistic and capitalist thinking become innate (Rickinson, 2001; Tilbury, 1995). If children have already formed strong opinions about the world, learning about environmental education can sometimes cause conflict and young learners will not stray from their personal belief systems (Hungerford and Yolk, 1990; Rickinson, 2001). Furthermore, being aware of good moral choices does not always ensure that an individual will make the most beneficial choice to the environment and therefore it is vital to try to influence values.

Tilbury (1995) suggests some methods for environmental education including class discussions, games, role playing, and use of photo and media. Further, suggesting that active participation is extremely important and discourages the laissez faire approach to learning (Tilbury, 1995).

Environmental education can help to encourage Cartesian thinking which enables the pupils to look at the world from a higher perspective (Tilbury, 1995). Tilbury (1995) argues that children need to develop an insight that can encourage them to develop an ethical stance about environmental issues by changing children's outlook this can help to solve problems that we face globally. It is essential that young learners recognise themselves to be a part of the solution for many environmental issues (Rickinson, 2001; Tilbury, 1995).

2.2 KS2

Learning as a child is critical for human development, since the brain has evolved to be educated and to educate. At a young age it is critical that children have exposure to activities that utilise imagination and creativity. These activities help to stimulate an interest in science based subjects (Solomons, 1993). Science is an ever-changing subject and requires use of imagination to fully understand some of the concepts (Bartholomew, Osborne and Ratcliffe, 2002).

Boyle and Bragg (2005) illustrate that there has been a considerable decrease of 1.7% in the number of taught hours in KS2 science. There is an average difference of twenty fewer hours teaching of science compared with English and Maths.

Only 56% of teachers felt that they were delivering a high standard of education for children in KS2, and only 29% of teachers felt that they were delivering good, quality lessons in KS2 science (Boyle and Bragg, 2005; 2006). In addition to this most English and Math teachers receive training to help deliver lessons, and this is rare or non-existent in science subjects (Boyle and Bragg, 2005).

The structure of the national curriculum seriously diminishes the value of practical/physical subjects and the focus of learning has become largely dependent on writing knowledge rather than verbally communicating what has been learnt. Using a transdisciplinary approach within subjects – i.e. teaching science and drama together can enable deeper learning as opposed to strict curriculum boundaries (Boyle and Bragg, 2005).

Bartholomew, Osborne, and Ratcliffe (2002) suggest role play and drama, group work and discussion and the use of stories which all relate science into the context of real life to help children understand concepts of science.

In conjunction with this there has been an increase in the amount of time spent preparing for examinations instead of actively learning about science (Boyle and Bragg, 2005). There is a risk in this approach that young learners become congealed bodies of knowledge (Boyle and Bragg, 2006; Smith, 1999). The apparent success in examinations hides worrying and damaging misconceptions in all areas of learning, especially science.

OFSTED have highlighted the challenge of ensuring that every subject area is taught to a high standard; it is therefore essential that the time spent actively teaching is as effective as possible in delivering high quality learning opportunities in science (Beggs and Murphy, 2005; Smith, 1999). The duration and depth of science and environmental education taught in primary schools largely depends on the school, demographics and teachers (Fossett, 2008).

The OCED report (2007) indicates that there are sensitive periods in education during which learners are highly receptive, one such period occurs during the early years of primary school education. The OCED report (2007) suggests that young learners' brains show high levels of plasticity and their learning can be significantly enhanced in relation to the exposure to different learning styles they receive. There is more focus on the affective domain opposed to cognitive whilst learning at a young age.

Hayes (1999) suggests that a holistic approach should be adopted when teaching children; furthermore teachers should use straightforward language to deliver the learning outcomes. The young learners should also have adequate time for reflecting upon what they have learnt in the lesson to allow for the processing of knowledge gained.

Research undertaken by Beggs and Murphy (2005) concludes that "hands on" techniques are more effective in primary schools whereas the use of discussion and analysis are more relevant for higher level learners. There is an ever-changing flow of children that enter schools, each with a different upbringing. At present many children in primary schools tend to have high levels of exposure to video games, television and computers because of modern day technology. This exposure tends make young children more receptive to visual and kinaesthetic learning styles.

2.3 VAK learning styles model

"Tell me and I forget
Teach me and I remember
Involve me and I learn"
Benjamin Franklin

The information retained from learning is highly dependent on how it is delivered, accessed and processed. Evidence suggests that preferred learning styles are in part determined by genetic make-up; however, they are also largely influenced by development and exposure to different environments whilst neural pathways in young minds are still developing (OCED, 2007).

Hayes (1999) suggests that children should have the opportunity to have fun in the classroom whilst feeling a sense of exploration. There are many methods to encourage enjoyable learning experiences for example: practical work – shows, drama, puppets (kinaesthetic), discussions and listening, sounds, emphasising key words, musical stimulation (auditory); and mind maps, films, pictures and flow charts (visual) (Bricheno and Younger, 2004).

The VAK model was created by neuro-linguistic programming research (Cassidy, 2004). Many people can access all three learning styles but tend to have stronger preferences for one or two of them (Bowkerb and Byrnec, 2008; Cassidy, 2004).

Miliband (2004) argues that recognising learning styles is becoming more important in primary schools. It is also important to recognise that as people learn in different ways they also take different meaning and understanding from the same learning event.

Research suggests that the 40% UK population tends to have a preference for kinaesthetic, 35% are visual and 25% auditory learners (Bricheno and Younger, 2004). Despite these results education is still predominantly delivered using auditory techniques, there has been some small introduction of more practical methods over the past decade (Roberts, 2002).

In the Bricheno and Younger study (2004) listening was considered the hardest skill by young learners. There is evidence to suggest that the children do not possess the complete understanding of adult linguistics and this therefore makes auditory learning difficult for many young learners (Tomasello, 2000).

Miliband (2004) expresses that it is important to consider that every school and the teachers within each school vary from one another greatly. However, there is a growing emphasis on raising standards by taking into consideration individual learning styles and also to develop more innovative ways of teaching children. This study, rather than focusing on specific individuals, aims to investigate whether at KS2 there is a predominant learning style that can be used as a tool for the successful implementation of environmental education in the classroom.

There is strong evidence that as children develop their learning styles change according to the type of exposure they receive. They develop the capacity to take advantage of more formal styles such as auditory learning. Exposure to higher education methods such as field trips, seminars and lectures will enable pupils to discover new efficient ways of learning. This is because as children progress through key stages they become more sophisticated because they become more literate.

Traditional methods of teaching tend to favour logical activities which represent the function of the left side of the brain. These consider activities such as writing, listening and reading. Kinaesthetic learning takes into account more imaginative, creative, and practical learning which is dominated by the right side of the brain (OCED, 2007).

Pound (2008) argues that formal and logical learning are not suitable for young children as it is only from the latter years of ages 7-9 that the ability to read and write fully develops. In conjunction with this, the research of Jolley (2010) further suggests that the development of the visual cortex influences how most young children learn, suggesting that many might have a preference for visual and kinaesthetic learning.

Jolley (2010) suggests that visual representations can help determine the level of knowledge in children; especially if young children are asked open ended questions then they can tend to show incomplete knowledge. Translating their knowledge through visual representations in the form of posters/booklets can show better levels of understanding.

Pound (2008) states that young children are inclined to participate in situations that offer the opportunity to play as it allows them to explore feelings and learn. Bartholomew, Osborne and Ratcliffe (2002) also suggest that role play, drama, group work, discussions and the use of stories can be used to enable children to better understand scientific concepts. Experimental role play enables pupils to develop a deeper understanding as opposed to simply memorising information learnt, without any real understanding of the subject.

