

**THE ECOLOGICAL FOOTPRINT AS AN ENVIRONMENTAL
EDUCATION TOOL FOR KNOWLEDGE, ATTITUDE AND
BEHAVIOUR CHANGES TOWARDS SUSTAINABLE LIVING**

A case study

by

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“We do not know exactly what the result will be of running this massive overdraft with the Earth. What is clear though is that it would be better to control our own destiny, rather than leave it up to chance.”

Jonathan Loth (The Living Planet Report, 2002)

Abstract

The investigation used the Ecological Footprint as an educational tool to assist Environmental Management and Water Care learners at Technikon Northern Gauteng, Soshanguve learners in gaining insight in their consumption of natural renewable and non-renewable resources and generation of wastes. In addition, it also aimed to assist them in understanding the ecological impacts of their behavior on the available international and national productive land and thus on planet earth.

The results of the investigation indicated a significant decrease in the post-test questionnaire knowledge, attitude, and behaviour scores of the learner group. The implication however was clear; the Ecological Footprint did not directly have an effect on the attitude and behaviour of the learners but indirectly influenced the knowledge base of the learners, which then should have an impact on their attitude and behaviour over time.

The Ecological Footprint could thus be an educational tool that could be incorporated into the curricula of the two academic programs at TNG, *viz* Water Care and Environmental Management for increasing knowledge and improving the attitude and behaviour of learners towards a more sustainable lifestyle.

Key terms:

Ecological Footprint; Sustainable Development; knowledge; attitude; behaviour; educational tool; Environmental Education

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Education is an essential tool for achieving sustainable living and Sustainable Development. Public awareness, education, and training are the keys to moving any society towards sustainability. However, it is essential to distinguish between education about and Education for Sustainable Development. Education about Sustainable Development is a lesson in awareness, while the Education for Sustainable Development will be the use of education as a tool to achieve sustainability. Education for Sustainable Development calls thus for providing people with knowledge and skills for lifelong learning to help them find new solutions to their environment, economic and social issues (McKeown, 2002:6).

1.2 BACKGROUND TO THE PROBLEM AND INVESTIGATION

Five years ago in Rio de Janeiro, the United Nations Conference on Environment and Development (UNCED) - better known as the Earth Summit - produced an unprecedented vision for guiding the world community towards a more secure, equitable and sustainable future. That vision, and the agreements that resulted from it, called for a new global commitment to Sustainable Development - economic growth that meets human needs while protecting nature's ability to renew itself.

However, in spite of the Earth Summit's initial success much more has to be done to translate the Earth Summit commitments into realities. Greater cooperation is needed at the international level to deal with global issues, particularly those dividing developed and developing countries. To develop the necessary social, political, and financial capacity required to operationalize Sustainable Development, appropriate governance, management and delivery systems are urgently needed, especially at the national and local levels.

Partnerships between different actors of civil society to exchange relevant information, negotiate with governments, and contribute meaningfully to decision-making processes must be established. Furthermore, political space must be created to discuss issues relating to public interest.

To support and strengthen these objectives, several organizations pursuing the goals of sustainability have launched the Rio+5 global campaign. The purpose of this campaign is to translate Sustainable Development from agenda to action. The Rio+5 Forum study commissioned and financed by The Earth Council (www.ecouncil.ac.cr/focus/report, s.a.), found that humanity collectively uses more than one third of the resources and eco-services generated by nature. The fact that humanity is not living within the supplied ecological means will lead to the destruction of the earth, the only home of humanity. Most people are however ignorant of their direct and indirect impact on the limited natural resources and the earth's carrying capacity (Simmons, 2001). The direct results of not living in a sustainable way and having insufficient natural resources at one's disposal leads to conflict and a degradation of the social fabric.

Human beings have an impact on earth and all its ecosystems through consumption of natural renewable and non-renewable resources and generation of waste products that need assimilation. This impact corresponds with the amount of nature occupied by each person to keep him/her alive. Alarmingly, the population on earth has doubled since 1960 to 6.1 billion with the greatest increase in the poorer countries, while the consumption expenditure has more than doubled since 1970 especially in richer, more developed countries (Biosphere, 2002:5).

As humanity's behavioural patterns can either lead to environmental degradation or contribute towards Sustainable Development, it is essential to determine how people perceive and relate to the environment in order to identify behavioural patterns. This will enable the people to address any negative patterns and change their behaviour to be more sustainable within the carrying capacity of earth (Fiedeldey, Craffert, Fiedeldey-VanDijk, Marais, van Staden and Willers, 1998).

1.3 RESEARCH PROBLEM

Bearing the above-mentioned facts in mind, the following questions emerged:

- How can the Water Care and Environmental Management learners of TNG be educated about environmentally related issues at hand in order to increase their knowledge?
- How can the Water Care and Environmental Management learners of TNG be motivated to change their behaviour, attitudes, and lifestyles to live more sustainably or within the carrying capacity of the earth?
- Can the Ecological Footprint be incorporated at TNG as an Environmental Educational tool to facilitate learning and changes in attitude and behaviour of learners?

1.4 EDUCATIONAL FOCUS OF AND MOTIVATION FOR THE INVESTIGATION

According to the South African White Paper on Environmental Education (Department of Environmental Affairs, 1989:5), the aim of Environmental Education is to “*stimulate education processes that develop responsible lifestyles in harmony with the environment as a whole*”. Furthermore, it supports the objective that it will “*motivate people to accept responsibility for the environment and to cultivate the necessary knowledge and values in order that solutions may be found for identified problems*”.

The following principle of the Department of Environmental Affairs and Tourism (1989: 6) supported the approach followed in this research investigation:

“Encourage active participation in learners of all ages by using

diverse learning environments, a broad spectrum of educational approaches, and all the available teaching aids to prevent and solve environmental problems"

One can draw holistically from teaching aids and resources in a wide range of social and natural science disciplines in order to demonstrate the root of current environmental problems and suggest ways in which learners could either prevent or remedy these. The decision to use these aids and resources ideally should be based on one or more of the criteria listed below:

- Be standards based (based on the specific instructional offerings or programmes);
- Contain hands-on activities that lead to problem solving and critical thinking;
- Have community-based instruction (i.e. solving real life problems in the learners' own communities);
- Be interdisciplinary;
- Include authentic assessments;
- Be appropriate for the specific age group;
- Use inquiry-based approaches;
- Use scientific processes to investigation interactive systems;
- Serve all learners (address all social, cultural, and physical diversities);
and
- Promote independent thinking (Patton, 1999).

The Ecological Footprint is a consistent tool of high quality that was developed

by Redefining Progress and conforms to most of the criteria listed above (Wackernagel and Rees, 1996:24). The Ecological Footprint aimed to advocate the fact that if you broaden your knowledge, it should have an impact on your attitude and/or behaviour and subsequently your lifestyle choices. The proposed investigation thus made use of the Ecological Footprint as an educational tool to promote Sustainable Development and responsible living in the proposed population at TNG. The results obtained from the investigation would only give an indication of the usefulness of integrating the tool into the curriculum of the two academic programmes at TNG, viz., Water Care and Environmental Management.

1.5 **AIMS AND OBJECTIVES OF THE INVESTIGATION**

The main aim of the proposed investigation was to create awareness in the proposed population by increasing their knowledge and changing their attitude and behaviour in order to live within the carrying capacity of the earth i.e., live more sustainably. Thus, the aim was to make Environmental Management and Water Care learners at Technikon Northern Gauteng, Soshanguve, aware of and offer them the opportunity to gain insight into the ways that they consume the natural renewable and non-renewable resources and generate wastes. In addition, it also aimed to assist them in understanding the ecological impacts of their behavior on the available international and national productive land and thus on planet earth. This educational action would hopefully have lead to an appreciation of sustainable practices, policies, and designs and give the learners insight into global realities.

In order to achieve these aims, the research objectives of the proposed research were to:

- apply a pre-test questionnaire to determine the learners' knowledge of and their attitude and behaviour towards their specific environment;

- calculate the Ecological Footprint of Environmental Management and

Water Care learners at Technikon Northern Gauteng's (TNG) main campus, using The Living More Lightly Profile (Appendix II);

- compare the calculated Ecological Footprint of each Environmental Management and Water Care learner with the average South African and African Ecological Footprint scores;
- compare the calculated Ecological Footprint of each Environmental Management and Water Care learner with the average global Ecological Footprint;
- report analysed results to each participating Environmental Management and Water Care learner and make the learners aware of the effect of their Ecological Footprints on earth and its limited resources. In addition, enlighten learners on the concept of Sustainable Development;
- suggest action plans on how to reduce their Ecological Footprint (Ecological Footprint savings) and increase Sustainable Development in their daily lives; and
- apply the post-test questionnaire to determine any change in their knowledge, attitude, and behaviour towards their environment after the interventions mentioned above was applied.

1.6 CONTENT CLASSIFICATION

In order to provide a global view of the investigation, the proposed content classification of the thesis consisted of the following:

Chapter 1: Exordium

Chapter 2: Literature overview

Chapter 3: Research design

Chapter 4: Data analyses, interpretation and discussion

Chapter 5: Conclusions and recommendations

References

Appendices

1.7 **SUMMARY**

The preceding chapter introduced the background to the research problem and motivated the necessity for the investigation. The aims and objectives of the study were introduced. Chapter 2 will give an overview of the essential points that relate to the study and that supports the investigation as found in the cited literature.

CHAPTER 2

LITERATURE OVERVIEW

2.1 INTRODUCTION

Environmental Education and Sustainable Development are inseparable concepts. Environmental Education plays a major role in trying to ensure that human beings live sustainably on earth. It provides knowledge about the environment, inculcating a positive attitude and responsible behaviour towards the environment as well as a lifestyle that contributes towards Sustainable Development. This chapter provides an overview of literature consulted and cited on the various variables related to the investigation.

2.2 LEARNING AND ACQUIRING KNOWLEDGE

According to Papalia and Olds (1992:332), learning can be defined as a relative permanent change in the behaviour of human beings, resulting from various experiences. Learning is the act, process, or experience of gaining knowledge or skills. Learning helps us move from novice to expert and allow us to gain new knowledge and abilities. Learning also strengthens the brain by building new pathways and increasing connections that we can rely on when we want to learn more. Definitions that are more complex add words such as “comprehension” and “mastery” through experience or study.

Learning begins from the moment of conception. Although everyone is born with the ability to learn, learning only really takes place through experience and adaptation to the environment. Learning, however, should not be defined by what happened earlier in life, it should be a lifelong process. One should constantly make sense of one’s experiences and search for meaning. In doing this, you continue to learn. Certain neurological, sensory, and motor capacities should be present and maturation should occur before any related learning can occur. Maturation implies the unfolding of patterns of behaviour in biologically

determined age-related sequences that are programmed by the genes.

Learning usually occurs through three processes: habituation; classical conditioning; and operant/instrumental conditioning. Habituation can be described as a process where the individual is repeatedly exposed to a particular stimulus, which then results in a reduced response to the specific stimulus. It is a simple form of learning as there is an alteration of the behaviour based on the experience.

Pavlov's experiments with dogs describe classical conditioning. In this process of learning, a person learns to respond to an originally neutral stimulus. The person now anticipates events instead of just reacting on them after they occur.

On the other hand, operant or instrumental conditioning illustrates that the person learns to make a certain response in order to get a pleasing reaction (Papalia and Olds, 1992:333). Most learning involves more than cognitive material (ideas and concepts). Little substantive learning takes place without involving something of all the three processes. Learning also involves having feelings about the concepts (emotions) and doing something (action). These elements need not be distinctive. They can be, and often are, integrated (Connor, *et al.*, 1996).

Three perspectives can be identified in the learning process: psychometric; Piagetian or cognitive; and information-processing. Psychometric approaches try to determine and measure the factors that make up an intelligent/learned human being. The Piagetian or cognitive approach deals with the growth in the thought processes that enable people to acquire and use knowledge about the world. Jean Piaget claims that active learning only takes place if one uses old knowledge to develop new solutions through solving concrete and real problems (Kelley-Laine, 1997). The information-processing approach sees people as the manipulators of perceptions and symbols. The goal of the approach is to discover what people do with the information from the time they perceive it until they use it (Baron and Byrne, 2000:25).

According to Bennett (1987) knowledge is one's ability to recall information stored in your memory, whereas understanding refers to the comprehension of

meaning and information and the ability to explain it to others. To acquire knowledge the learner must gather the content and data that is being considered. This involves memory, repetition, and description, and includes the use of appropriate materials, methods, techniques, facts, and theories (Van den Aardweg and Van den Aardweg, 1993:34).

2.3 ATTITUDE AND VALUES

Attitudes are a tendency to respond negatively or positively towards a certain situation, idea, object, or person. It is related closely to our beliefs and opinions and is based on experiences (Smith, 1996). Baron and Byrne (2000:125) see attitude as an ambivalent evaluation of any aspect of the social world; thus evaluating it both negatively and positively. Our attitudes reflect our feelings towards situations or objects and include many emotions that subsequently influence our value systems (Bennett, 1987:12).

Our attitudes are often acquired through social learning and formed because of social comparison (Baron and Byrne, 2000:125). An important factor in the acquisition of attitudes is the homogeneous expression of any attitudes and values in a learner's environment; i.e. no expression of conflicting attitudes that can confuse the learner. For example, our exposure at home will compliment the attitudes and values outside the home environment. This exposure will be selective because of class, education, and parents' occupation amongst others. This selectivity will eventually extend into adulthood where each social group will have a set of norms accepted by reference groups with constant pressure to conform to these norms. The acceptance of a new opinion and hence attitude formation is largely dependent upon incentives that are offered in the education process, i.e. a prosperous future for all if we look after the earth's resources (Smith, 1996).

According to Clacherty (1992), attitudes and values can develop through learner-centered, active, and experiential approaches to learning. These learning experiences should however be constructed and executed very carefully. The experience of other people's ideas and opinions and having

unrestricted and non-subjective choices, is of the utmost importance in the development of values and attitudes (Baron and Byrne, 2000:155).

The changing of attitudes is a difficult exercise, but it can be achieved through persuasion, imitation, observation, evaluation, conditioning, thinking, and learning. It will however, take a great deal of learning or acquiring knowledge to develop or change one's attitude as both systematic and heuristic processing will be involved in this action (Van den Aardweg and Van den Aardweg, 1993:28; Baron and Byrne, 2000:155).

The measurement of the change in attitude can be done in one of two ways; viz., through questionnaires and attitude scales or through self-reporting and observation, as in peer appraisals for example.

2.4 BEHAVIOUR

Behaviour implies the actions performed by, and thoughts that occur in the minds of individuals, i.e. their feelings, beliefs, memories, and inferences. According to Baron and Byrne (2000:32), five categorical factors play a role in the behaviour of people namely: (i) the actions and characteristics of other people; (ii) cognitive processes; (iii) environmental variables and their impact on the physical world; (iv) cultural contexts; and (v) biological factors. People are strongly influenced by the visible characteristics, appearances, and actions of others. People would rather be associated with beautiful, attractive people or with well-known or famous persons, than with unattractive or unknown persons. Their actions and behaviour are thus very strongly dependent on the memories of people's past behaviour and the inferences about the truth of their behaviour. It is imperative that we understand the thinking of people under certain conditions, to be able to understand their behaviour in these situations.