The OCED report (2007) highlights the importance of encouraging kinaesthetic learning to completely develop both the right and left sides of the brain. Furthermore, there is a strong need to encourage learners to be tactile when learning new subjects and concepts to help establish a simple body based memory system (Roberts, 2002). By linking body movements to knowledge gained, a deeper learning experience will take place (OCED, 2007; Roberts, 2002).

Joiner & Smith (2008) indicate that having a better knowledge of the mechanisms of long term memory retention will improve the effectiveness of teaching practices. The slower the learning process the higher the long-term memory function.

Therefore, whilst teaching about the environmental in primary schools is it important that the sessions take place over a long period of time. Unfortunately, due to time constraints this limited study will undertake a 1.5 hour session for each KS2 class. This will give an indication to which learning style is most effective for this age group.

2.4 The main aims of this project

Fossett (2008) considered various learning styles based upon Howard Gardener's multiple intelligences theory. By trying to incorporate multiple learning styles into an activity pack to enhance environmental education Fossett (2008) was able to effectively engage all the children.

The work carried out in this research project aims to build upon the knowledge gained by Fossett (2008) to see if there is a particular learning style that is predominantly effective in teaching KS2 children about environmental issues, to enable a deeper learning experience to take place.

Discovering if there is a predominant learning style in KS2 will enable educators to deliver lessons which enable children to have a deeper understanding of the environmental issues of the world and perhaps to positively influence the moral decisions they make throughout their adult life.

Rayner (2007) states that more research into the effectiveness of different learning styles is essential because at present the literature is very limited. This is because many educators calculate the effectiveness through use of intuition as opposed to scientific research. For example, if a class appears to be engaged and enjoying the lesson it is tempting to believe that deep learning is taking place.

Rayner's (2007) research is primarily based upon learning styles in SENCO within primary schools. This report validates how identifying learning styles can have a profound impact upon young learners in the classroom, especially focusing upon inclusive learning.

In a study by Bricheno and Younger (2004) the use of the learning styles questionnaire was tested and results showed that it did not correspond with the learning style that young learners found in practice the easiest/hardest. For example, only 17% of boys and girls appeared to be kinaesthetic learners but the questionnaire results showed that a majority actually preferred the practical hands on activities (Bricheno and Younger, 2004).

The research by Bricheno and Younger (2004) also revealed that learning styles are based upon individual preference and are independent of gender. The study showed that there are differences in preferences based upon how the teacher delivers lessons (Bricheno and Younger, 2004). In this study "listening" was considered the hardest skill and "doing" the easiest skill. A majority of learners reported that they did not find copying from books an effective way of learning (Bricheno and Younger, 2004).

The study also distinguished a clear preferred choice from children for more active subjects, such as arts, it, drama, P.E and practical science (Bricheno and Younger, 2004). There were concerns from teachers between links with kinaesthetic learning and behavioural management (Bricheno and Younger, 2004).

The teachers in this experiment also stated that it was difficult to represent a singular learning style as the VAK model combines together in such a way that it is difficult to separate them. Therefore this study will attempt to identify the most predominant learning style (Bricheno and Younger, 2004) to see if this can improve the delivery of environmental education in KS2.

The Bricheno and Younger (2004) study is one of few cases in literature based upon independent research around the VAK model. Most literature is focuses on modelling and theoretical work as opposed to practical work and development of learning styles in the classroom.

Chapter 3: Site descriptor

The research was carried out at Hyde Park school, Plymouth. The school has good levels of environmental and social awareness. The school promotes walking and cycling to school, encourages children to learn about fair trade produce and recycling. Energy monitors are also installed around the school, and there are well established environmental based clubs for the learners to join.

Despite the high level of effort to make children aware of environmental issues, there is still an issue of establishing a strong element of environmental education within the curriculum. This is mainly due to pressures of national curriculum and government standards, and in addition there is important emphasis placed upon SATs examinations in the upper years of the junior school.

The research was based upon three classes in KS2 (year 3) aged 7-8 years of age. There were on average 27 young learners in each class, and the children were not divided into sets based upon their learning ability which enabled a more balanced environment in which to test the learning styles. This research aims to expand and contribute to the scientific research investigating the actual effectiveness of the VAK learning styles.

Chapter 4: Methodology

4.1 The content and learning objectives

The content for the lessons was determined through discussions with the head teacher of year three. Endangered animals had not previously been taught to the young learners, and this topic was deemed suitable for the age group and mental capacity. There would be varying levels of baseline knowledge based upon the exposure to the topic the children had experienced outside of the school environment.

The three lessons were constructed around the VAK learning styles model and lasted for 1.5 hours taking place in the afternoon. The aim was to make the lessons as predominantly based around the one of the learning styles as possible due to great difficulty of designing an effective lesson based solely on one learning style.

The four learning objectives for the lessons were to: 1. gain an understanding about endangered animals, 2. to recognise the different habitats in which they live, 3. to understand the anthropogenic problems effecting habitats and finally, 4. understand the potential solutions to these problems.

The four learning objectives were delivered using the techniques of each of the different learning styles. This was to ensure that even if there was minimal crossover between learning styles the main objectives were delivered using the dominant learning style in each group.

4.2 Kinaesthetic

The kinaesthetic lesson consisted firstly of a very short introduction to what the children were going to be making. They were then set the task of making paper plate masks to represent a various selection of endangered animals, such as killer whales, lions, and sunbirds. Each table was divided into four different habitats: savannah, coral reef, ocean, and jungle.

The learners were asked to personify their mask by giving it a name for example ‘Paul the Panda’ and to introduce where their animal is from. Each learner introduced their animal to the rest of the class, and then everybody had to say ‘I am endangered’.

The repetition of this word was important to emphasise the importance that the animals were ‘endangered’. The learners were then asked to act out their animal’s behaviour, for example: a monkey swinging through trees in the jungle.

The teaching assistant then acted out an anthropogenic threat in this case: a wood cutter/bulldozer. If the children were tapped then they had to sit down because they were extinct, and the children that were left had become endangered.

The problem was then reversed if trees were planted, and then the children could come back and play in their habitat. This exercise was repeated for all of the tables. The threats for all the habitats were: coral reef & rubbish being thrown, oceans & overfishing and savannah & vehicles/development.

4.3 Visual

The visual lesson began with a PowerPoint presentation in which the young learners had to name various photographs of endangered animals, which also included photographs of the four previous habitats used in the kinaesthetic lesson.

The young learners then watched two silent videos of the coral reef and rainforest. Two interactive games on the whiteboard were played as a class related to coral reefs and rainforests.

Four large posters were then shown to the class, and pictures of the four correlating threats were stuck on to the posters. The class responded by talking about the visual stimulus, the threats were then taken away from the habitat posters by discussing what could be changed in order to prevent the negative impacts of the threats.

The children produced a pocket sized poster booklet based upon what they had learnt in the lesson. There were four pages in the booklet, on the first page they were asked to choose and draw an endangered animal, then on the respective pages draw what the habitat was, what are the threats to the habitat and the potential solutions to the problems.

4.4 Auditory

A story that I wrote was read to the young learners at the beginning of the auditory lesson. The story was based upon a chimpanzee that went on a journey through the jungle to search for his friend, along the way encountering some of the threats associated with urbanisation and logging in the jungle and ocean habitats.

The learners then explored their feelings towards the issues addressed in the story through paired hot seating, where they would interview one another as one of the characters from the story. A class discussion was then held about the story and the endangered animals, habitats, threats, and solutions featured.

The learners were then played audio clips of various endangered animals and had to identify the animals and their habitats. A second discussion was held and helped the children to identify the further selection of the four habitats – coral reef, and savannah and the animals that live within them.