The physical environment has been proven to influence our feelings, thoughts, and behaviour. This includes ecological variables where a clean and a dirty environment will be acted upon differently by people in different situations. Behaviour does not occur in a cultural vacuum. It is strongly affected by cultural

norms, membership to various groups, and changing social values. Lastly, biological factors such as genes play an important role in the behaviour of individuals. This links with the other categories where actions, characteristics, appearances, norms, association, human models, and other aspects will be dictated by the genes of each group or individuals.

Human behaviour is difficult to predict and it is assumed that individual constructs such as knowledge or attitudes cannot predict behaviour (Cottrell and Graffe, 1997). However, these individual constructs can collectively predict possible behaviour of people. Changing behaviour is very difficult, but when it is successful, the impact is long-term (Southbound, 2000). Behaviour is controlled by stimulus and consequences of the reactions on the stimulus. The implication is that if consequences are negative, behaviour might change (Van den Aardweg and Van den Aardweg, 1993:31). Authentic learning and lasting behavioural change comes because of adapting to our environment and experiencing new things. To evolve, we must be flexible and adaptable when needed.

2.5 INTERRELATIONSHIPS BETWEEN VALUES, ATTITUDES, AND BEHAVIOUR

Beliefs are seen as the knowledge or opinions a person has on an issue, attitudes are the emotions and evaluations with respect to the issue, intentions are the behavioural aims, while behaviour involves the action itself. Research by Hungerford and Volk (1990) focused on the linear model that assumed that knowledge is linked to attitude and attitudes to behaviour, while Ajzen and Fishbein (1980:8) developed a theory of reasoned action and distinguished clearly among the concepts of beliefs, attitudes, intentions, and behaviour. These authors postulated that there is a specific pattern of effect relations between the four concepts. Actual behaviour is seen to be, firstly, a function of intentions and secondly, one of attitudes that are in turn affected by knowledge.

Behaviour in a contemporary society is driven by new information, i.e. the information acts as a catalyst for change in behaviour. The information should

be formulated in ways that ideally keep a person's attention and actively involves him/her. People use and shape the information gained through the participatory process and then, only then, does information really become knowledge (Southbound, 2000). Thus, information gaining is a vital but insufficient ingredient for knowledge.

People's personalities make them susceptible to socializing influences through which they develop certain attitudes and behaviours. They learn the attitudes that are acceptable to parents and peers while practicing those behaviours that yield positive results and avoid those which produce negative consequences through reinforcement of behaviour. Social learning implies that a person learns through observation, observing the rewards and punishments other people reap from their behaviour as well as deducing from their behaviour the kind of behaviour likely to be viewed positively by others; thus gaining acceptance (Southbound, 2000; Underwood, 2000:10). Baron and Byrne (2000:155) indicated that when one gives careful thought to your attitudes, intentions derived from your attitudes would strongly predict your behaviour. However, through induced compliance, behaviour can influence attitudes negatively; i.e. in instances where external factors induce a person to say or do things inconsistent with their true attitudes.

2.6 ENVIRONMENTAL EDUCATION AND ENVIRONMENTAL LITERACY

Education is the vehicle through which society prepares its citizens to carry out their responsibilities (Ramsey, Hungerford and Volk, 1992). The ultimate aim of comprehensive life long education is to shape human behaviour. Environmental Education is one process that can achieve this aim. Through Environmental Education, learners' behaviour towards society, nature, and themselves is shaped.

2.6.1 Environmental Education

Environmental Education is a lifelong and gradual process that occurs at all levels of education (both teaching and learning) and is usually systematically constructed and theoretically valid in its goals (www.eecp.co.za, 2000). It provides skills and attitudes to improve life on earth and emphasizes the interdependence between man, society, and nature. Environmental Education follows a holistic approach so that the interrelationship of knowledge, attitudes or values, and behaviours are recognized. It informs environmentally sensitive behaviour through the development of appropriate environmental conceptions.

The Tbilisi Conference on the Environment in 1977 followed shortly after the launch of the United Nations Environmental Programme (UNEP) and it clarified the nature of Environmental Education as implemented and used today. The following principles for Environmental Education programmes were endorsed at the conference:

- Environmental Education is about the interactions that occur in the natural, built, and social environment. It should lead to an understanding of how human interactions, political processes and the nature of socio-economic issues that affect environmental degradation or enhancement.
- Environmental Education can be used to develop attitudes and value systems that lead to socio-economic improvement through positive social interactions and the maintenance and improvement of the natural and built environment.
- Environmental Education aims to develop an individual's understanding, skills, and the feelings of empowerment that are necessary for both positive behaviour towards the biophysical and social environment in everyday living, and for the active participation in group efforts to find the optimal solutions for environmental problems.
- Environmental Education requires a holistic and preferably interdisciplinary approach to teaching, with opportunities for diverse

learning experiences but with particular emphasis on direct experiential learning in natural, built, and social environments.

Environmental Education is thus an educational process that is responsive to the rapid changes in the world, understands contemporary world problems, and provides the skills needed for learners and educators to play an effective role in the improvement and maintenance of the environment.

2.6.2 Aim of Environmental Education

Prasaad (2001) summarizes the general aim of Environmental Education according to the IUCN (World Conservation Union) in the following statement:

“Developing a world population that is aware of and concerned about the total environment and its associated problems and which has the knowledge, attitudes, motivations, commitments and skills to work individually and collectively towards the solution of current problems as well as the prevention of new ones.”

The ultimate aim of Environmental Education according to Ballantyne and Packer (1996) is:

“...the development of responsible environmental behaviour through supplying learners with the opportunities to acquire knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment”.

2.6.3 Goal of Environmental Education

The imperative goal of Environmental Education is to encourage people to engage in more pro-environmental behaviours that are to be used to defend and improve the environment on behalf of present and future generations of all living things. Furthermore, it should help learners become environmentally knowledgeable, skilled, and dedicated citizens who are willing to work,

individually and collectively, toward achieving and maintaining a dynamic equilibrium between the quality of life and the quality of the environment (Ballantyne and Packer, 1996).

2.6.4 Objectives of Environmental Education

According to the Tbilisi Conference on The Environment in 1977, Environmental Education encompasses the following objectives: (www.gdrc.org/uem/ee/3-2.html. s.a.)

Awareness - helps social groups and individuals to acquire an awareness of and sensitivity to the total environment and its allied problems; develops the ability to perceive and discriminate among stimuli; processes, refines and extends these perceptions; uses new abilities in a variety of contexts.

Attitudes - helps social groups and individuals acquire a set of values and feelings of concern for the environment and motivates active participation in environmental improvement, protection, and maintenance.

- Sensitivity/knowledge - helps social groups and individuals gain a variety of experiences in and acquire a basic understanding of the environment and its associated problems; i.e. how the environment functions; shows how people interact with the environment; and shows how issues and problems dealing with the environment arise and how they can be resolved.
- Skills development - helps social groups and individuals acquire skills for identifying and solving environmental problems.
- Participation - provides social groups and individuals with an opportunity to be actively involved at all levels in working towards the resolution of environmental problems.

2.6.5 Outcomes of Environmental Education

The general outcomes of Environmental Education can be formulated as follows (www.eecp.co.za, 2000):

- Learners must understand their relation to other interlinking chains of natural systems and socio-ecological processes.
- Learners must interpret conditions into their own frameworks, since much of what we learn about reality is determined and shaped by our individual world-views and backgrounds.
- Learners must be able to review conditions and uncover hidden ideologies or assumptions underlying specific problems. Knowledge on environmental issues must be built for the ultimate objective of action and practical change. That which is learned must drive the learner towards transformation.

2.6.6 Classification of Environmental Education

Three types of Environmental Education approaches and types are recognized:

- **Education about the environment** provides information about phenomena. This is an information gathering and knowledge expansion exercise e.g. formal lectures, seminars, literature searches and reviews.
- **Education in the environment** uses field studies and outdoor activities for skills development and learning. This can be practical hands-on activities, effectively a learning-by-doing exercise, where the learner gains knowledge through real life applications in the environment.
- **Education for or with the environment** is an activity directed at influencing an environmental concern or issue. This type of Environmental Education approach involves the learner in solving a real

problem in the setting it is occurring, and solving the problem with experts in the field.

All of the above types are useful and valuable, but it is encouraged to place increased emphasis on the last approach, as this approach will have a direct influence on the way people treat or manage their environment (Ministry for the Environment, 1998:11).

2.6.7 Environmental Literacy

Environmental Literacy is of central importance to any Environmental Education effort (Hurry, 1982:44). An environmentally literate person is:

- aware of his environment and sees himself as an integral part of the ecosystem he lives in;
- aware of the natural resources on which he directly and indirectly depends and has some understanding of finite and renewable resources;
- convinced of his responsibility for the sustainability and self renewal of the land;
- stimulated into positive actions in his normal day to day life;
- concerned with having a quality of life acceptable to other human beings; and
- is in harmony with the capabilities of the environment.

Clacherty (1992) suggests that an environmentally literate person will have a critical awareness of all political, social, and economical forces and their relationships with environmental quality and the quality of life. Such a person is

not easily swayed by current opinions or assumptions and acts for positive change.

2.7 ENVIRONMENTAL EDUCATION AND ENVIRONMENTAL LITERACY AND THE PERSPECTIVES UNDERLYING KNOWLEDGE, VALUES, ATTITUDES, AND BEHAVIOUR

Today's young people will be tomorrow's decision-makers. However, they are left with a plethora of major environmental problems that have serious implications for social, health, political, economic, and cultural developments. Educators are therefore obliged to include a repertoire of skills appropriate to the scale of the environmental problems learners are going to be confronted with.

The youths' views and solutions are influenced and formed through social influences of cultures and lifestyles. For example, the habits and values of family-life lead one to adopt the family's values and practices in an unquestioning way. This influence of parental behaviour on the youth indicates that there is a dire need for education of everybody in the household. Social and cultural factors such as fashion, gender, and views of peer groups also play a significant role in the development of views and solutions (Papalia and Olds, 1992: 312).

Schools have an enormous impact on how learners think about environmental issues. Environmentally illiterate learners will feel powerless if they have to think too globally. Thus, the main objective of Environmental Education must be to instill autonomy and ownership of their local environment. Environmental Education should go beyond mere defining and describing the problems, it should address implications for and of actions. This type of education will need to supply the learners with the tools and self-confidence to think and give possible solutions to environmental problems. Appreciation and understanding of other people's perspectives and points of view must also be instilled in learners.

By understanding how everyday behaviour in its widest sense is shaped, it is possible to explore new approaches to Environmental Education, where the acquisition of factual knowledge may be just one starting point. Environmental Education often requires sophisticated language and advanced reasoning skills that can be instilled in young learners who are developing and growing with age and abilities. The required language and reasoning skills can easily be built into existing curricula.

Information technologies are essential tools in achieving results and behavioural changes in people. They employ emotive or sensational messages that can be used in Environmental Education. It is often assumed that young learners are particularly perceptive to messages about the environment, because the future lies in their hands and they can make a difference.

Much Environmental Education is taught in the abstract and at a global scale (www.eecp.co.za, 2000). Today's youth receive information from the media through the advertising of consumer products as well as through contact with family members and peers. This gives contradictory messages as far as sustainability is concerned and they usually cannot interpret the essence of Environmental Education and the received messages in context of the local situations. Environmental Education needs to acknowledge and address these and other elements of our youth's everyday world and provide them with skills needed to seek out information and understand the interaction of environmental, social, and economic processes. The ultimate success of Environmental Education is to enable individuals to make educated decisions about how to achieve more environmentally sustainable lifestyles.

An Environmental Education curriculum that focuses on these skills and processes will better equip individuals to engage with the complexity of Sustainable Development. The golden rule should be to educate the youth whilst at the same time highlighting the cause and symptoms of environmental problems. A young person who is in touch with the profound realities of his/her environment will develop a creative attitude to his/her surroundings.

2.7.1 Environmental knowledge

The provision of timely and relevant information with regard to environmental issues, employment of appropriate and effective communication for motivation, supporting of people's ability to act through the acquisition of life skills, and fostering an enabling environment, can result in sustainable changes in attitudes, values, behaviour, and Sustainable Development.

Increased environmental knowledge could alter attitudes, which in turn could change behaviour. One of the striking features of the youth is the social nature of their daily experiences. The places learners visit, activities they engage in and their localities are most often framed with reference to friends, family, parents, and other relations. Tapping into actual experiences and activities and stressing the importance of own experiences and knowledge with regard to their own localities, as well as equipping them with essential skills, will serve to empower both children and adults to take control of activities and decisions that affect the future of their environment, homes and families (Papalia and Olds, 1992:300). Cottrell and Graffe (1997) indicated that a person's knowledge about the ecology has a weak relationship with his/her environmental concerns; i.e. their level of feelings and/or concern for the environment is influenced by the amount of knowledge they have about the ecology. Thus, as concerns develop, personal responsibilities should also grow and develop. For any person to act responsibly, he/she must have some knowledge about the issue in question.

2.7.2 Values and attitudes

When one addresses environmental knowledge without referring to attitudes and values held by learners, it will limit the extent to which knowledge can be translated into actions. Similarly, one cannot address environmental attitudes and values without an accurate and relevant knowledge base. This will result in the limitation of the power and/or effectiveness with which one's attitude or values are applied. Thus, it can be concluded that neither a knowledge-based nor a values-based education approach on its own will be enough to achieve

the aims and objectives of Environmental Education. A holistic approach that includes the interrelatedness of environmental knowledge, attitude, and behaviour is needed. In addition it tries to promote informed environmentally sensitive behaviour through development of appropriate environmental conceptions is needed (Ballantyne and Packer, 1996). The constructivist approach will be ideal for such a learning framework.

Critical components of Environmental Literacy is attitudes and values (Clacherty, 1992). It will be important to highlight past successes and experiences to change attitudes and behaviour toward the local environment. By enabling learners to talk about all aspects of everyday behaviour, the web of influences and factors that shape behaviour will be broadened and the view of others respected, understood, and appreciated. Learners can develop sensitivity through talking to peers, families, and friends. Furthermore, they usually make much of activities, experiences and immediate events while at the same time developing the ability to grasp synthetically generated ideas. Learners can solve problems; think and decide synthetically in order to find their own solutions; develop attitudes to conduct ideas and solutions independently; and finally acquire knowledge and technical skills in the field of their specialization (Parry and Scott, 1997: 32; Delta Environmental Centre, 1998; 1999a; 1999b).

2.7.3 Behaviour

One of the objectives of the Tbilisi Conference declaration of 1977 was to operationalize responsible environmental behaviour. A good attitude will help people to acquire sets of values and feelings of concern for their environment and motivate them to actively participate in the improvement and protection of the environment (Hungerford and Volk, 1990).

Knowledge and behaviour are rarely specifically the main objective of Environmental Education except as cognitive and behavioural components of an attitude-development strategy. There are three reasons why a values-

education approach that emphasizes attitude rather than environmental knowledge, is followed. Firstly, there is a widespread belief that positive attitudes are more important in bringing about change in environmental behaviour than environmental knowledge (Ballantyne and Packer, 1996). This is supported by Iozzi (1989), who indicated that one not necessarily uses knowledge to select the more environmentally responsible option from available alternatives. This is especially true, as it has been seen that the most educated nations leave the deepest ecological footprints or detrimental impacts on the natural resources of earth (McKeown, 2002:9).

The second reason is of comfort and accessibility. The values-education approach is supported as it “sounds” good and usually comes in readily available packages (Boyd and Bogan, 1984). Lastly, the values-based approach focuses on the process of decision-making by the learner rather than on content or outcomes. In addition, the information explosion has led many educators to question the value of teaching ever changing information (Ballantyne and Packer, 1996).

Three variables, namely perceived skills for using environmental action strategies, level of environmental sensitivity, and the perceived knowledge of environmental action strategies, will predict responsible environmental behaviour (Sia, Hungerford, and Tomera, 1986). Human behaviour towards their environment can be linked to ethnicity and culture (Pandey, 1990:23).

2.8 SUSTAINABLE DEVELOPMENT

Sustainable Development was first endorsed at the General Assembly of the United Nations in 1987. Simultaneously, the parallel concept of education that could support development was being explored. The concept matured through discussion and negotiation from 1987 until 1992 when Agenda 21 and specifically Chapter 36 dealing with the promotion of education, public awareness and training, was published. It became apparent through all these discussions and writings that education will be the key to sustainability. The challenge however is that humanity has to raise their education levels and

knowledge without creating an ever-growing demand for resources and consumer goods and the accompanying production of pollutants (McKeown, 2002:5).

There are various definitions for Sustainable Development, but for purposes of this investigation, the following definition is used:

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Department of Environmental Affairs and Tourism, 2002:2).

The eight identified themes of Sustainable Development are all linked to poverty alleviation in the future. The themes are biodiversity; climate change; energy; food security and agriculture; health; pollution; technology; and water. Biodiversity implies the variety of life found on earth that includes people, plants, animals, and micro-organisms. It encompasses thus the overall health of the earth as it includes the environmental diversity (ecosystem), differences between species, and genetic diversity within species (Department of Environmental Affairs and Tourism, 2002: 4).

Climate is defined as a balance between the earth's and the atmosphere's energy levels (the Greenhouse effect). Should this balance be changed, dramatic effects such as a rise in sea level and earth temperatures and loss of biodiversity could be experienced (Department of Environmental Affairs and Tourism, 2002: 10).

The main source of energy is from natural resources such as fossil fuel that does not only pollute the environment through the release of greenhouse gases, but is also in limited supply and will eventually be depleted. We need to reduce energy use and use what we have available more efficiently in order to prevent a catastrophe (Department of Environmental Affairs and Tourism, 2002:14).

Food security means that all the earth's people have access all the time to the food necessary for a healthy and active life. Agriculture is the tool that is used worldwide to provide food security. As a result, however, of change in climate, urbanization, wars, and pollution amongst others, it becomes very difficult to ensure food security and the result is famine and starvation in many poor countries in the world (Department of Environmental Affairs and Tourism, 2000:6).

The Department of Environmental Affairs and Tourism (2000:16) defines health as not just the absence of disease but also a state of complete physical, mental, and social well-being and the prevention of disease. For this to be achieved, every person in the world should have access to basic healthcare, basic medicine, education, and food.

The next theme of Sustainable Development is pollution. Pollution involves any change in the natural environment either through the actions of man or through natural actions that result in the environment becoming harmful to all living things, i.e. plants, animals, microorganisms, and people. The different types of pollution include air, water, soil, and noise (Department of Environmental Affairs and Tourism, 2002: 18).

Technology implies methods that are developed to help people improve their lives. The challenge lies in transferring the knowledge and methods to all involved in order for them to apply it to their respective situations. However, in many instances technology is either seen as a threat to the health of people, for example, through biotechnology and genetically engineered foodstuffs. Alternatively, the technology used is so complicated and of such a high standard that it becomes economically non-sustainable for poorer communities or countries (Department of Water Affairs and Tourism, 2000:8).

Finally, water is seen as the source of all life on earth. However, with less than 1% of the water on the planet available for life on earth, it is a precious commodity that is unfortunately treated with disrespect by the very people that

rely on it as a life vein. Through pollution, industrialization, population explosion, and deforestation the quality and availability of water are decreasing at an alarming rate. This has a drastic effect on agricultural practices, food security, the economy, and the health of all life on earth (Department of Environmental Affairs and Tourism, 2000:12).

The biggest challenge humanity faces is endeavouring to secure a quality life for all. Sustainability requires decent and equitable living within the means of nature. Having insufficient natural resources and not living decently and equitably, will cause conflict and degrade our social fabric. Not living within our ecological means will lead to the destruction of humanity's only home.

It thus becomes important to investigate whether people's quality of life improves over time. In order to do this, one needs to start monitoring whether each person lives within his or her ecological means and at what rate they are depleting the biosphere on planet earth. These investigations are of the essence as humans are part of nature and depend on the steady supply of the basic requirements of life: energy, wood, fibres, food, water, ecological sinks, and other life support services (www.ecouncil.ac.cr/rio/focus/report, s.a.).

2.9 EDUCATION FOR SUSTAINABLE DEVELOPMENT

Education is identified as the key to a desirable future. Within the education arena, various groups are committed to global and economic education, cultural diversity, and environmental protection and improvement. The key is linking the expertise and activities of these groups and articulating a shared vision that encourages a new comprehensive approach to Education for Sustainable Development (ESD).

2.9.1 Themes of Education for Sustainable Development

Sustainability will develop and mature in the future as environmental,

economical, and social forces undergo changes. The philosophical principle that sustainability is a process will need to be affirmed continually as we advance along the path of sustainability.

The implementation of Education for Sustainable Development depends on the following six (6) core themes: (www.gdrc.org/uem/ee/3-2, s.a.)

Lifelong learning: Education is an ongoing process throughout one's life (not a prerequisite to living, but its accompaniment (Hopkins, 2000)). The potential for learning about Sustainable Development throughout one's life exists both within formal and nonformal education settings.

- Interdisciplinary approaches: Education for Sustainable Development provides a unique theme to integrate content and issues across disciplines and curricula.
- Systems thinking: Learning about Sustainable Development offers the opportunity to develop and implement integrated systems.
- Partnerships: Partnerships forged between educational institutions and the broader community is the key to advancing education for sustainability.
- Multi-cultural perspectives: Achieving sustainability is dependent upon the understanding of diverse cultural perspectives and approaches to problem solving.
- Empowerment: Lifelong learning, interdisciplinary approaches, systems thinking, partnerships, and multi-cultural perspectives empower individuals and institutions to contribute towards Sustainable Development.

Through these six themes the foundation for the following strategic actions and initiatives for achieving sustainability through education are realized (www.gdrc.org/uem/ee/3-2, s.a.):

- Designing and supporting opportunities for integrating the concepts and principles of Education for Sustainable Development into formal educational programmes from early primary school through to tertiary level.
- Encouraging the incorporation of education for sustainability in pre-service and in-service professional development activities, e.g. learnerships.
- Identifying and formalizing a set of essential skills and knowledge for all learners that reflect a basic understanding of the interrelationships among environmental, economical, and social equity issues.
- Supporting a campaign to raise public awareness of sustainability, conveying information on indicators of Sustainable Development, and encouraging individuals to adopt sustainable practices in their daily lives.
- Establishing an extension network to enhance the capacity of individuals, workforces, and communities to live sustainably.
- Encouraging partnerships and activities that support community visioning and assessment activities.
- Infusing sustainability concepts and practices into development of the South African workforce, e.g. through using of unit standards in the relevant Sector Education and Training Authorities (SETA).
- Encouraging lifelong learning about sustainability at individual, household and community levels.
- Initiating strategic policy changes and establishing necessary partnerships as the foundation for a coordinated strategy for education for sustainability.

- Coordinating or enhancing existing essential tools for formal and non-formal environmental and Sustainable Development education, including multimedia computer and telecommunications technologies; i.e. E-learning.
- Emphasizing and reflecting on multi-cultural perspectives at all levels for formal and non-formal education.
- Continuing to expand international linkages for Environmental Education and Education for Sustainable Development.

2.9.2 White paper on Environmental Education

The White Paper on Environmental Education (Department of Environmental Affairs, 1989:5) supports the concept of Education for Sustainable Development. The aim of Environmental Education according to the White Paper is:

“...to stimulate education processes that develop responsible lifestyles in harmony with the environment as a whole, on the part of all the inhabitants of the Republic of South Africa (RSA), and that make them aware of the fact that an acceptable quality of life is dependent on their judicious utilization of the environment.”

The stated principles of Environmental Education in the White Paper can be summarized as follows:

- The environment should be considered in its totality. This implies the natural and man-made phenomena, their interdependence, and the ecological, socio-economical and cultural processes that affect them; i.e. all elements that have a bearing on human lives and the relationships between these elements.

- Environmental Education should be a continuous lifelong process. It should commence at pre-school level and continue in all the formal, informal, and non-formal education sectors.
- Furthermore, Environmental Education should be interdisciplinary in approach, characterized by a balanced outlook that emphasizes the complexity of the interrelationships and problems of the environment.
- Active participation in learners of all ages should be encouraged by using diverse learning environments, a broad spectrum of educational approaches, and all other available teaching aids to prevent and solve environmental problems.
- Examine major environmental issues by focusing on current and potential situations, on the learner's immediate surroundings and culture, and relating topics under discussion to provincial, regional, national, and international issues and perspectives.
- Stressing individual responsibility towards the environment by emphasizing both individual and collective involvement and the importance of public participation.

The White Paper (Department of Environmental Affairs, 1989:8) also encourages researchers and research institutions to evaluate the *“impact and effectiveness of teaching and interpretative techniques used to convey information and to form public opinion on environmental conservation and the development of methods and teaching aids and tools that can be used in Environmental Education, with due regard to local needs.”*

2.10 THE ECOLOGICAL FOOTPRINT

Mark Twain wryly observed: *“The problem with land is that they stopped*

making it some time ago.” The question arises whether humanity can learn to live within the natural limits of our finite planet earth without compromising the prospective living conditions of the future generations. The Ecological Footprint (Figure 1), an ecological accounting tool used to measure and manage the impact we have on our environment, was developed to address this question.

If something cannot be measured it cannot be managed. Therefore, to be able to be sustainable, humanity needs to know where they are now and where they need to go in respect of their impact on earth and its resources. The Ecological Footprint is a tool that quantifies the biologically productive area necessary to provide resources to people on a continuous basis and to absorb their generated wastes using prevailing technologies. The Ecological Footprint informs us about the human pressure on the earth’s resources and allows comparisons between the demands placed on nature and the earth’s capacity to meet these demands (Ecologic, s.a.).



Figure 1: The Ecological Footprint is a measure of the “load” imposed by a given population on nature (from Wackernagel and Rees, 1996:5)

The key questions addressed by the Ecological Footprint of any defined human population are:

- How much space is required for humanity to live the way they choose to live?
- How much space do the other species on earth need if they are to survive?
- If everyone lived this way, what would our world look like?
- How can one take care of humanity's basic needs and take care of the earth?

The surface area of earth is about 510 billion square kilometer (km^2) of which less than 150 billion square kilometer (km^2) is land. Of this available land, only two-thirds is classified as productive in the sense that it can support forest cover, is permanent pasture, or arable land. The rest of the land area is inhospitable desert, ice-covered, and rock.

Assuming that an estimate of 100 billion km^2 is actually available and that 6 billion people populate this available land, the average share of earth per capita is 17 km^2 which will be reduced to just over 10 km^2 by 2025 if the United Nations medium term population prediction of about 9 billion is realized (Simmons, 2001). This space must serve all the needs of human beings such as food, materials, recreation, living space, and energy as well as serve the needs of all the other living things sharing the planet with us. In addition, it must be capable of assimilating all the waste created by humans during the process of satisfying all these needs. Currently the average global citizen has a footprint (land area need) of 22 km^2 , thus an overshoot of 37% when compared with the 17 km^2 available. The situation is even more alarming when one realizes that the more affluent nations' citizens are using over three times their share of the productive land available on the planet, leaving the rest of the world's people to live at subsistence levels or worse (Graig, s.a.).

Urgent action needs to be taken to address unsustainable consumption patterns, i.e. improve resource efficiency and limit the world's huge resource consumption "overdraft" (<http://story.yahoo.com/news>, 2002). In order to

improve the quality of life of people on earth, one needs to monitor whether each person is living within his/her ecological means. One needs to measure the effects each person has on nature in order for them to reduce and manage their impact on the resources of the earth. The Ecological Footprint helps people to see how change in their behaviour and lifestyle affects the size of their individual and global footprints and how it affects the earth. Footprinting intentionally says nothing about our quality of life. This aspect is dealt with in the concept of Sustainable Development. The present situation is not sensationalized and exaggerated and thus the true impact on earth is underestimated and the available incapacity exaggerated.

The Ecological Footprint is thus not a precise model but rather a utilitarian view of nature. This can be explained using the Water Bucket Analogy. Imagine a bucket being filled with water at a fixed rate. The water in the bucket is capital stock that can be drawn upon as rapidly as the bucket is being refilled. This balanced withdrawal rate is a form of sustainable income. Similarly, nature is a “bucket” that is continuously replenished by the sun (photosynthesis produces plant matter, the basis for all biological capital and most other life). Climatic, hydrological, and other biophysical cycles are solar powered too. Sustainability implies that nature’s capital should be used no more rapidly than it can be replenished. However, trade and technology have enabled humankind to exploit nature progressively far beyond sustainable levels so that present consumption exceeds natural income (the “interest” on our capital). This leaves the next generation with depleted capital and less productive potential even as the population and material expectations increase.

This simple model described above appeals to “scientific illiterate” persons, especially those reluctant to accept the idea of ecological constraints. It communicates effectively, resonates who takes what, and illustrates the value a person gets from the use of resources (Chambers, Simmons and Wackernagel, 2000:5).

2.11 LINKING SUSTAINABLE DEVELOPMENT, EDUCATION FOR SUSTAINABLE DEVELOPMENT, AND THE ECOLOGICAL FOOTPRINT WITH CHANGES IN KNOWLEDGE, ATTITUDE, AND

BEHAVIOUR

Environmental Education implies more than just transmitting knowledge about the environment and Sustainable Development. It involves changing people's attitudes, values, behaviours, and patterns of consumption. The aim is to make people feel a personal responsibility towards the environment and to motivate them to act appropriately (Kelley-Laine, 1997).