The children were then read a poem that had been written; it was a four lined rhyming poem and structure of the poem followed the four learning objectives, i.e.

Line 1: There was a tiger called Bungle,

Line 2: He lived in a vast green jungle,

Line 3: A bulldozer came and cut down all the trees,

Line 4: So remember to recycle, please, please, please!

The children were then set the task in pairs of writing their own poems to represent what they had learnt. There were varying levels of reading and writing ability, however, it was felt that this exercise was acceptable for their level of knowledge. The children then read aloud their poems aloud to the rest of the class to share ideas generated from this task.

4.5 The questionnaires

Fossett (2008) assessed the pupil's responses in KS2 by semi structured interviews as this was deemed most suitable because writing questionnaires can be too difficult for young children to complete effectively. Based upon meetings with Rachel Cheney (Head teacher of year 3) it was discovered that many of the pupils still struggle to read and write.

The young learners were asked questionnaires as a whole class and told to move to the corner of the room in silence and without conferring to the labelled corner (i.e. a, b, c, d) of the room they thought corresponded with the correct answer.

The children were not told the correct answer but just asked the next question; this test was used because of the varying level of reading and writing ability, and because of this a written questionnaire could have shown inaccurate results. Furthermore, due to time constraints it was not possible to ask each child individually.

The young learner's baseline knowledge, short term retention and long term retention of knowledge was assessed through conducting multiple choice questionnaires. The questionnaire was designed around the four learning objectives. The questionnaire consisted of four questions each with four possible answers:

1. What does endangered mean?

a) Animals are happy

b) Animals are changing their homes

c) The number of animals is getting less and less

d) The animals are dangerous

2. What is a habitat?

a) Where animals live?

b) Where people go to work?

c) Where you learn habits?

d) A place that's always dark?

3. How are habitats getting destroyed?

a) Strong wind?

b) The internet?

c) Too many animals?

d) Pollution?

4. What can you do to help habitats?

a) Don't use the internet?

b) Be environmentally friendly?

c) Watch nature programmes?

d) Don't climb trees?

The questionnaire was conducted at the start of the lesson (prior to lesson being taught) immediately after the lesson and three weeks after the lesson. This method measured the baseline level of knowledge within each class, short-term learning retention and long-term learning retention.

On the three week review, it was possible to test a sample of ten children from each class. The learners were individually asked the questions prior to the final class questionnaire, and were not told the correct answer.

A small amount of learners selected for individual testing were specifically chosen because they had repeatedly answered incorrectly in the class testing (the rest of the individuals were chosen at random). This was to investigate if it being tested with the peer pressure removed made any difference to the answers chosen. The individual sample questionnaires provided valuable supporting evidence to back up the findings from the class questionnaires.

Semi-structured interviews were also conducted with two young learners from each class, and with the class teachers. Questions such as: 'Did you enjoy the lesson? Did the lesson inspire you to change your behaviour, i.e. recycling more often? Do you remember what was taught in the lesson? Did you feel that the young learners benefited from the lesson?

A letter was sent out to parents prior to the lessons taking place, to make parents aware of the content of the lessons, and that the children were taking part in this research, and semi structured interviews would be carried out.

Chapter 5: Results

5.1 Results from the visual lesson

Figure 1 shows the number of pupils answering the four questions correctly before the lesson (baseline knowledge), after the lesson to assess short term retention and three weeks later to assess long term retention from the visual lesson. There were 30 pupils in the lesson.

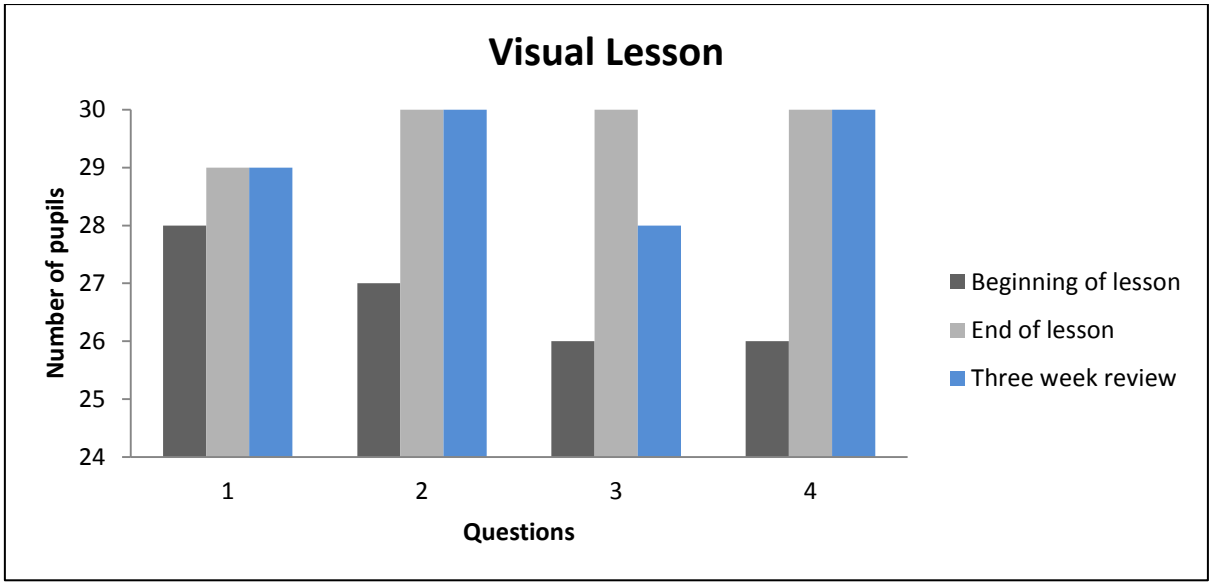

Figure 1: Figure 1 shows the number of children that answered each of the 4 questions correctly from the visual lesson. This figure shows the results prior to teaching the lesson, at the end of the lesson and at the three week review.

Fig 1 shows that two learners out of 30 (2/30) answered question 1 incorrectly. However, after the lesson and on the three week review, this child answered correctly.

Question 2 also shows an increase from baseline knowledge. Three children answered incorrectly and all managed to answer correctly after being taught (see fig 1).

Question 3 received some interesting results as initially 4/30 children answered incorrectly then immediately after being taught the entire class answered correctly. The long term retention appeared to decrease because only 28/30 children answered correctly, showing an improvement of only 2 learners retaining this information from the initial baseline knowledge of the class. Clearly this result is not statistically significant.

Question 4 showed the largest consistent increase for the visual lesson of correct answers from 26 children answering correctly to 30 for both short term and long term retention (see fig 1). This result was also not statistically significant.

5.2 Results from the auditory lesson

Figure 2 shows the amount of children that answered questions correctly from the auditory lesson. There were 24 children in the class. Question 1 showed an increase from baseline knowledge 21/24 to 23/24 after the lesson (short term retention), however, this decreased to 22/24 on the three week review (long term retention). There was still an overall improvement of 1 child retaining this information in comparison to baseline knowledge.