Sustainable Development aims to improve the quality of life of human beings while at the same time living within their ecological means. This implies a change in the attitude and behaviour of each person towards the environment and a change in lifestyles considering environmental concerns. Knowledge from the natural and social sciences and humanities is needed to understand the principles of Sustainable Development, how it can be implemented, the values, and attitudes involved, and the ramifications of their implementations (McKeown, 2002:7-9).

A range of educational opportunities and avenues must be tapped as tools for raising public awareness and knowledge of sustainability. More attention must be directed to those tools used by the business and non-profit sectors as well as those whose primary mission is education. In the first century of the new millennium, the quest for environmental improvement is framed in terms of science and new technologies, but it will also benefit from the wisdom and values espoused by indigenous peoples of the world. However, educators and educational systems can respond more vigorously to the global challenge with new methodologies or tools, information technologies and partnerships on national and international levels.

2.11.1 Knowledge development

Education and dissemination of knowledge is essential for achieving

sustainability (McKeown, 2002:7). The Ecological Footprint is a tool that can be used to achieve this by supplying information on the concerns and consequences that unsustainable lifestyles will have on the earth and its resources and the life of human beings. Chambers *et al.* (2000:3) indicated that through the knowledge of the impact of the various species on planetary ecosystems, ecological footprinting could bring society closer to understanding and relating in a positive manner to the natural world.

Education for Sustainable Development (ESD) enables people to develop the knowledge, values, and skills to participate in decision-making about the way we do things as individuals and collectively as human beings, both locally and globally, that will improve the quality of life now without damaging the planet for the future (Department for Education and Employment, 1998:2). As Sustainable Development includes the environment, economy, and society, learners need to acquire basic knowledge from the natural sciences, social sciences and the humanities before they can understand the principles of Sustainable Development (McKeown, 2002:6). When sufficient knowledge and skills have been imparted, learners can then make appropriate choices in their behaviour relating to the environment (Scott and Oulton, 1998).

2.11.2 Changing attitudes and behaviour to live more sustainably

The Ecological Footprint concept helps one to explore concerns and perceptions of sustainability. As an Environmental Education tool, it challenges our assumptions about society, the economy, and nature. Learners that are exposed to the Ecological Footprint model could discuss the implications, consequences, and concerns with much ease. According to Wackernagel and Reed (1996:114-116), these discussions eventually move away from the obvious basic sustainability concerns such as pollution, waste recycling, and biodiversity amongst others, and discussion topics then start to include human dependence on nature, the effect on the economy, social aspects, and the consequences of continued degradation. Through discussions with peers and others, learners start to:

- accept that a pre-requisite for sustainability is reducing our throughput;
- acknowledge that human-uses are in direct competition with nature;
- show a willingness to reconsider personal actions, behaviours and attitudes;
- recognize that a condition for sustainability is to maintain nature's capacity for self generation; and
- accept that this condition for self generation is not being satisfied.

These acceptances, acknowledgements, recognitions, and re-considerations promote a very short leap to accepting individual changes in behaviour and attitude.

2.12 SUMMARY

From the literature overview above, the importance of using Environmental Education to teach the public and especially the youth about Sustainable Development became clear. The overview tried to show the importance of learning and education as a way of changing the knowledge, attitude and behaviour of learners. The usefulness of ecological footprinting was described and although it is by no means the only tool to indicate ecological impacts, it could prove to be a method that can be used extensively as it can be adapted to address the eight themes comprising Sustainable Development. The linkage between the Ecological Footprint and knowledge, attitude, behaviour and Environmental Education was highlighted in order to illustrate how the Ecological Footprint can be used as an educational tool in the two academic programmes at TNG.

CHAPTER 3

RESEARCH DESIGN

3.1 INTRODUCTION

The feasibility of using the Ecological Footprint as an educational tool for Environmental Education was determined using learners in two environmental disciplines at Technikon Northern Gauteng's main campus in Soshanguve, Pretoria. An action learning approach that places more emphasis on learning than the actions *per se* was followed. This approach was used as Environmental Education lends itself to action learning that entails using information, new knowledge, and skills acquired to change attitudes and behaviours of the learner towards their environment (Mashile, 2001).

3.2 POPULATION

The population for the investigation included 29 registered second year learners from the Department of Biomedical and Nursing Sciences and 23 registered second year learners from the Department of Chemistry at Technikon Northern Gauteng (TNG). The learners were studying towards National Diplomas in Environmental Management and Water Care, respectively. Although the population comprised of 52 learners in total, only the learners attending lectures at the time of distribution and application of the pre-test questionnaire were considered for the intended investigation (n=37).

3.3 RESEARCH DESIGN

This case study followed an empirical-analytical paradigm (quantitative research) in the form of a classical experimental one-group pre-test/post-test design that dealt with quantitative data from which inferences of the various phenomena could be drawn. Table 1 depicts the research design followed. The assumption was made that if there was a reduction in measurement scores of

knowledge, attitude, and/or behaviour that it was due to the intervention of the developed lectures on Sustainable Development and the Ecological Footprint.

Table 1: The research design of the investigation (adapted from Singh, Chetty, and Brijball, 2000)

	PRE-TEST		POST-TEST
SUBJECTS (LEARNERS)	Measure knowledge, attitude, behaviour and Ecological Footprint scores	Discuss Ecological Footprint scores and Lectures on Ecological Footprint and Sustainable Development	Measure knowledge, attitude, behaviour and post-pledge Ecological Footprint scores

3.4 DATA COLLECTION

A one-group pre-test/post-test was used before and after the intervening lectures on the Sustainable Development and the Ecological Footprint to gauge the knowledge of and the attitude and behaviour of each learner towards their specific environment. The pre- and post-test questionnaire (see appendix I) consisted of 40 statements relating to knowledge of the environment and Sustainable Development and to one's attitude and behaviour towards your specific environment. An four point interval (Lickert) scale (1 = definitely agree; 2 = agree; 3 = do not agree; 4 = definitely do not agree) was used to measure the individual responses of the learners before and after the determination and analyses of their respective Ecological Footprints and the presentation of the developed lectures as described later in this chapter. An open-ended question that asked each learner to define the concept of Sustainable Development in his or her own words was also included in the questionnaire.

A pre-prepared closed-ended questionnaire (see appendix II), The Living More Lightly Profile (www.earthday.net/footprint/info.asp, 2002), focusing on aspects related to food consumption and packaging, household energy and supplies, water and wastewater, transportation, recycling and reusing, natural contact

and respect, and environmental participation was obtained via the internet from the Redefining Progress Group. Permission was obtained from the Redefining Progress Group to adapt the questionnaire to the South African situation with regard specifically to language and Standard International (SI) units. The researcher was aware at the time of the philosophical and methodological debate surrounding the application of the Ecological Footprint in a developing world scenario. However, this will not be addressed in this report as it fell outside the original aim and scope of the investigation. The learners completed the Ecological Footprint questionnaire and the Ecological Footprint for each Environmental Management and Water Care learner within the selected population was determined.

In order to suggest action plans to reduce their respective Ecological Footprints, one lecture on Sustainable Development and another on the aspects related to the Ecological Footprint were developed (see appendix III). An independent lecturer presented the lectures to all the registered Environmental Management and Water Care learners. Group discussions and debates related to issues emerging in the pre-test questionnaire were encouraged after the formal presentations. The decision to include all learners in the lecturing session was made as to reach as many persons as possible, thereby educating and empowering as many learners as possible in Sustainable Development.

The learners were encouraged to make personal pledges for changes in the behaviour and attitude towards their environment. Each learner completed the Ecological Footprint questionnaire again after the formal lectures, this time incorporating their respective pledges. It aimed at showing the learners the impact their pledges on any conscious or unconscious lifestyle and behavioural changes will have on their respective Ecological Footprints and on the earth's natural resources.

3.5 DATA ANALYSES

Parametric statistical analyses were performed on the collected data from both the pre- and post-test questionnaires using Microsoft Excel and SPSS. Analyses included frequency analyses of the raw data, paired t-tests to determine any significant difference between the pre- and post-test scores of each individual learner within the selected population group, and correlations between the various variables (Bluman, 1997:278). An assumption was made that the data was approximately normally distributed.

Statistical analyses of The Living More Lightly Profiles were performed on-line using an analysis tool designed specifically for determining Ecological Footprint scores (www.RedefiningProgress.org, 2000). The paired t-test (using SPSS) was used to determine if there are any significant differences between the scores of the two Ecological Footprint analyses of each learner. Correlations between the Ecological Footprint and the knowledge, attitude and behaviour of the learners were also determined.

3.6 ETHICAL CONSIDERATIONS

The pre- and post-test questionnaires and The Living More Lightly Profiles were distributed to each Environmental Management and Water Care learner in an envelope, accompanied by a letter signed by both the Director of Research (TNG) and the researcher, explaining the research process and the research aims and objectives. Completed and signed questionnaires and profiles were collected from each learner immediately after completion. All data collected and analyzed were discussed with the learners after completion of the investigation.

3.7 VALIDITY

To ensure validity of the collected data, the standardized (www.earthday.net/footprint/info.asp, 2002) pre- and post-test questionnaire and The Living More Lightly Profile were piloted on second year learners in the National Diploma Environmental Chemistry, which was on the same study

level, were in the same age, cultural and ethnic groups as the suggested population group. This was quite useful as it ironed out a few problems that were experienced with respect to language (e.g. English is the learners' second and in some cases, their third language), ethics, and cultural differences (e.g. the use of words such as faeces was a problem for some learners). The internal validity of the chosen research design was thus addressed.

External validity of the design was achieved by not generalizing the results to other programmes, groups, or institutions. The results were only treated as an extension of understanding because of the small population group and the particular features of the respondents. This investigation report however aims to enable other researchers and interested parties to understand similar situations and extend these understandings into subsequent follow up research.

3.8 RELIABILITY

The reliability of the standardized questionnaires was firstly tested during the piloting phase as discussed under validity and secondly during the experimentation using triangulation (group discussion, verbatim accounts and questionnaires). Participants were asked to partake in group discussions to clarify some answers to the two questionnaires. This happened after the presentation of the formal lectures and served the purpose of verifying some of their answers, thereby limiting any bias in understanding of their views by the researcher (participant review). In addition, verbatim written accounts of the participants' understanding with regard to Sustainable Development were used in the text (chapter 4) to support their knowledge scores.

As a last effort to reduce any threats to the reliability, an impartial researcher was used to present the lectures. The aim was to try to prevent the selective and biased transfer of knowledge and information and to eradicate subsequent influence and manipulation of the knowledge, attitude, and behaviour post-test scores of the participants by the researcher.

3.9 CONSTRAINTS

A few constraints were identified for this investigation. There was a possibility that answers could be biased and not truthful, i.e. answers given could be what the learners thought the researcher wanted to know. As no control group was used, the number of competing alternative explanations arising either from the design itself or from the external factors were not taken into consideration during the interpretation of the results. The research design lent itself to the fact that the data collected could not be generalized. The case study only supplied weak support for drawing of scientific conclusions. The data however provided useful ideas for future research under more controlled settings. It also gave an indication whether to use the Ecological Footprint as an Environmental Educational tool in the existing curricula of the specific two academic programmes at TNG.

3.10 SUMMARY

The chapter gave a description of the research design followed during the investigation. It indicated how the researcher tried to ensure the reliability and validity of the results and which constraints were taken into consideration. The following chapter analyses, interprets, and discusses the data obtained through following of the research methodology and design as described here.

CHAPTER 4

DATA ANALYSES, INTERPRETATION, AND DISCUSSION

4.1 INTRODUCTION

The relevant pre- and post-questionnaires and The Living More Lightly Profiles were applied and completed by the population group. All data collected were encoded and statistically analysed as described in the chapter on Research Design (chapter 3). This chapter reports on, analyses, interprets, and discusses the data collected.

4.2 THE KNOWLEDGE, ATTITUDE, AND BEHAVIOUR OF THE LEARNER GROUP

The questionnaire as described in Chapter 3 and Appendix II was given to each learner in the sample group to complete. Their knowledge of the environment and environmentally related issues, specifically on Sustainable Development, was tested with 31 of the closed ended statements and the one open-ended question. Their attitude and lifestyle towards the environment and related issues was tested with 19 of the 40 closed ended statements, while their behaviour towards the environment was evaluated with 15 of the statements. It is evident from the explanation that some of the statements measured more than one of the three variables.

The positive responses were scored on a Lickert scale as follows:

1 for definitely agree
2 for agree
3 for do not agree
4 for definitely do not agree

This was the case for all statements except statement 7, 9, 10, 19, 22, 27, 29, 30, and 34. These statements were stated in the negative and the score was subsequently inverted:

4 for definitely agree
 3 for agree
 2 for do not agree
 1 for definitely do not agree.

Figure 2 illustrates the linear scales used for the respective scores. The absolute minimum score for knowledge would be 31, for attitude 19 and for behaviour 15. A minimum score for the three variables would indicate that a particular learner has an *excellent general knowledge* of environmental related issues. It also indicates a *recommendable attitude* and *exemplary behaviour* towards the environment.