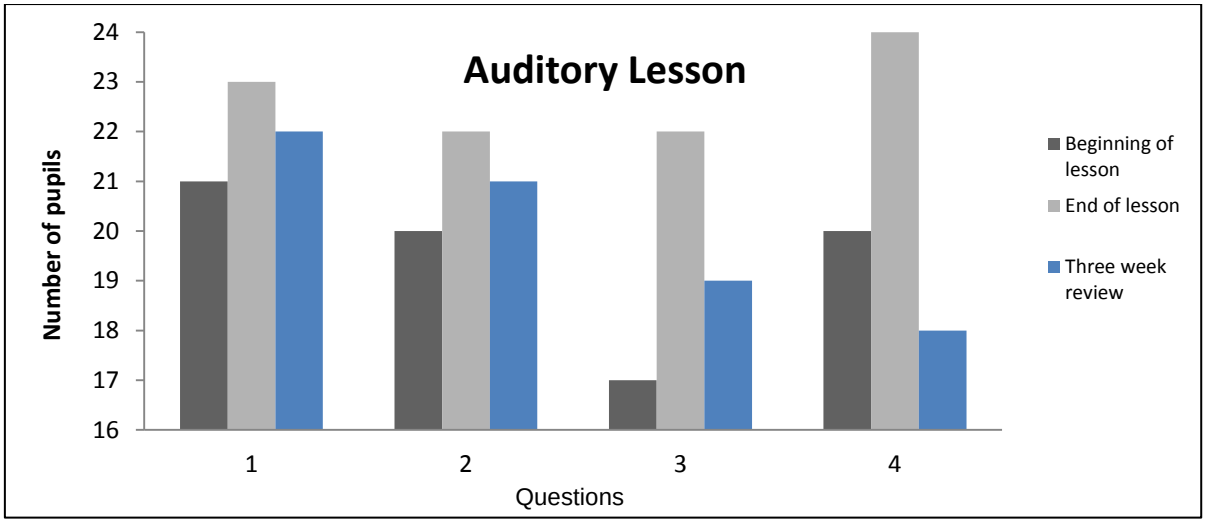

Figure 2: Figure 2 shows the amount of children that answered each of the 4 questions correctly from the auditory lesson. The figure shows the results prior to teaching the lesson, at the end of the lesson and at the three week review. A chi squared test was run on the data from question four; the test showed a significant population of the class misinterpreted the content of the lesson when tested three weeks later; there was a dependency of response on the question period.

Question 2 (see fig 2) shows that 20/24 children answered correctly when baseline knowledge was tested, this increased to 22/24 children after the lesson, and finally 21/24 children answered correctly after the three week review.

Question 3 (see fig 2) shows that only 17/24 children answered correctly prior to the lessons being taught. Seven children answering incorrectly was the highest amount of incorrect answers, this is also shown for question 1, in the kinaesthetic lesson (see fig 3). There was a large increase from 17/24 – 22/24 children answering correctly after the lesson. On the three week review this figure decreased down to 19/24 children answering correctly. It is clear that on question 3, it may have been possible that deep learning was not present because there was an improvement of correct choice of answers when tested after the lesson, however, on the three week review it is clear that potentially only two of the learners that initially answered incorrectly managed to select the correct answer on the three week review, this is just an assumption based upon results, it would be more effective to follow each individual throughout the testing period. This was not possible due to time restrictions.

Question 4 (see fig 2) shows that 20/24 children answered correctly prior to teaching, this increased to 24/24 after the lesson was taught, but decreased to 18/24 children answering correctly after the three week review. This figure shows that an extra 4 children got the question wrong in comparison to the baseline knowledge. Therefore it may have been possible that the lesson content and questions generated a misconception. However, that should have shown in the immediate post-lesson test. It may therefore be that the pupils' surface learning was sufficient for them to answer the questions correctly immediately after the lesson despite them not having fully understood why the answer(s) was/were correct. This was demonstrated in the deep learning test (3 weeks hence) in that short-term or surface knowledge had now departed and seeds of doubt had been sown. Interestingly, the level of correct answers was higher before the lesson, so a

misconception had been generated; it was not simply children reverting to their "common sense view" previously held.

A chi-squared test was run on the data set; chi-squared analysis itself has some drawbacks but is a more appropriate analysis for the available data set in comparison to paired t-tests. The test showed a p-value .014 so there is a dependency of response on time and questioning period. This therefore shows that a significant proportion of learners generated a misconception on the three week review.

If each individual child had been followed throughout the three question periods, we would have a richer data set, and would be able to assess better any changes that may have taken place. A suitable analysis for this could have been a two-way analysis of variance followed by a series of paired t-tests.

Interestingly, 3 learners when tested prior to the lessons being taught answered incorrectly but selected option A instead of option D. These individuals may have been some of the learners that generated the misconception; therefore their misconception could have been transferred.

5.3 Results from the kinaesthetic lesson

Figure 3 shows the number of children that answered questions correctly from the kinaesthetic lesson. There were 29 children in this lesson. Question 1 shows a very low baseline knowledge 22/29 children answering correctly, after the lesson was taught this increased to 28/29. After the three week review this increased to 29/29 children answering correctly.

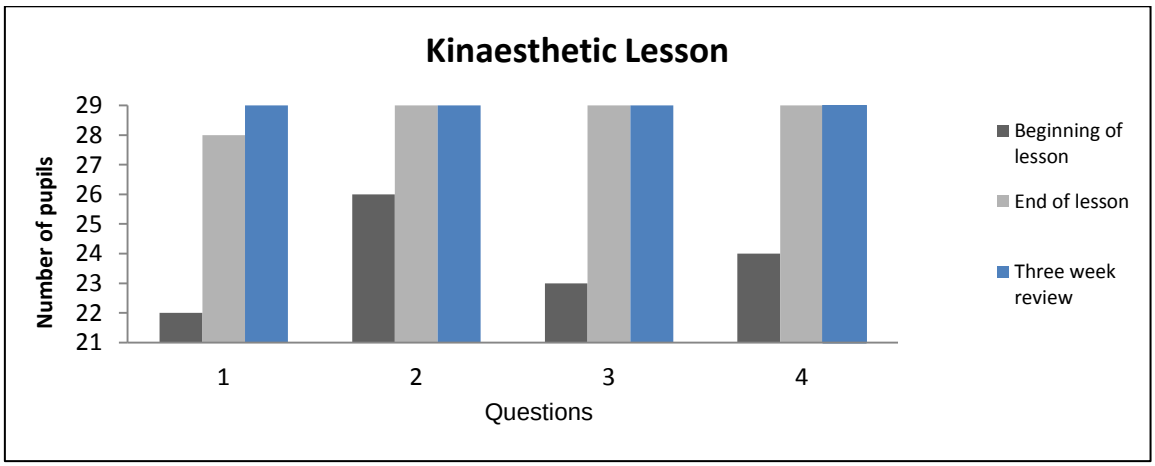

Figure 3: Figure 3 shows the amount of children that answered each of the 4 questions correctly from the kinaesthetic lesson. The figure shows the results prior to teaching the lesson, at the end of the lesson and at the three week review.

Question 2 (see fig 3) showed that 26/29 learners answered correctly prior to the lessons being taught, this increased to 29/29 when short term and long term knowledge were tested.

Question 3 (see fig 3) showed that 23/29 learners answered correctly prior to teaching, this increased to 29/29 when both short term and long term knowledge were tested.

Question 4 (see fig 3) also showed a consistent improvement from baseline knowledge of 24/29 to 29/29 when both short term and long term knowledge were tested.

5.4 Average class results

Due to the varying amount of young learners in each of the classes the average percentage of correct answers was calculated to show the increase/decrease of knowledge gained based upon each learning style (see fig 4). Both auditory and kinaesthetic showed similar levels of baseline knowledge - 80.75% and 81.25% respectively, only a 0.5% difference. The baseline knowledge for visual was 11% higher than that of auditory and 10.5% higher than kinaesthetic (see fig 4).

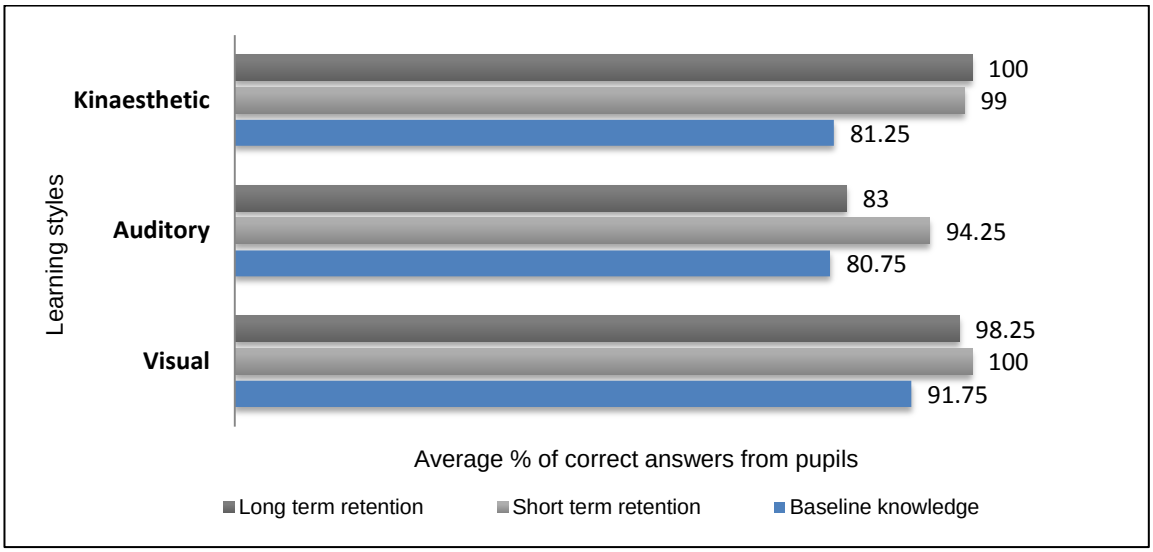

Figure 4: Figure 4 shows the average percentage of correct answers to show the increase/decrease of knowledge for each learning style. Baseline knowledge is the level of knowledge prior to teaching the lessons. Short-term retention refers to when testing

Kinaesthetic showed a good level of improvement from 81.25 - 99% for short term retention, and the long term retention this improved to 100% (see fig 4).

Auditory showed an improved from 80.75 - 94.25% for the short term retention, however, this decreased to 83% after the three week period (see fig 4).

Visual improved from 91.75-100% for short term retention, however, decreased to 98.25% after the three week review (see fig 4).

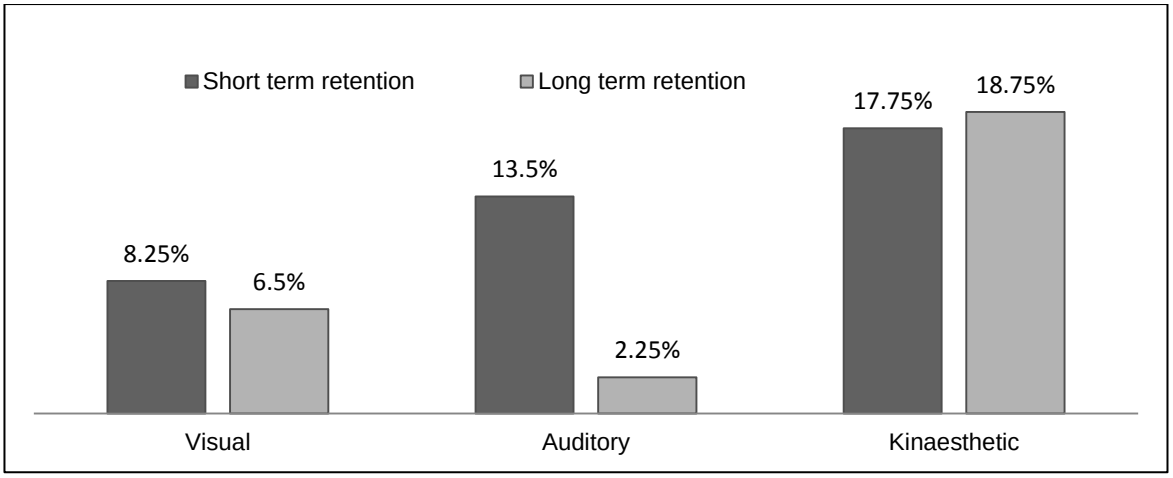

Figure 5: Figure 5 shows the average percentage increase of questions answered correctly in comparison to baseline knowledge for each learning style.

Figure 5 shows the average increase in percentage of questions answered correctly in comparison to baseline knowledge for each learning style. Fig 5 shows that visual experienced an initial increase of 8.25% from baseline knowledge, however, on the three week review the long term retention decreased by 1.75% to only a 6.5% increase from baseline knowledge.

Auditory showed an initial increase of 13.5% from baseline knowledge, however, this decreased from 13.25% to just a 2.25% increase for long term retention. This was the largest decrease of 9.5% from short term- long term retention (see fig 5).

Kinaesthetic showed the largest improvement of 17.75% from baseline knowledge; this improvement was consistent and increased by 1% to 18.75% on the three week review (see fig 5).

5.5 Results from individual questionnaires

Figure 6 shows the average percentage of questions answered incorrectly whilst testing a sample of 30 pupils individually on the three week review.

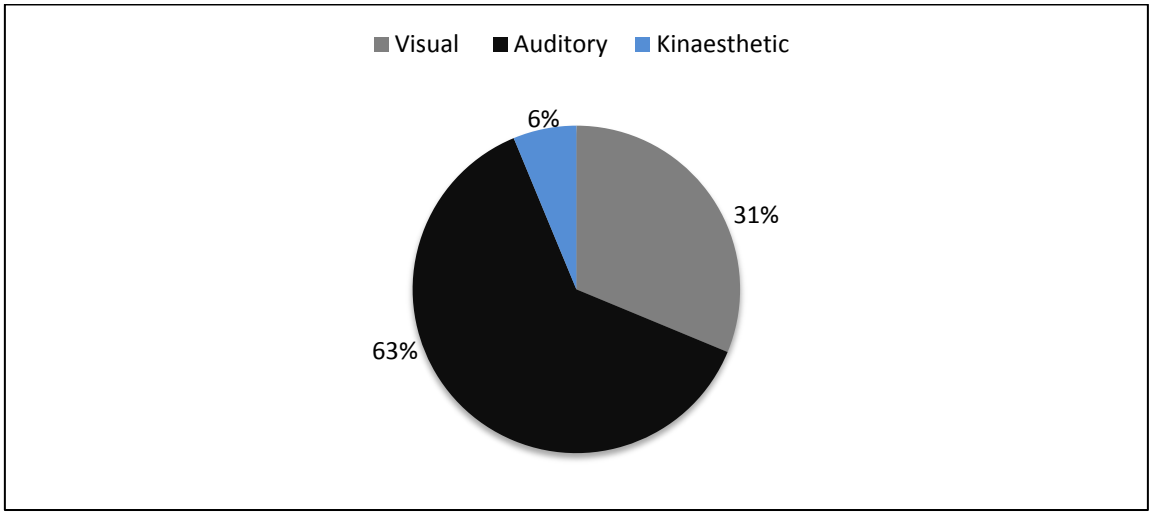

Figure 6: Figure 6 shows the average percentage of questions answered incorrectly whilst testing a sample of 30 pupils individually on the three week review.

63% of incorrect answers came from the sample of ten children taken from the auditory lesson. 31% of incorrect answers came from a sample of ten children

taken from the visual lesson. Only a very small proportion of incorrect answers came from the kinaesthetic lesson, with only 6% of incorrect answers coming from the sample of ten children from this lesson.