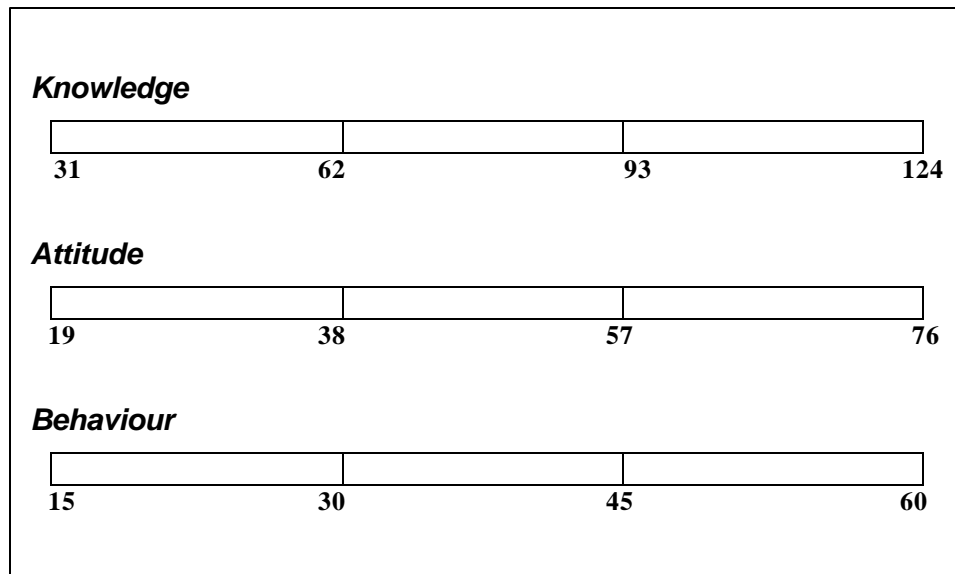


Figure 2: Linear scales for knowledge, attitude, and behaviour scores

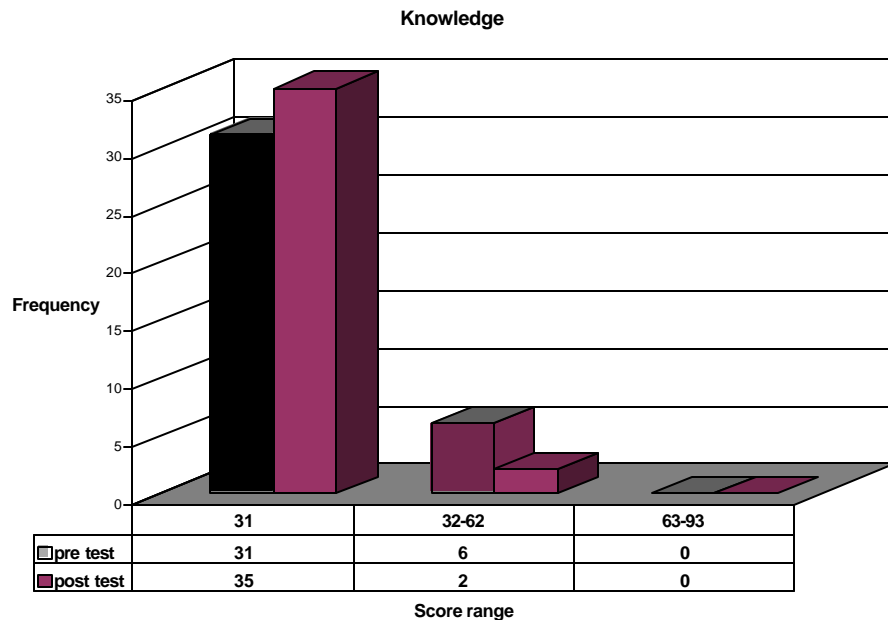
A score between 31 and 62 (knowledge), 19 and 38 (attitude), and 15 and 30 (behaviour) respectively was taken as an indication of a *good basic knowledge*, *relative good attitude*, and *acceptable behaviour* towards the environment.

Scores higher than these ranges gave an *indication of problems* in the learner's knowledge, attitude, and/or behaviour towards the environment.

4.2.1 The frequency distributions of pre- and post- test scores for knowledge, attitude, and behaviour

4.2.1.1 Knowledge

Figure 3 shows that 10% of the learners had a lower knowledge score after completion of the post-test questionnaire, i.e., thirty one (84%) of the respondents had a *good basic* pre-test knowledge score on environmental issues while thirty five (94%) of the respondents had a *good basic* post-test knowledge score. This could be an indication that the learners expanded their knowledge on the environment and Sustainable Development. This was encouraging especially since all the learners were in their second year of study in environmental related fields and one would expect them to have some basic knowledge at this stage in their studies.



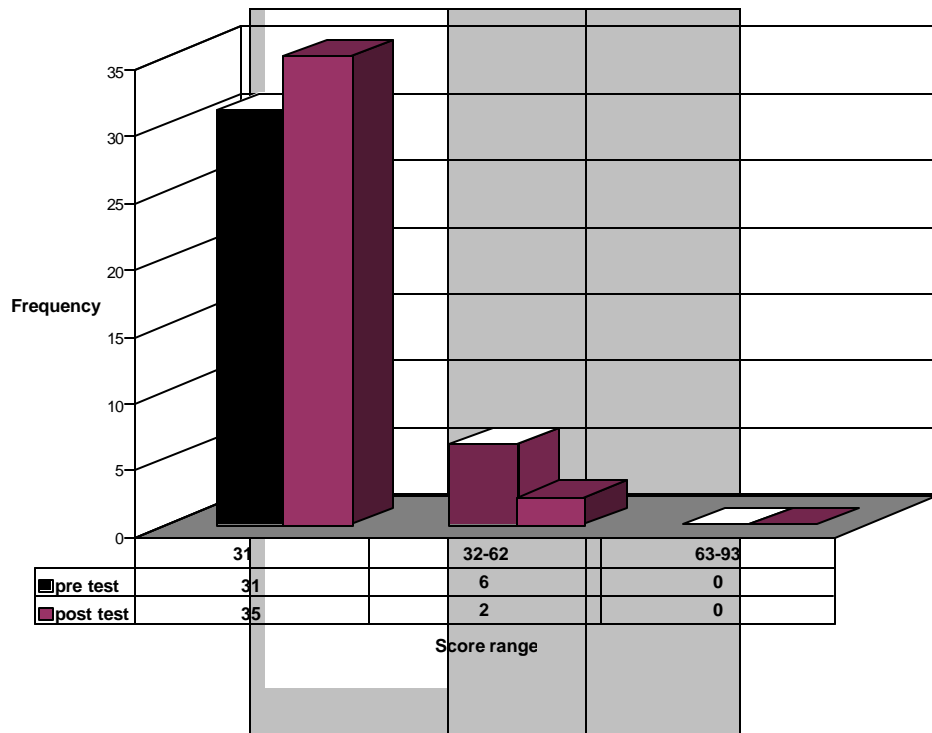


Figure 3: Comparison of pre- and post-test frequencies (knowledge; n=37)

The apparent change in the learners' knowledge level is supported by the following selection of direct quotes taken from the learners' answers on the open-ended question on what the learners perceive Sustainable Development to be. The following definition of Sustainable Development highlights the keywords that had to be present in the answers given by the learners that would give an indication of their level of understanding of the concept:

*“Development that **meets the needs** of the **present without compromising** the ability of **future generations** to **meet their own needs**” (Department of Environmental Affairs and Tourism, 2002:2).*

In spite of piloting the said questionnaire, this proved to be a challenge as language competence and grammar usage were found to be an obstacle in the selected method of evaluation. As seen in the pre-test verbatim statements from the participants below, their knowledge of the concept of Sustainable Development ranged from a *very good* knowledge (75%) to a *limited or vague* knowledge (15%) and finally to *no knowledge* at all (10%). One would have

expected the population consisting of second year learners from the environmental disciplines to have a good knowledge of Sustainable Development. However, this was not the case as 25% of the learners had a *very vague to no knowledge* of the concept of Sustainable Development.

Pre-test verbatim statements

Very good knowledge

“Sustainable development is all about taking care of the environment by conserving natural resources, preventing environmental issues or activities that will result in causing detrimental impact on the environment. It is also about thinking of present and future generation and impact on environ.”

“Sustainable development means the protection of our natural resources and their conservation so that the future generations is able to utilize the available resources and be present to them. It does not mean that we must not use our resources rather it says that we must use them to the allowable limits so that they can grow again and be available for us.”

Limited or vague knowledge

“A sustainable development I understand that resources should not be misused, but can be recreated by means for recycling and converted into other materials for the sake of not hurting them or getting into extinction. For the sake of present and future generation.”

“The use of resources in a way as to benefit both present and future generations. Resources may be used up with newer technologies

so as to minimize their depletion, so that the future generation might be able to enjoy the same benefits as us.”

No knowledge

“I think it simply means that government together with communities and individuals must work together on developing the country so that there can be improvement.”

“I think that the sustainable development is the duty of the government to develop/make our environment look better by building schools, houses, constructing roads, etc. it is important to us as members of the community to protect the environment and prevent the pollution of the environment.”

The knowledge of the learners with specific regard to Sustainable Development changed after the intervention of the Ecological Footprint analyses as seen in the post-test verbatim quotes below. Referring once again to the given definition on page 47, 89% of the learners now reflected a *very good* knowledge by using more of the keywords identified in the definition for Sustainable Development while a few learners (11%) replied with *vague* description that still indicated a *limited or vague* knowledge of the concept of Sustainable Development. None of the learners reflected this time in their description of the concept of Sustainable Development that they had no knowledge of it. This correlated well with the decrease in the average knowledge scores in the post-test questionnaire.

Post-test verbatim statements

Very good knowledge

“Sustainable development is the way people are living using their resources in a way that is sustainable by conserving them. It doesn’t say that developments must not be developed or resources must

not be used, rather that people must use resources in a way that they can be replaced for future generations; developments be kept in Earth's carrying capacity."

"Sustainable development is the interacting of socio-economic factors that affect humans and the environment. It is also the usage of renewable and nonrenewable resources in a sustainable way, so that future generations can be able to enjoy them."

"Sustainable development is the way in which human beings use natural resources in a manner that will favour future generations and also we can say it is the way in which industry or procedure in the industry does not harm the environment and they use resources in a sustainable way, so that they don't destroy the resources."

Limited or vague knowledge

"Sustainable development, resources should not be wasted for the sake of future generation, there should be the recycling of wastes and use of renewable resources."

"I think should live in a clean environment and never waste food and water as the pollution is ever increasing and we're running short of water, if we continue wasting things that are needed for us to survive obviously we are going to die."

4.2.1.2 Attitude

Seventy eight percent of the learners showed a *reasonably good* pre-test attitude towards their environment (Figure 4). This correlated well with their pre-test behaviour scores. This observation supports the assumption of Kuhlemeier, Van den Bergh, and Lagerweij (1999) that a good attitude could

lead to responsible behaviour towards the environment. The remaining of the learners had an attitude score that gave an indication of possible negative attitudes towards their environment.

Referring to the post-test attitude score, 35 (97%) of the learners had a score that reflected a *reasonably good* attitude towards the environment (an average decrease of 16% in the average scores). This decrease is supported by the fact that the distribution of the post-test scores shifted to the left compared to the pre-test distribution as seen in Figure 6. One student obtained the minimum score of 19, a *commendable* attitude that can be used to help set an example for the other learners. This correlated again well with their respective post-test behaviour scores.

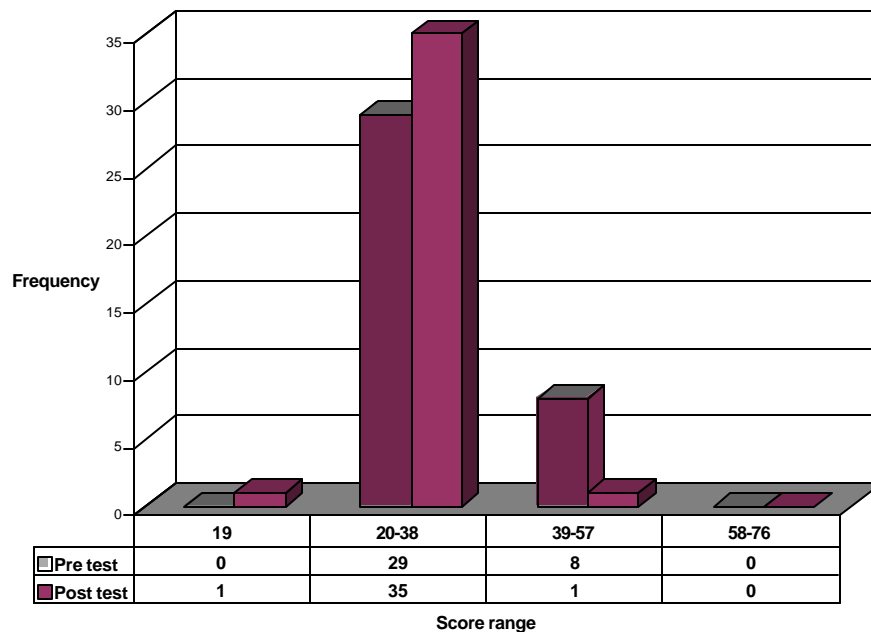


Figure 4: Comparison of pre- and post-test frequencies (attitude; n=37)

4.2.1.3 Behaviour

Figure 5 shows the pre- and post-test behavioural frequency comparison. Twenty nine (78%) learners reported pre-test *responsible* behaviour and 34

(97%) showed post-test *responsible* behaviour. There is also a shift to the left on the distribution curve (Figure 6) as six more learners reflected a lower score (a 17% difference). As stated above, the lower scores for their behaviour correlate well with both lower scores observed for their attitude and knowledge.

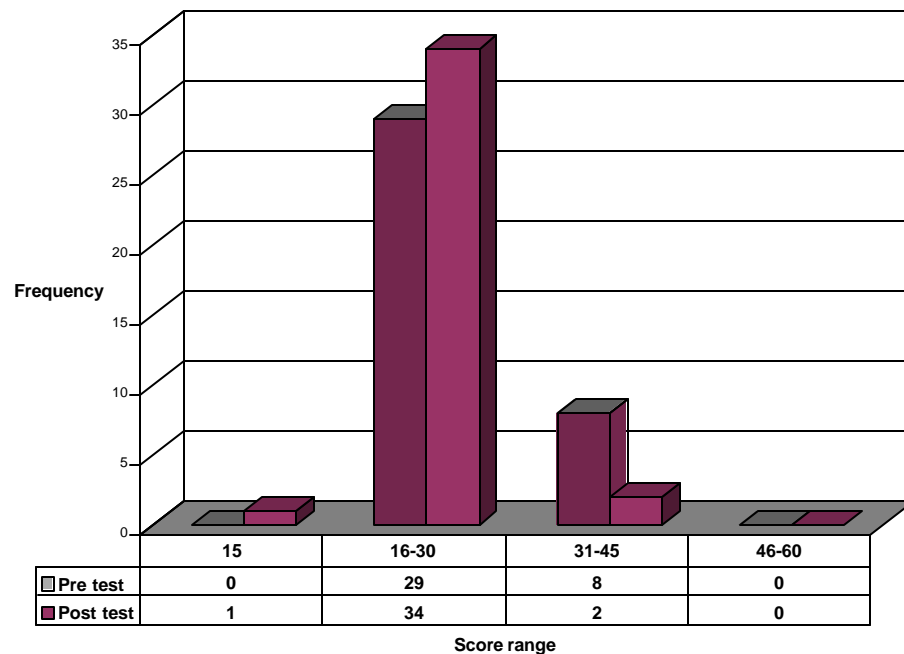


Figure 5: Comparison of pre- and post-test frequencies (behaviour; n=37)

4.2.2 Statistical analyses of the collected pre- and post- test questionnaire data

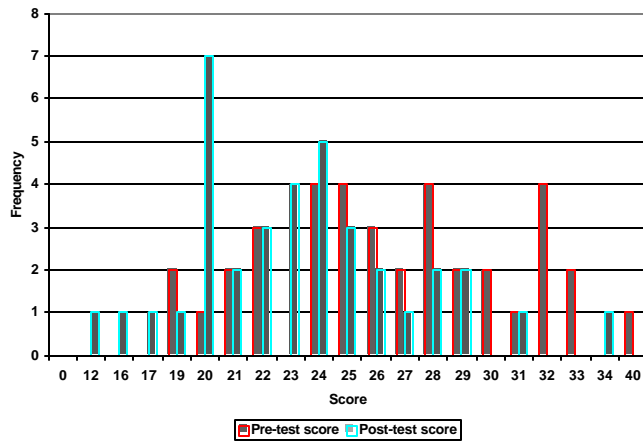
Figure 6 and Table 2 reflect the univariate statistical analyses of both the raw pre- and post-test data. The statistical analyses were performed in order to gain information on the central tendency, distribution, mean, mode, median, and variability of the collected data (Bennett, 1987; Bluman, 1997:71; Dytham, 2003:4). The mean, mode, and median of the scores have decreased for all three variables. The mean scores however still leave room for improvement and expansion of learners' knowledge, as ideally one would want the score to be reduced closer to 31 for environmentally knowledgeable learners. The univariate statistical analyses indicated that the means of the scores for all

three variables were lower and slanted more to the left of the distribution curve. The difference between the pre- (33.621) and post-test (29.08108) attitude means, indicated a decrease in the scores of the learners. This was an indication of better attitude towards the environment and environmentally related issues. A reduction in the pre- (26.729) and post-test (23.162) mean behaviour scores were also observed. The median values decreased by 10.9%, 15.2% and 11.5% respectively, while the most commonly occurring scores (mode), especially for behaviour, were also lower. The significance of this observed reduction was investigated with the paired t-test that is reported on later in this section.

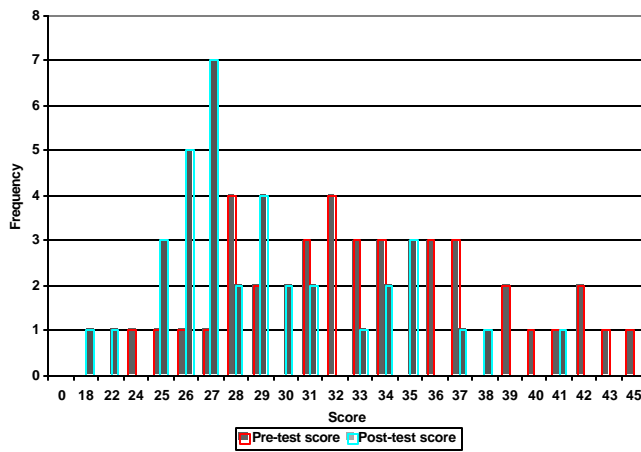
The standard deviation as an indication of the measure of spread, showed a near normal or symmetrically skewed distribution. The majority of the data values are evenly distributed on both sides of the mean. The mode, median and mean values are virtually the same and are at the centre of the distribution. The low positive values of skewness indicated that there are more values in the right tail of the curve than are expected in a normal distribution. The distribution changed from a positively skewed to more or less symmetrically skewed curves. This can be seen in the skewness of the analyzed data, where more data points are distributed near the mode, mean and median as compared to the values near the right tail of the curve (Figure 6).

The kurtosis for the knowledge variable changed from where most values were close to the mean (positive value) to where more values could be found in the shoulders of the curve (negative value). The pre-test value for behaviour was positive, but the value for attitude was negative indicating that most of the values could also be found in the shoulders of the distribution curve and very few around the tails or the mean values. The post-test kurtosis showed positive values (0.606 and 0.924) of attitude and behaviour respectively indicating that most of the scores were very close to the mean and in the tail of the distribution curve (either near 31 or near 62 for knowledge and 15 or 30 for behaviour).

Knowledge



Attitude



Behaviour

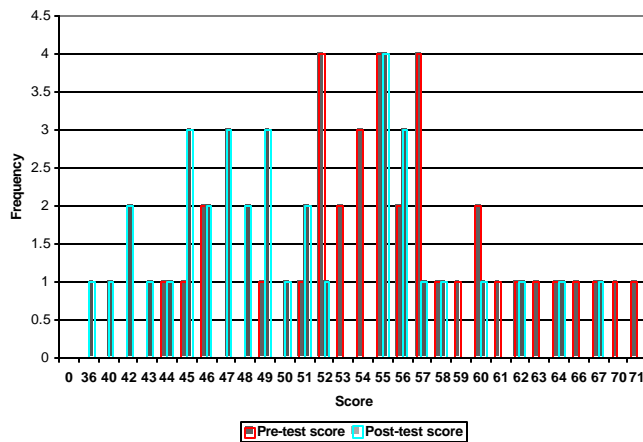


Figure 6: Histograms of frequency distributions for knowledge, attitude, and behaviour scores (pre- and post-test)

The pre-test sample variance for all three variables was high and gave an indication that the data is more dispersed and there is high variation. The post-test sample variances still indicated dispersed and variable data for the three variables, with a smaller range and values for the lowest and highest scores in the post-test data in all instances.

Table 2: Statistical analyses results of the collected pre- and post-test knowledge, attitude and behaviour scores (n=37)

	Knowledge		Attitude		Behaviour	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Mean	56.162	50.460	33.621	29.081	26.729	23.162
Median	55	49	33	28	26	23
Mode	52	49	28	27	25	20
Standard deviation	6.457	6.878	5.355	4.639	4.604	4.259
Sample variance	41.695	47.310	28.686	21.521	21.202	18.139
Kurtosis	0.131	-0.059	-0.651	0.606	0.450	0.924
Skewness	0.351	0.371	0.259	0.493	0.472	0.073

In order to test whether the three mean scores for the sample group in the post-test is indeed significantly lower than the average pre-test scores the following

hypotheses were tested for all three variables:

$$H_0: \quad i_1 - i_2 = 0 \quad H_1: \quad i_1 - i_2 \neq 0 \text{ (two tailed test)}$$

From the two tailed paired t-test analyses results as depicted in Table 3, the researcher drew the following conclusions. The paired two-tail t-test values in all three cases (5.984; 5.545; and 4.876 respectively) fell outside the critical region and thus the null hypotheses stated above were rejected (not accepted). This indicates that there was enough evidence to support the claim that the post-test knowledge, attitude, and behaviour scores are different from that of the pre-test scores. The P-values also supported the fact that there are statistically significant differences in the means of the various scores as all three the P-values are < 0.05 (Table 3).

Table 3: Paired two-tailed t-test results for knowledge (K), attitude (A), and behaviour (B) (pre- and post-test; $P < 0.05$)

	Mean	N	Std. Deviation	Std. Error Mean
K (pre)	56.162	37	6.4572	1.0616
K (post)	50.459	37	6.8783	1.1308
A (pre)	33.622	37	5.3559	0.8805
A (post)	29.081	37	4.6391	0.7627
B (pre)	26.730	37	4.6046	0.7570
B (post)	23.162	37	4.2591	0.7002

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
K (pre) – K (post)	5.7027	5.7969	0.9530	3.7699	7.6355	5.984	36	0.000
A (pre) – A (post)	4.5405	4.9810	0.8189	2.8798	6.2013	5.545	36	0.000
B (pre) – B (post)	3.5676	4.4506	0.7317	2.0837	5.0515	4.876	36	0.000

4.2.3 Correlation analyses between knowledge, attitude, and behaviour

For this study, the researcher used correlation analysis to determine whether any two ranges of data move together. Thus, whether large values of one set

are associated with large values of the other (positive correlation), whether small values of one set are associated with large values of the other (negative correlation), or whether values in both sets are unrelated, i.e. the correlation is near zero.

Tables 4 and 5 summarize the pre-test and post-test correlation results and it indicated variable degrees of positive correlations between the three variables. The strongest positive pre-test correlation was observed between attitude and behaviour (0.802), followed by knowledge and attitude (0.521) and then by knowledge and behaviour (0.475).

Table 4: The correlations between knowledge, attitude, and behaviour (pre-test)

		Knowledge	Attitude	Behaviour
Knowledge	Pearson Correlation	1	0.521(**)	0.475(**)
	Sig. (2-tailed)	-	0.001	0.003
	N	37	37	37
Attitude	Pearson Correlation	0.521(**)	1	0.802(**)
	Sig. (2-tailed)	0.001	-	0.000
	N	37	37	37
Behaviour	Pearson Correlation	0.475(**)	0.802(**)	1
	Sig. (2-tailed)	0.003	0.000	-
	N	37	37	37

** Correlation is significant at the 0.01 level (2-tailed)

The post-test correlation analyses (Table 5) indicated stronger positive correlations between all three variables especially between attitude and behaviour (0.930). The correlation values between attitude and knowledge (0.767) and between behaviour and knowledge (0.778) were also strongly positive.

Table 5: The correlation between knowledge, attitude, and behaviour (post-test)

		Knowledge	Attitude	Behaviour
Knowledge	Pearson Correlation	1	0.766(**)	0.778(**)
	Sig. (2-tailed)	-	0.000	0.000
	N	37	37	37
Attitude	Pearson Correlation	0.766(**)	1	0.930(**)
	Sig. (2-tailed)	0.000	-	0.000
	N	37	37	37
Behaviour	Pearson Correlation	0.778(**)	0.930(**)	1
	Sig. (2-tailed)	0.000	0.000	-
	N	37	37	37

** Correlation is significant at the 0.01 level (2-tailed)

There was thus a noticeable increase in all three correlation relationships when compared with the pre-test values. The highest increase was between behaviour and knowledge, followed by attitude and knowledge, and then finally by behaviour and attitude. This is an indication that the increased knowledge attained by learners during the lectures and through completing and understanding the Ecological Footprint determination, could have affected their behaviour and attitudes.

4.2.4 Summary

To summarize, the frequency analyzed pre-test data implied that the majority of the learner group showed a *good basic* knowledge of environmental issues, a *reasonably good* attitude, as well as, *responsible* behaviour towards their environment. The univariate statistical analyses indicated that the means of the scores for all three variables were high and slanted to the right hand of the distribution curve. This showed that there was room for improvement in the scores, thus creating a possibility to decrease the scores with the application of an Environmental Education tool such as the Ecological Footprint.

The post-test data showed differences in the frequency and statistical analyses with regard to all three variables. The decrease in the scores, the lower means, and the more symmetrical distribution of the curves indicate that after the lectures the learner group had gained knowledge that affected their attitude and behaviour towards their environment. This was substantiated by the results of

the paired two-tailed t-tests.

4.3 THE ECOLOGICAL FOOTPRINTS OF THE LEARNER GROUP

The Living More Lightly Profile of each learner in the sample group was determined one week after the completion of the pre-test questionnaire. This evaluated knowledge, attitude, and behaviour on environmental issues and Sustainable Development. Their respective pre-pledge Ecological Footprints were subsequently calculated using the on-line scoring method as explained in Appendix II. The calculated Ecological Footprint scores and Figure 7 were used to determine the land area needed by each of the learners. The Living More Lightly Profile analyses not only calculated learners' Ecological Footprint and land area needed per capita, but also indirectly assessed their behaviour and attitudes. Learners with high Ecological Footprint scores will have a high land area need. This could imply that the learners are living a lifestyle that is placing a huge strain on the natural resources in the world and in South Africa. Their behaviour with regard to pollution and consideration of their fellow man were seen in their answers to statements in the pre-test questionnaire. The more inconsiderate their behaviour, the higher their Ecological Footprint scores (especially section E: recycling and reusing). The information was fed back to and discussed with the learners after the intervening lecturing series.

After the lecturing series and discussion sessions, each participant made a pledge or commitment to change a few aspects of their behaviour in order to decrease their respective Ecological Footprints on earth. The learners were encouraged to promise to change only a few aspects in their behaviour in order to make a difference. This approach will make it easier for them to apply it in their day-to-day living, as it will not be seen as a major lifestyle change. Their Living More Lightly Profile and land area were then calculated again with each learner "implementing" their pledges into the questionnaire (post-pledge).

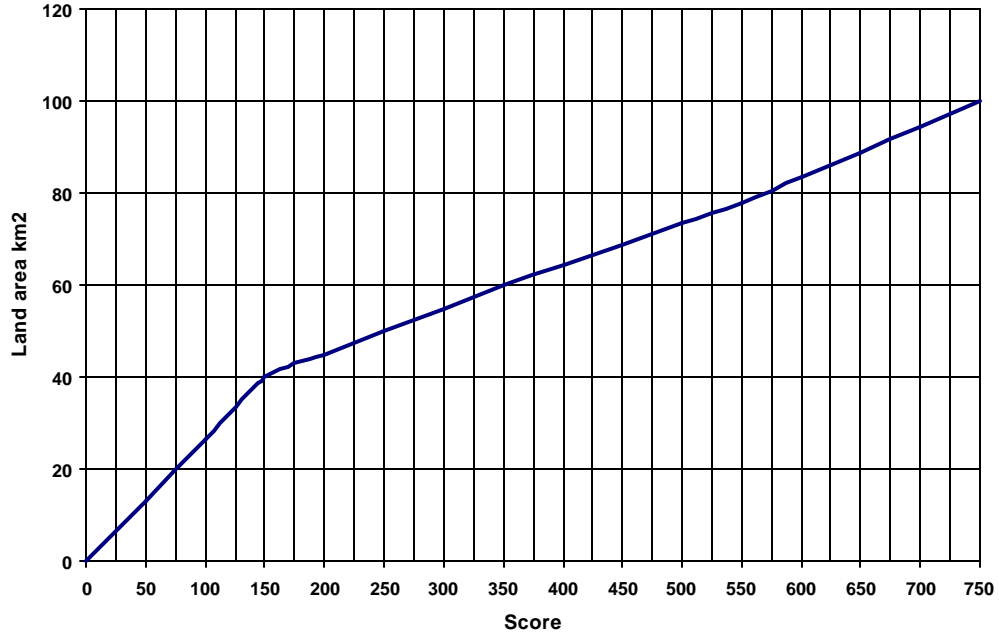


Figure 7: Baseline land area vs Ecological Footprint scores (adapted from The Institute for Earth Education, 1990)

4.3.1 Ecological Footprint scores and land area need analyses (pre- and post-pledge)

Figure 8 illustrates that the world and national average of land area available for sustainable living is 22 and 30 km² respectively (Chambers *et al.*, 2000). This implies a maximum Ecological Footprint score of 80 per capita to saturate the world's average land area available and 120 per capita to saturate the national land area available. It is alarming to see that South Africans are already living beyond the world's average earth share, at a deficit of 8 km² per capita. South Africa has thus an ecological debt and is non-competitive economically. This indicates directly that South Africa will experience great difficulty adjusting its economy to meet future ecological challenges. Currently South Africa relies on purchasing ecological capacity elsewhere, i.e. importing goods, while depleting its natural resources indiscriminately. If South Africans do not act now to improve the efficiency with which they use resources, they are heading for internal conflict, upheavals and scarcity (Chambers *et al.*, 2000).