Chapter 6: Discussion

6.1 Kinaesthetic

In the Bricheno and Younger (2004) study the teachers had concerns regarding behavioural management relating to kinaesthetic learning techniques. These concerns were relevant to this study, as the kinaesthetic lesson was the hardest lesson to deliver and maintain a level of control over the learners.

There was quite a high level of disturbance created by the rest of the class because when the learners introduced themselves and acted out their animal in front of the class a number of the children sitting down watching lost interest and started chatting amongst themselves. Despite this, each group that were acting out remained fully engaged in the activity. This could suggest why each of the objectives of the lesson were fully understood and retained by the individuals in the kinaesthetic lesson. Regardless of the perceived classroom management issues, learning appears to have been particularly effective.

The information that the pupils learnt in the kinaesthetic lesson showed an improvement of 17.75% whilst being tested for short term retention, with this improving further whilst testing for long term retention to 18.75% (see fig 5), resulting in 100% of the young learners answering correctly.

These outcomes show a very good improvement from baseline knowledge and excellent retention rates. This learning style was the most effective for teaching this age group of children that are 7-8 years of age.

Whilst testing the learner's only question 4 (see fig 3) was answered incorrectly. It can be assumed that the children had three weeks to process the information learnt, and as stated in the research by Hayes (1999) allowed the process of deep learning to take place to enable the young learners to accurately answer the questions on the three week review. This could explain the 1% increase in correct answers whilst testing for long term retention.

In the study by Bricheno and Younger (2004) only 17% of young learners tested were identified as kinaesthetic learners. In this study it is evident that a larger proportion of the young learners can be classified as kinaesthetic learners, due to the 100% long term retention rate and largest consistent increase from baseline knowledge of 18.75% (see fig 5).

Potential reasons for these contrasting results might be because the Bricheno and Younger (2004) study was conducted eight years ago and there may have been more emphasis for this generation to read books and well-constructed literature. Whereas in the present day technological advancements surround many children and young learners receive more time and exposure to videos games and television. Young learners will therefore tend to show higher preferences for kinaesthetic and visual learning, which has been demonstrated in the results.

The trends found in the class questionnaires were repeated in the individual testing carried out on the sample of the young learner's. Only 6% of incorrect answers came from the kinaesthetic young learners in comparison to 31% of wrong answers coming from the visual learners and 63% wrong answers coming from auditory learners (see fig 6). This supports the results found in group testing and suggests that each individual had retained the information and deep learning had occurred in the kinaesthetic lesson.

These results are in agreement with Bartholomew, Osborne and Ratcliffe (2002) where experimental role play allowed the learners in the kinaesthetic lesson to develop a deeper understanding of the environmental issues that were being presented to them. Further to this the learners were likely to have established a simple body based memory system as suggested by Roberts (2002) due to the tactile nature of the lesson.

One learner interviewed from the kinaesthetic lesson expressed that the lesson did provoke them to think more deeply about recycling, however, stated that it did not encourage them to change their behaviour. The second learner interviewed from the kinaesthetic lesson, stated that they did not see the point in the lesson, but then decided they did see the point because they like animals. However, it was clear that no ecocentric viewpoint had been generated.

6.2 Visual

The visual lesson was the easiest to deliver as the young learners appeared to be fully engaged throughout the 1.5 hour lesson. They were very receptive to the visual stimulus such as the guessing the endangered animals PowerPoint and silent videos; this may have been due to the fact that children are not often exposed to the concept of silent videos.

The learners displayed great levels of enthusiasm and discussed amongst themselves about the various tropical fish, plants and animals that appeared on the screen. This gave the opportunity to listen and gauge to how the learners were responding to watching the silent videos.

This study is in agreement with the suggestions made by Bricheno and Younger (2004) because using films and pictures allowed the learners to create a visual connection with the endangered animals and habitats.

The learners from the visual lesson showed quite a high level of baseline knowledge of 91.75% in comparison to the other two classes.

The learners from the visual lesson showed good short term retention rates of 100% (see fig 5), the use of representing what they had learnt through drawing was an effective method. This seemed to become more effective than the auditory method of writing a poem. The results from the visual lesson still showed good levels of long term retention with 98.25% of the young learners answering correctly (see fig 4) despite not meeting the same outcomes of deep learning that had taken place in the kinaesthetic lesson.

The results show that children's knowledge improved on questions 1, 2, and 4. However, for some reason question 3 did not produce the same consistent level of long term retention.

There may have been a slight misconception generated in the visual lesson because some of the young learners thought that the reason why habitats are getting destroyed is because of 'the internet'. This is why the amount of correct answers declined 1.75% from short term retention. The correct answer to this question was 'pollution'. This misconception could have been generated in the visual group because of ideas being generated about remembering to turn of computers and not using too much electricity.

This misconception could have been enhanced in the visual lesson because the interactive white board and internet were used to deliver the lesson, so there was a direct connection with this issue. This could perhaps be overcome by careful use of language or further explanation of the term.

The two learners from the visual lesson that were interviewed, both shared similar viewpoints of the lesson, both expressed an enjoyment for the lesson. However, they both stated that it made them feel the same as they did prior to being taught. It did not encourage a shift in their moral viewpoint.

6.3 Auditory

The learners in the auditory lesson responded very well to the stimulus. They listened and paid attention whilst the story was being read, every few paragraphs the class would be asked questions based upon the story and characters to ensure that the children were grasping the content of the story and not getting confused by the African names. As stated in Pound (2008) children can find it difficult to grasp the concept of formal, auditory lesson because their adult linguistics skills have not fully developed.

Furthermore, as children spend less time actively reading at home and engaging with books there is an increasing number of children that are exposed to language that is not well constructed i.e. reading magazines, texting and also an increase in illiteracy.

The storytelling was the first activity of the lesson and the vast majority of the class were fully engaged. However, it became apparent that after fifteen minutes the learners began to find listening hard as they became distracted.

This study shows similar results to the studies carried out by Tomasello (2000) and Bricheno and Younger (2004) as both state that young learners can find listening a difficult skill. This point was also demonstrated in the kinaesthetic lesson when the learners started to lose interest and did not listen to their classmates whilst they were acting out their endangered animals.

In the auditory lesson, approximately 50% of the class did not understand the written task and their poems reflected this as this example shows:

There was a tiger called Bungle,
He lived in a jungle,
He had porridge for breakfast.

Writing the poem appeared to be a challenging task for quite a number of the learners in the auditory class; this could have been due to the varying level reading and writing ability in the class.

Prior to the research a KS2 literacy lesson had been observed in Hyde Park school to attempt to gauge the general level of ability and knowledge. Therefore the exercise was not considered too difficult for this age group as some pairs produced poems of high quality.

The learners were divided into random pairs for this task and therefore it would be assumed that some of those with lowered abilities could be counterbalanced by their partner, as both could generate ideas and both help one another to write the poem.

Guessing the audio sound clips of endangered animals appeared to provoke a good response from the learners, as they appeared to enjoy this part of the lesson. A variety of animals noises where selected from the four habitats covered in each of the lessons – savannah, coral reef, jungle and ocean.

The testing for short term retention showed a good improvement of 13.25% (see fig 5). 100% young learners answered question number 4 correctly in the class questionnaire for short term retention (see fig 2). However, when tested again for long term retention there was a significant increase in the number of learners that answered incorrectly and thought that the correct answer of how to help habitats was to ‘not climb trees’ (see fig 2).

These results suggest that a significant misconception had been generated in the three week review and that the responses were dependant on the question time period p-value .014, because initially only 1 child (see fig 2) thought that not climbing on trees was the correct answer. This misconception may have been generated through the story being set in the jungle and that monkeys were climbing through the trees.