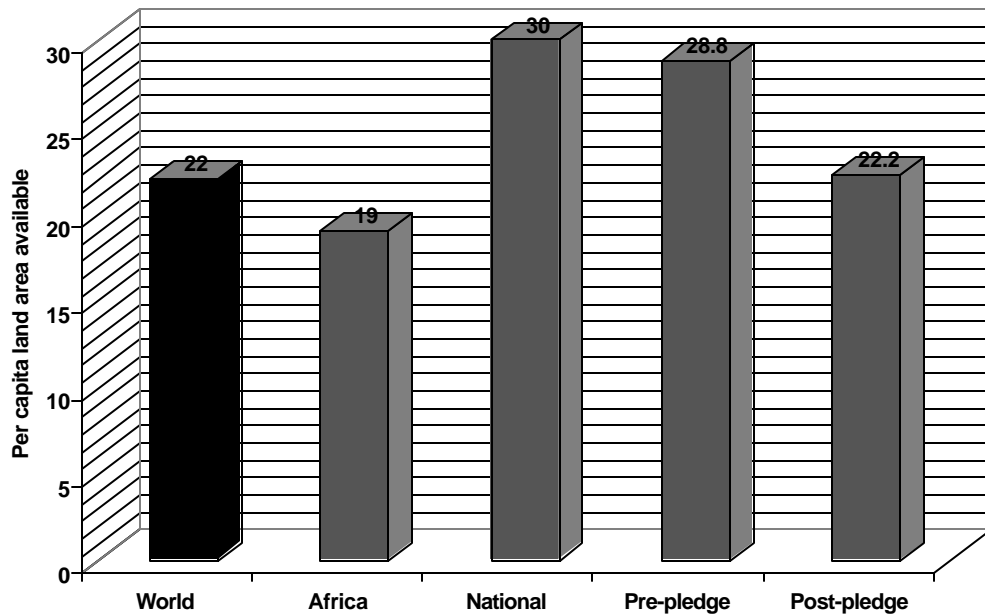


Figure 8: Comparison of land area available and the land area needed (pre- and post-pledge)

From the data presented in Figure 9 below, one can see that 78% of the participants had a pre-pledge Ecological Footprint score of 150 or less (40 km² needed per capita) while 43% had a score of 100 or less (26.7 km² needed per capita). Pre-pledge data indicated only 8 (22%) of the learners living within the world average of 22 km² and 18 (49%) within the national average of 30 km². It became evident that more than half of the learners participating in the investigation live far beyond the average national and world land area available. This was somewhat surprising as most of the learners came from rural areas and live in very basic accommodation during their stay at the technikon. These high scores and the interpretation thereof made it clear to the researcher and the participants that every person on earth has an impact on the natural resources, no matter how and in what conditions they live. The impact on the natural resources depends on attitude, behaviour, and embedded knowledge.

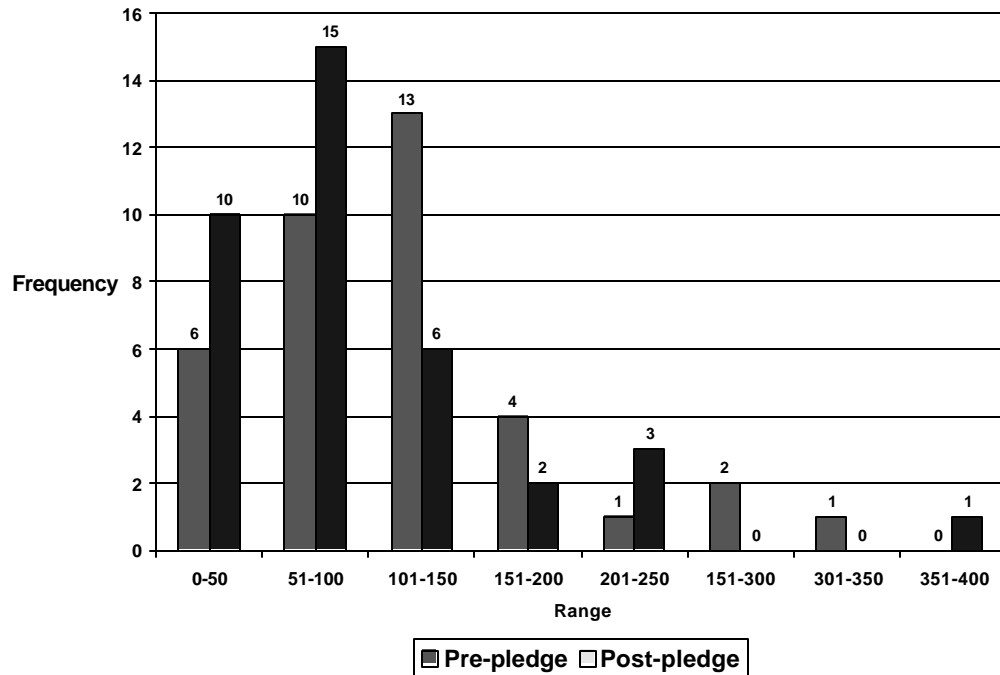


Figure 9: Frequency ranges of the pre- and post-pledge Ecological Footprint scores

After the pledge to change a few aspects in each learners' individual lifestyles, their Living More Lightly Profiles were completed again incorporating the suggested changes into their profiles. Their Ecological Footprint scores were calculated again and this time 18 learners proved that they could live within the world average and 27 within the national average if they made some lifestyle and behaviour changes. Should this be realized, it could result in a reduction of 23% in their land area needed. The learner's post-pledge scores showed that they would be significantly less demanding on the land area available. This promised change in attitude and behaviour could have significant positive effects on the land area needs and resource utilization of South Africa and the world. However, this can only be verified if the same Living More Lightly Profile is to be completed by the same learners after a period of time in order to see whether they indeed changed their behaviour and/or lifestyles.

4.3.2 Statistical analyses of the Ecological Footprint pre- and post-pledge scores

Univariate statistical analysis of the pre-pledge and post-pledge scores was performed in order to obtain the central tendencies and variability of the variables (Table 7). The two variables follow a positively skewed distribution when looking at the mode, median, and mean. This is also reflected in the high values of standard deviation of the two sets of data, i.e. the data will be widely spread over a distribution curve.

Table 6: Statistical analyses results of Ecological Footprint pre- and post-pledge scores (n=37)

Statistical parameter	Pre-pledge	Post-pledge
Mean	121.189	91.945
Median	121	81
Mode	94	0
Standard deviation	73.052	75.570
Sample variance	5336.657	5710
Kurtosis	2.007	2.976
Skewness	1.081	1.429

There is a difference in the mean, median, and mode of the two sets of data, but the standard deviation difference was insignificant. This indicates that the mean scores of the post-pledge scores from the learners were reduced by 30 points resulting in a reduction of about 5 km² in land area needed. If the learners apply their pledges, it will have thus a remarkable impact on the land area required for the sample group and will subsequently reduce their impact on earth's resources.

The kurtosis that shows the shape of the score distribution on a curve is not only positive but also has high values. This is an indication that it is a leptokurtic distribution with more observations/scores very close to the mean and in the two tails. The difference between the two variables is not significant and is not discussed further.

In order to test whether the mean Ecological Footprint scores for the sample group in the post-test is indeed significantly lower than the average pre-test scores the following hypotheses were tested using the paired two-tailed t-test:

$$H_0: i_1 - i_2 = 0 \quad H_1: i_1 - i_2 \neq 0 \text{ (two tailed test)}$$

From the paired two tailed t-test analyses (Table 7), the researcher drew the following conclusions. The two tailed test value falls inside the critical region of 2.029 and the null hypotheses is thus rejected indicating that there is enough evidence to support the claim that the mean post-pledge Ecological Footprint score is different than the pre-pledge score of The probability values (P-values) indicate that for the two tail test, the area underneath the distribution curve (between 1.983 and 2.029) is equal to 5.5%. The chance for any data point to fall in this area is low and thus not supports the fact that there are statistically significant differences between the means of the scores.

Table 7: Paired t-test sample statistics – Ecological Footprint

	Mean	N	Std. Deviation	Std. Error Mean
Pre-pledge	121.1892	37	73.05243	12.00975
Post-pledge	91.9459	37	75.57040	12.42370

Paired Differences							
Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		T	df	Sig. (2-tailed)
			Lower	Upper			
29.243	89.69529	14.74581	-0.6626	59.1491	1.983	36	0.055

The paired sample correlation also indicated no significant relationship between

the pre- and post-pledge Ecological Footprint scores (Table 8). The null hypotheses was not rejected, substantiating that there is no significant relationship between the two variables.

Table 8: Paired sample correlation – Ecological Footprint

	N	Correlation	Sig.
Pre- and post-pledge	37	0.272	0.104

4.3.3 Summary

Although the land area needs of more than half the learners were above the national and international land area available, it was important to note that the Ecological Footprints of the sample group could be reduced even with small changes in the lifestyles and habits of each individual. Even with a small reduction in the Ecological Footprint scores, a 23% reduction in the national land area needed for sustainability could be achieved.

Lastly, as it was only a pledge to revise their respective behaviour, it is recommended to complete a Living More Lightly Profile for each individual in the sample group after a period of time to see if any reduction in their Ecological Footprints have been achieved.

4.4 THE CORRELATION BETWEEN KNOWLEDGE, ATTITUDE, BEHAVIOUR, AND THE ECOLOGICAL

The correlation between knowledge, attitude, and behaviour and the Ecological Footprint was only determined for the post-test scores as the Ecological Footprint (the educational tool) could not have an affect on the pre-test scores of the three variables. Table 9 summarizes this correlation analyses results. The relationships between the various variables showed weak negative relationships between the pre-pledge Ecological Footprint and the attitude and behaviour of the learners. The Ecological Footprint thus did not directly have an effect on the attitude and behaviour of the learners. It indirectly influenced the knowledge base of the learners, which then had an impact on their attitude and behaviour as can be seen in the increased strong positive correlations

discussed in section 4.2.3.

Table 9: The correlations between the pre- and post-pledge Ecological Footprint and post-test knowledge, attitude, and behaviour (n = 37)

	Knowledge	Attitude	Behaviour
Ecological Footprint (pre-pledge)	0.069	-0.016	-0.054
Ecological Footprint (post-pledge)	0.586	0.482	0.544

The correlations between the post-pledge Ecological Footprint and knowledge, attitude and behaviour could thus increase by 0.517, 0.498, and 0.598 respectively if the learners' apply the pledges they made. This, in all cases, could result in stronger positive relationships. It could imply that the increased knowledge and changed attitude and behaviour of the learners influenced the Ecological Footprint scores by influencing the conscious decisions of each learner to make changes in their lifestyles in order to have sustainable lives. However, these relationships are really of no significance if the learners do not implement the pledges in their day-to-day lives. It can only be verified if the Ecological Footprint scores are calculated for each of the learners after a period of time to see whether there are any significant changes in the true Ecological Footprints of the learners.

4.5 SUMMARY

The results interpreted, and discussed in the preceding sections showed that there was a significant decrease in the calculated knowledge, attitude, and behaviour scores of the learners. There was an indication that the Ecological Footprint influenced the learners' knowledge, attitudes and behaviour positively. This was also reflected in the post-pledge Ecological Footprint scores that reduced significantly after the lecturing series on Sustainable Development and the impact of human activities on the resources of earth.

The methodology of using the Ecological Footprint as an Environmental Education tool to teach the concept of Sustainable Development still needs some further development and refining. There was however an indication that it can be used successfully in the development of a broadly based Environmental Education programme of reforms to move learners in the Environmental Management and Water Care programmes at TNG in the direction of sustainability.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The feasibility of using the Ecological Footprint as an educational tool to change the behaviour, and attitude of the learners and thus adding to their knowledge of Sustainable Development was evaluated. The information presented, interpreted and discussed in Chapter 4, gave an indication that the knowledge, attitude, and behaviour scores of the learners were lower after using the The Living More Lightly Profile to calculate their respective Ecological Footprint scores. The average knowledge scores of the learners showed a decrease, indicating a decrease in both the average scores for attitude and behaviour after the application of the Ecological Footprint.

The pre-test knowledge, attitude, and behaviour of the learner group were of a reasonable standard. Through the use of the Ecological Footprint, the scores of the three variables were decreased. This indicated an increased knowledge, and better attitude and behaviour towards the environment, specifically towards Sustainable Development. The increased knowledge and improved attitude and behaviour could lead to a more responsible lifestyle and subsequently a reduction in the Ecological Footprint of each learner that participated in this investigation.

It can thus be concluded that the Ecological Footprint can successfully be used as an Environmental Educational tool to increase the knowledge and change the attitudes and behaviour of Environmental Management and Water Care learners at Technikon Northern Gauteng towards sustainable living within their respective environments.

5.2 CONCLUSIONS

The following conclusions can be drawn from the data presented and discussed in Chapter 4:

- The knowledge, attitude, and behaviour scores obtained in the pre-test questionnaire showed that most members of the sample group had a *good basic* knowledge (84%); *reasonable good* attitude (78%); and *responsible* behaviour (78%) of and towards the environment. (section 4.2.1)
- The learners' knowledge, attitude, and behaviour scores from the post-test questionnaire were lower than the pre-test scores. The scores indicated that after the completion of the Ecological Footprint analyses and attendance of the intervening lectures, 94% had a *good basic* knowledge; 97% had a *reasonable good* attitude, and 95% displayed *responsible* behaviour of and towards the environment. (section 4.2.1)
- The paired two-tailed t-test and P-values of the statistical analyses showed that these reductions in the mean scores of knowledge, attitude and behaviour were statistically significant. (section 4.2.2)
- There was a positive pre-test relationship of significance between all three variables. (section 4.2.3)
- There were also strong positive relationships between all the variables in the post-test data collected; in fact, it showed much stronger positive relationships compared to the pre-test relationships between the respective variables. (section 4.2.3)
- The Ecological Footprint scores indicated that only 8 learners are living within the world's average land area available and only 18 within the national (South African) average land area available. (section 4.3)

- The post-pledge Ecological Footprint scores showed that 18 learners could live within world average land area available and 27 learners within the national average if they implement the pledged changes. The changes in their lifestyles could thus reduce their impact on the Earth and its limited resources. (section 4.3)
- The relationship between the post-test knowledge, attitude and behaviour and the pre-pledge Ecological Footprint was insignificant and weak. (section 4.2.3)

5.3 RECOMMENDATIONS

The following recommendations can be made as a direct result from the information gathered during completion of this investigation:

- It will be of significant value to do a follow up on the pledges made by the learners for their post-pledge Ecological Footprint to observe if there were any real significant changes in their knowledge, attitude or behaviour and in their respective lifestyles that could have a positive impact on the earth and its resources.
- From the results discussed in the preceding chapter, it will be worthwhile to consider the incorporation of the Ecological Footprint into the curricula of the two academic programmes, Environmental Management and Water Care at TNG.
- The results presented in this report are valid only for the specific case study and are not generalized. It is recommended that this investigation be applied to urban and rural schools and tertiary institutions that have a compilation of learners with different backgrounds. The results for each case study can then be compared, in order to make some form of final decision concerning the viability of using the Ecological Footprint as an educational tool to increase the knowledge and improve the attitude and behaviour of individuals towards their environment.

- It will be worthwhile to investigate and consider the incorporation of the Ecological Footprint into the curricula of Environmental Education at all levels and develop a lecturing series that can be distributed to primary and secondary schools for use in their Environmental Education activities.