The young learners may have remembered the story because this engaged with their imagination; however, they may not have retained anything that was taught to them after this. The outcomes from the auditory lesson are in agreement with Pound (2008) in that didactic teaching is not effective for young learners in KS2 and that auditory is not a very effective learning style with poor retention rates.

Despite poor levels of retention, the children in the auditory lesson expressed a more ecocentric viewpoint whilst being individually interviewed. Bartholomew, Osborne and Ratcliffe (2002) note that the use of stories set in the context of real life issues can help children understand concepts of science and environmental issues; the study shows the effectiveness of this method and is in agreement with their research. The imaginative side of the brain was engaged in the storytelling and therefore allowed the learning to be accessed by the right side of the brain as stated in OCED (2007).

It can be assumed that the element of storytelling within the auditory lesson may have enabled some learners to develop Cartesian thinking. However, the other methods used in the auditory lesson such as writing poems, and class discussions were not as effective. The majority of learners did not remember the correct terminology, and got the largest percentage of questions wrong whilst being tested for long term retention.

One of the learners in the auditory lesson expressed that the lesson encouraged them to think more about recycling and being environmentally friendly, however, it did not encourage a change in their behaviour. The second learner to be interviewed stated that the lesson had taught them a great deal more and improved their knowledge, as well as encouraging them to recycle more at home and change their behaviour.

6.4 Fair testing

The easiest method of measuring how much knowledge the pupils had of endangered animals was through a class questionnaire. This approach could have generated problems for fair testing because some of the learner's answers could have been influenced by peers. The issue of fair testing was mitigated through conducting the learners to carry out the class questionnaires in absolute silence and individual questionnaires.

It became apparent that some of the learners chose the incorrect answers just to amuse their classmates, purposely selecting a different answer once the vast majority of other children had chosen their answers. The class teachers picked up on this issue and the children were asked to carry out the questionnaire properly and choose what they thought was actually the correct answer.

Firstly, one learner in the visual lesson continually selected the wrong answers before the lesson and on the three weeks review; this was thought to be the case because they wanted to amuse peers. However, this child was specifically asked to come out for individual questioning on the three week review and answered 3/4 questions incorrectly (see fig 1).

It was therefore assumed that this learner may have been slightly less engaged with the lesson because of a lack of concentration explaining the reason for the questions still being incorrectly answered even when the element of peer pressure was removed.

The second learner answering incorrectly after the lesson was in the kinaesthetic class. After discussions with the class teacher it was made apparent that this learner was not comfortable being around large groups of children but responded much better to one-one contact, especially with adults.

This learner was also selected for individual questioning and answered 3/4 questions correctly. This demonstrates that the child either purposely chose the wrong answer in order to not be around the other children, or genuinely did not know the answer but after having three weeks to process the lesson perhaps understood the concepts of what was taught more deeply. Interestingly, when the final class questionnaire took place this learner answered all questions correctly,

therefore may of felt more comfortable around peers to be influenced by their decisions as they answered 4/4 questions correctly (see fig 3).

The learners that were asked individually were not told whether they answered correctly as to not influence class questionnaire results.

6% of incorrect answers came from the kinaesthetic group on individual testing, however, none of the young learners answered incorrectly when tested as a class (see fig 6). Therefore, it can be assumed that the learners answering incorrectly had realised their mistake when being asked a second time or were influenced by the decision that the majority of their peers selected.

The outcomes from this research are valid because each class has been tested in the same way, and the individual questionnaires support the findings from the class questionnaires, and followed the same trends.

Two young learners were selected at random and asked to participate in semi-structured interviews. Questions such as 'Did you enjoy the lesson? Did the lesson make you think differently about endangered animals and habitats? Did the lesson make you think you could make a difference and change your behaviour at home?' were posed to the learners (due to time constraints the individual questioning and semi-structured interviews was limited).

Conducting the individual questionnaires revealed that 95% of the learners remembered the lesson and could briefly explain the content of the lesson without any guidance.

Whilst conducting the semi-structured interviews the children were asked to express their true opinions i.e. if they did not enjoy the lesson or felt what was taught was useful. This was to get a true insight into the learners' views of the lessons.

6.5 Limitations of the study

There are limitations within this research due to time restrictions. The report by Joiner and Smith (2008) indicates that a deeper learning experience will take place if the process is slow and carried out over a long period of time.

The limitation of time within this study does though represent the difficulties of implementing environmental education within the curriculum. Therefore by trying to identify the most effective learning style from the VAK model there is hope that educators can strongly influence moral viewpoints in relation to environmental issues even if they only have one scheduled lesson to teach this. This study has contributed towards the scientific literature on the effectiveness of learning styles as stated by Rayner (2007).

A number of learners were taken out for music lessons whilst the auditory lesson was being delivered and therefore these children were not taken into consideration whilst conducting the class questionnaires because this could influence the results. Furthermore, because the auditory was the final lesson to be delivered this could

have impacted upon the quality of the delivery of the lesson, and may have impacted upon some of the results.

There are further limitations within this research because to conduct a fair test, ideally there would be equal baseline knowledge in each of the three classes. However, this is an uncontrollable variable. The learners in the visual lesson had 11% higher baseline knowledge than the auditory and 10.5% higher than the kinaesthetic young learners (see fig 4). Because of this there was a limit to number of learners that could access new information taught in the visual lesson. Despite this uncontrollable variable, visual only achieved 98.25% of correct answers, unlike the 100% long term retention rate experienced in the kinaesthetic lesson (see fig 4).

The visual lesson showed a 4% increase in long term retention in comparison to the auditory lesson (see fig 5). This increase could be explained by the higher baseline knowledge in the visual class. However, despite having lower baseline knowledge there is a 12.25% increase in the kinaesthetic lesson (see fig 5), therefore the presence of higher baseline knowledge is not an important factor when considering the most effective learning style for this age group (7-8 years of age).

Separating each of the VAK learning styles is very difficult as stated in the Bricheno and Younger (2004) study. However, this research managed to ensure that the objectives of the lessons were delivered predominantly through each of the learning styles and they could be clearly separated into the three different styles despite some inevitable cross-over.

6.6 Engaging young learners and wider audiences

Tilbury (1995) states the importance of engaging pupils in environmental science. Through carrying out semi-structured interviews it became clear that a feeling of environmental responsibility appeared to have been developed in the auditory lesson. Therefore to some extent the lesson had fulfilled the “main goal of environmental education” as stated by Gigliotti (1990) & Hungerford and Yolk (1990) as recognising one’s self as part of the solution.

The semi structured interviews also validated that producing masks, booklets and poems that the learners were allowed to take home allowed intergenerational learning to take place as stated by Ballantyne, Fien and Packer (2001). “I found the lesson useful and always have to remind my mother to put rubbish in the right bin” a quote from a learner in the auditory lesson.

After discussions with the class teacher of the visual lesson it was discovered that there was a wide variation of how parents respond to lessons that cover environmental and social issues. The learners had been previously taught about fair-trade and had been shown a balanced viewpoint enabling them to make their own choices about fair-trade items. One learner refused to consume any produce that was not fair-trade, and the school received negative feedback from the parent because their child was not eating the food that they could afford to buy.

This is an example of how it is difficult to strike a balance between educating children and actually allowing them to express what they have learnt within their

home environment. Conflicting views from parents can cause problems and discourage children from generating a more ecocentric point of view.

Despite this it remains vital that children are educated about environmental issues because it can encourage a more innate response when they mature into adults.

This research found that suggestions made by Tilbury (1995) to achieve active learning and to use imagination such as role play, media, and games were effective ways of engaging young learners.

This study found that using the transdisciplinary approach as suggested in the Boyle and Bragg (2005) report can allow young learners to more easily access complex subjects such as environmental education more easily through use of art, drama, mixed media, and English.

6.7 Effectiveness of learning styles to enhance environmental education

Evidently the best learning retention rates were shown in learners from the kinaesthetic lesson, with 99% and 100% retention rates (see fig 4). Therefore, this research is in agreement with Beggs and Murphy (2005) to recommend that "hands on techniques" are most suitable for young learners.

The individual semi-structured interviews provoked interesting responses from the young learners. One learner from the kinaesthetic lesson began by stating that "they enjoyed making the masks but did not really see the point in the lesson" however, once they continued talking they changed their mind and decided that the "lessons were valuable and could how the lessons were important, but it did not make them change their behaviour".

The learners from the auditory lesson however expressed a different viewpoint and it had encouraged them to change their behaviour at home. Thus suggesting that the use of storytelling as suggested by Bartholomew, Osborne, and Ratcliffe (2002) can have a profound impact on young children due to their capacity to imagine and relate to the story. Therefore, in a sense the story has managed to provoke a greater outcome then seen in the visual and kinaesthetic lessons.

The use of storytelling may have enabled learners to draw conclusions independently and begin to seek solutions unlike those in the visual and kinaesthetic lesson that had possibly compartmentalised the learning but not internalised it in order to form a considered moral viewpoint.

Chapter 7: Conclusions and recommendations for further study

7.1 Conclusions from the study

The findings from the study correlate with the trends found in the research of Bricheno and Younger (2004) stating that 40% of the UK population tend to be more predominantly kinaesthetic learners. Furthermore, visual learners represent 30% of the population and auditory represent 25%.

This report is in agreement with Pound (2008) that formal and logical learning is not suitable for young learners, until their ability to read and write fully develops

and they can then start to access more disciplined styles of learning such as auditory. This point is demonstrated in this research because the auditory learning style showed the poorest long term retention rate, with only a 2.25% increase from baseline knowledge (see fig 5).

Despite clear evidence that kinaesthetic is most effective because of the largest improvement from baseline knowledge, 17.75% and 18.75% (see fig 5) it has become apparent that the learners in the auditory lesson were able to make a humane connection with the issue of endangered animals which was expressed in the semi-structured interviews. It is assumed that the use of the story enabled the young learners to relate with the endangered animals issue on a different level, encouraging a more ecocentric viewpoint.

This is an important finding because this study is trying to recognise the learning style from the VAK model that is most effective for enhancing environmental education. It is clear though that the children did not retain the meanings of the scientific terminology that was taught to them and a misconception was generated that only occurred in the auditory lesson so therefore auditory teaching techniques are possibly not as concise and reliable as visual and kinaesthetic.

Auditory techniques should be used with caution because as this study suggested misconceptions can be easily generated and long term memory retention is very low.

The findings from this study are in agreement with Hayes (1999) which suggests that young learners should have the opportunity to have fun in the classroom whilst feeling a sense of exploration. Therefore the use of teaching methods such as practical work, stories, drama, artwork, and games can engage young learners and enhance environmental education for KS2.

7.2 Recommendations for further work

Combining the work of Fossett (2008) and the information gained in this research a recommendation for further research would be to create an environmental education pack that is predominantly based upon kinaesthetic learning techniques with the inclusion of a story using visual aids. This improved learning pack could be tested in schools to measure the effectiveness and more follow up research could be conducted in order to measure the effectiveness the lessons have had in the home environment.

It would be interesting to deliver these lessons to secondary school students and to actually gauge if the content of the lessons had encouraged them to change their behaviour. This could also generate problems though because young adults can be more preoccupied with their own problems and making friends, finding their place in the world.

Another recommendation would be to return to the learners from Hyde Park school and investigate why the misconception of climbing trees was generated as this would provide useful insight into the effectiveness of the auditory lesson.

References

Ballantyne, R.R., Fien, J.M., and Packer, J. (2001) School Environmental Education Programme Impacts upon Student and Family Learning: A Case Study Analysis. *Environmental Education Research* **7**(1), 23-27.

Ballantyne, R.R., and Packer, J.M. (1996) Teaching and learning in environmental education: Developing environmental conceptions. *Journal of Environmental Education* **27**(2), 25-30.

Bartholomew, H., Osborne, J., and Ratcliffe, M. (2002) *Teaching pupils 'ideas-about-science': case studies from the classroom*. *Evidence-based Practice in Science Education*. London: (EPSE) Research Network.

Beggs, J., and Murphy, C. (2005) *Final Report to the Welcome Trust: Primary science in the UK: a scoping study*. Belfast: University of Belfast.

Boyle, B., and Bragg, J. (2006) A curriculum without foundation*. British Educational Research Journal* **32**(4), 569–582.

Boyle, B., and Bragg, J. (2005) No science today - the demise of primary science. *The Curriculum Journal* **16**(4), 423-437.

Bricheno, P., and Younger, M. (2004) *Some unexpected results of a learning styles intervention*. Manchester: Paper Presented BERA Conference.

Cassidy, S. (2004) Learning styles: An overview of theories models and measures. *Educational psychology* **24**(4).

Fossett, K. (2008) *School project: Encouraging Environmental Education and Sustainability in Primary Schools.* Plymouth University.

Gigliotti, L.M. (1990) Environmental education: What went wrong? What can be done? *The Journal of Environmental Education* **22**(1), 9-12.

Hayes, D. (1999) Planning*, Teaching and Class Management in Primary Schools*. London: David Fulton Publishers.

Hungerford, H.R., and Yolk, T.L. (1990) Changing learner behavior through environmental education. *The Journal of Environmental Education* **21**(3), 8-21.

Joiner, W.M., and Smith, M.A. (2008) Long-Term Retention Explained by a Model of Short-Term Learning in the Adaptive Control of Reaching Adaptive Control of Reaching. *Journal of Neurophysiology* **100**(5), 2948-2955.

Jolley, B.P. (2010) *Children & Pictures – drawing and understanding*. *Visual Pictures & recall.* Cambridge: Wiley- Blackwell.

Miliband, D. (2004) *Personalised learning: Building a new relationship with schools.* UK: Department for education and skills Conference pamphlet.

OCED (2007) *Understanding the Brain: The Birth of a Learning Science Centre for Educational*. UK: Research and Innovation.

Pound, L. (2008) *How children learn- from Montessori to Vygotsky – educational theories and approaches made easy*. London: Step Forward Publishings.

Rayner, S. (2007) A teaching elixir, learning chimera or just fool's gold? Do learning styles matter? *Support for Learning* **22**(1).

Rickinson, M. (2001) Learners and Learning in Environmental Education: a critical review of the evidence. *Environmental Education Research* **7**(3).

Roberts, J. (2002) Learning preferences and pupil attainment: an investigation into improvement strategies. Copenhagen: ICSEI.

Sharpa, J.G., Bowkerb, R., and Byrnec, J. (2008) VAK or VAK-uous? Towards the trivialisation of learning and the death of scholarship. *Research Papers in Education* **23**(3), 293–314.

Smith, A. (1999) *Accelerated Learning in Practice*. London: Network Educational Press.

Solomons, J. (1993) *Teaching science, technology and society. Developing Science and Technology Series.* Bristol: Taylor and Francis.

Tilbury, D. (1995) Environmental education for sustainability: Defining the new focus of environmental education. *Environmental Education Research* **1**(2).

Tomasello, M. (2000) Do young children have adult syntactic competence? *Cognition* **7**(4), 209-253.