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APPENDICES

***“Hoc erat in votis: modus agri non ita magnus, hortus ubi et tecto vicinus
iugis aquae fons et paulum silvae super his foret” - Horace – 65-8 BC***

*(This was among my prayers: a piece of land not very large, where a garden
should be and a spring of ever flowing water near the house, and a bit of
woodland as well as these)*

Appendix I

MEd (ENVIRONMENTAL EDUCATION) QUESTIONNAIRE (pre- and post-test)

IMPORTANT INFORMATION!!!!!! PLEASE READ THIS SECTION CAREFULLY BEFORE YOU PROCEED WITH THE COMPLETION OF THE QUESTIONNAIRE.

This questionnaire has been designed to allow you to assess your knowledge of the concepts "The Ecological Footprint" and "Sustainable Living" and to assess your behaviour and attitude towards the environment and sustainable living. Please respond truthfully, so that your answers will accurately describe your actual knowledge, behaviour, and attitude. Remember, there is no right and no wrong answers to the given statements. This is not a test or an examination. Respond with what you feel and know and not what you think the project leader wants you to say or know.

Name:	
Student number:
Age (in years):
Gender:	Male Female
Have you completed an Ecological Footprint analysis?	Yes No

Before you start, please supply us with the following information before you complete the questionnaire:

<p><u>LICKERT SCALE</u></p> <p>1 = definitely agree</p> <p>2 = agree</p> <p>3 = do not agree</p> <p>4 = definitely do not agree</p>
--

Please work through the following statements and, use the values in the Lickert scale above to give your immediate response.

Work your way quickly through the questionnaire, but please check that you have answered all questions.

			SCALE			
		STATEMENT	1	2	3	4
KAB	1	I feel recycling can make a positive impact on the environment				
KA	2	I believe that watching programmes on environmental related issues, changes my attitude towards the environment				
KAB	3	I read articles about environmentally related issues				
AB	4	I think it is important to be a member of an environmental club				
KAB	5	I believe it is important to act quickly on environmentally related issues				
KAB	6	I am responsible for the sustainability of the environment				
A	7	I believe it is the government's responsibility to protect the environment				
K	8	I have knowledge of strategies available for use in improving environmental issues				
KAB	9	I do not see the environment as part of me				
AB	10	The environment is not important to me				
K	11	I understand the impact of human activity on the environment				
AB	12	I make others aware of the environment				
A	13	I see environmental responsibility as an act to make a positive change				
AB	14	I am involved with Environmental Education projects in my community				
AB	15	I recycle waste				
AB	16	I reuse waste				
KAB	17	I have experienced personal growth through Environmental Education				

		STATEMENT	1	2	3	4
B	18	I use the necessary skills to evaluate information about environmental issues				
A	19	I am powerless to make a difference to the environmental situation				
KA	20	I understand various environmentally-related problems and issues				
K	21	The Ecological Footprint is a measure of the load imposed by a given population on nature				
K	22	Human society is not part of the ecosystem				
K	23	The Ecological Footprint is a tool used to predict human impact on the Earth				
K	24	The Ecological Footprint is a tool used to learn about ecological limitations				
K	25	The Ecological Footprint is a tool used to learn about developing a sustainable lifestyle				
K	26	An ecosystem is a community of living organisms interacting with their environment				
K	27	Natural resources is the supply of man-made materials for use by other humans				
K	28	Biodiversity indicates the overall health of the Earth				
K	29	Food security means that all people must have their food in a secure place				
K	30	Technology is the use of science and knowledge to create tools to benefit only a few people in the world				
K	31	The world population is increasing but the amount of land for growing food is not				
K	32	The climate is controlled by balancing the Earth's and the atmosphere's energy levels				
K	33	If the Earth's temperature increases, food and water shortages will occur				
K	34	Water on Earth is evenly distributed				
K	35	Water is in short supply around the world				
K	36	Using renewable energy can help to slow global warming				

		STATEMENT	1	2	3	4
K	37	Pollution can only be contributed to man				
AB	38	I do not waste energy				
K	39	Health is defined as a state of complete physical, mental and social well-being and the prevention of disease				
KAB	40	I live my life sustainably				

Finally,

In your own words, describe what you understand by "sustainable development".

.....

.....

.....

.....

.....

How well do you think you were being informed at primary school about the environment?

Very well Quite well Not so well Rather poorly

How well do you think you were being informed at secondary (high) school about the environment?

Very well Quite well Not so well Rather poorly

How well do you think you were being informed at home (parents, guardians, family members) about the environment?

Very well Quite well Not so well Rather poorly

Any comments you wish to add?!!!!!!

.....
.....
.....
.....

.....

Your Signature

Date

Thank you for completing this questionnaire: your cooperation is much appreciated. Please return the completed questionnaire to the front.

Ms Verena Meyer
Principal Lecturer, Department Chemistry

[Adapted from: The Institute for Earth Education, 1990]

Appendix II**THE LIVING MORE LIGHTLY PROFILE****MY ECOLOGICAL FOOTPRINT**

NAME:	
STUDENT NUMBER:	
DATE:	
HAVE YOU COMPLETED A LIVING MORE LIGHTLY PROFILE BEFORE:	
YES	NO

INSTRUCTIONS

To complete the profile simply choose an answer to the statements given and mark it with a clear cross in the columns provided. Make a decision for all statements given on this profile. Please pay close attention to the sequence of the option, as it may vary. If any item is not applicable to you (e.g. you do not own a car), choose NA. Remember this is not a test. Don't try to do well. Just be as honest as you can. You may be surprised!!!

KEY

The following Lickert scale was used for this questionnaire (sections A to H):

R = rarely
S = sometimes
U = usually
NA = not applicable

SECTION A: FOOD CONSUMPTION AND PACKAGING

I use paper towels and/or napkins	R	S	U	NA
I take my own paper bags (or other containers) to the grocery store	U	S	R	NA
I avoid purchasing things in plastic containers	U	S	R	NA
I grow some of my own food	U	S	R	NA
I compost- organic food waste	U	S	R	NA
I use Styrofoam products	R	S	U	NA
I purchase food in bulk quantities and containers	U	S	R	NA
I eat red meat more than twice a week	R	S	U	NA
I avoid eating animals raised in modern factory-farm production	U	S	R	NA
I read the labels before buying foodstuffs	U	S	R	NA
I prepare meals without using processed foods	U	S	R	NA
I grow or buy organically produced foodstuffs	U	S	R	NA
I eat at fast-food restaurants	R	S	U	NA
I belong to a food co-op in my community	U	S	R	NA
I eat food grown locally and in season	U	S	R	NA
I avoid snacks and other foodstuff with lots of packaging	U	S	R	NA
I make use of leftovers	U	S	R	NA
I eat on airplanes	R	S	U	NA
Score:				

SECTION B: HOUSEHOLD ENERGY AND SUPPLIES

I turn off electrical lights and appliances when no one is in a room	U	S	R	NA
I heat a portion of my home using renewable resources (wood, solar, biogas)	U	S	R	NA
I run a dishwasher only when it is full and then let the dishes drip dry	U	S	R	NA
I decide what I want from the fridge/freezer before opening it	U	S	R	NA
I use air conditioning in the summer	R	S	U	NA
I avoid using non-essential electrical appliances	U	S	R	NA
I turn the pilot switch off on my stove	U	S	R	NA
I check the insulation and fittings in my house and improve it if necessary	U	S	R	NA
I keep the windows closed when cooling or heating my home mechanically	U	S	R	NA
I make my own household cleaners out of non-toxic materials	U	S	R	NA
I use storm doors and windows	U	S	R	NA
I use a non-motorized push lawnmower and avoid mowing my lawn	U	S	R	NA
I avoid washing clothes before they really need it	U	S	R	NA
I wash my clothes in cold water	U	S	R	NA
I let my washing drip dry	U	S	R	NA

I avoid using decorative lighting	U	S	R	NA
I use low wattage and/or energy saving light bulbs wherever I can	U	S	R	NA
I use facial tissues	R	S	U	NA
I use natural cleaning and grooming agents	U	S	R	NA
I use pesticides or other chemical fertilizers	R	S	U	NA
I avoid buying plastics of all kinds	U	S	R	NA
I purchase well-made, functional clothing	U	S	R	NA
I avoid purchasing a daily newspaper	U	S	R	NA
I share things with my neighbours	U	S	R	NA
Score:				

SECTION C: WATER AND WASTE WATER

I bathe/shower every day	R	S	U	NA
I limit my showers to five minutes or less	U	S	R	NA
I turn off the geyser when leaving the house for more than a day	U	S	R	NA
I turn off the water when brushing my teeth or shaving	U	S	R	NA
I use regulators on shower heads to reduce the water used	U	S	R	NA
I use phosphate free detergents	U	S	R	NA
I place something inside my toilet tank (or install a device) to reduce the amount of water used per flush	U	S	R	NA
I avoid pouring toxic substances or unknown chemicals down the drain	U	S	R	NA
I purchase scented, imprinted toilet paper	R	S	U	NA
I use naturalistic landscaping	U	S	R	NA
Score:				

SECTION D: TRANSPORTATION

I purchase internal combustion vehicles with more than four cylinders	R	S	U	NA
I drive a vehicle that achieves 9 km/l	U	S	R	NA
I regularly walk or ride a bicycle somewhere rather than driving	U	S	R	NA
I car pool or use mass transit	U	S	R	NA
I keep my vehicle properly tuned and serviced for the best energy efficiency	U	S	R	NA
I purchase radial tires and keep them properly inflated	U	S	R	NA
I drive the same car for eight years or more	U	S	R	NA
Score:				

SECTION E: RECYCLING AND REUSING

I recycle aluminum	U	S	R	NA
I recycle paper	U	S	R	NA
I recycle glass bottles	U	S	R	NA
I recycle metal cans	U	S	R	NA
I recycle motor oil	U	S	R	NA
I use returnable bottles whenever possible	U	S	R	NA
I reuse envelopes	U	S	R	NA
I use both sides of a sheet of paper	U	S	R	NA
I do not throw away items which could be repaired or reused	U	S	R	NA
I give unnecessary clothing and furnishings to charity	U	S	R	NA
I reuse plastic and paper bags	U	S	R	NA
I buy throw away pens	R	S	U	NA
I refuse paper or plastic bags for my purchases	U	S	R	NA
I use disposable diapers	R	S	U	NA
Score:				

SECTION F: NATURAL CONTACT AND RESPECT

I visit or take a walk in a natural area each week	U	S	R	NA
I notice the changing phases of the moon	U	S	R	NA
I share the love of nature with others	U	S	R	NA
I seek support within my spiritual views for living more lightly on the Earth	U	S	R	NA
I pay attention to the natural changes in the seasons	U	S	R	NA
I make an extended visit to a natural setting at least once each year	U	S	R	NA
I notice the colour of the sky	U	S	R	NA
I treat all living things with respect	U	S	R	NA
I eat baby animals (veal, lamb, baby chickens)	R	S	U	NA
I kill things for recreation	R	S	U	NA
I practice minimum impact techniques when I go camping	U	S	R	NA
I purchase products made from wild animals	R	S	U	NA
Score:				

SECTION G: MISCELLANEOUS

I engage in recreational activities (low energy, no power boating, racing, etc)	U	S	R	NA
I spay or neuter my dog or cat	U	S	R	NA
I work at learning more about ecological processes and what they mean to me	U	S	R	NA
I purchase simple, durable, low energy things whenever possible	U	S	R	NA
I work consistently at improving my own habits	U	S	R	NA
Score:				

SECTION H: ENVIRONMENTAL PARTICIPATION

I discuss pending environmental legislation with people around me	U	S	R	NA
I ask my workplace to engage in more environmentally-sound practices	U	S	R	NA
I help restore natural areas	U	S	R	NA
I keep abreast of current environmental issues	U	S	R	NA
I actively support an environmental action group	U	S	R	NA
I inform my elected officials about my environmental concerns and recommend actions	U	S	R	NA
Score:				

SECTION I: STANDARD ADDITIONS

Number of rooms in my dwelling	1-3	4-7	7 or more
Number of cars I own	0	1	2 or more
Number of recreational vehicles I own	0	1	2 or more
Number of houses I own or rent	0	1	2 or more
Number of kilometers I travel to work	0-6	7-23	24 or more
Number of medium to large pets I own	0	1	2 or more
Number of kilograms I am overweight	0	5-9	10 or more
Score:			

SECTION J: REPRODUCTION SURCHARGE

The number of children I have produced										
0	1	2	3	4	5	6	7	8	9	10
Score:										

SECTION K: STANDARD SUBTRACTIONS

I wash my dishes by hand (5 points)	False	True
I use a composting toilet (5 points)	False	True
I buy used clothing or make my own (5 points)	False	True
I wash my clothes by hand and let them drip dry (5 points)	False	True
I do not use an air conditioner to cool my home (5 points)	False	True
I have made arrangements for a natural burial (5 points)	False	True
I do not own a car (10 points)	False	True
I buy very few material things (10 points)	False	True
I teach my children how to live more lightly (if this is true, select the number of children you have - 10 points per child)		
0 1 2 3 4 5 6 7 8 9 10		
I have relatives, friends, etc. living with me (if this true, select the number of people living with you - 10 points per person)		
0 1 2 3 4 5 6 7 8 9 10		
Score:		

SCORING INFORMATION

The completed tables are being scored as follows:

Sections A to H (Environmental habits and participation)

Left column = 0 points

Middle column = 2 points

Right column = 5 points

NA = 0 points

Section I: Standard additions

Left column = 0 points

Middle column = 10 points

Right column = 25 points

Section J: Reproduction surcharge

Number of children multiply with 200 and then divided by 2

Section K: Standard subtractions

False = 0 points

True = 5 or 10 points (see table for more information)

Number of children multiply with 10 points

Number of people multiply with 10 points

YOUR LIVING MORE LIGHTLY SCORE

Take each calculated score form each section and write it in this table.

SECTION	SCORE
Food consumption and packaging	
Household energy and supplies	
Water and waste water	
Transportation	
Recycling and reusing	
Natural contact and respect	
Miscellaneous	
Environmental participation	
Total impact points (add the scores from sections A to H)	
Standard additions	
Reproduction surcharge	
Standard subtractions	
Your living lightly score = total impact points plus standard additions plus reproduction surcharge and then subtract the standard subtractions	

YOUR CORRESPONDING ECOLOGICAL FOOTPRINT

Your living lightly score	Your Ecological Footprint		
	Hectares	m2	km2
150	4	40 000	40
150-350	4-6	40 000-60 000	40-60
350-550	6-7.8	60 000-78 000	60-78
550-750	7.8-10	78 000-100 000	78-100
More than 750	> 10	> 100 000	> 100

The lecture that follows will explain what your Ecological Footprint means, how it impacts on the Earth and its resources and the effect it has on humanity and sustainable living and development. You will also be able to compare your Ecological Footprint with your peers and with average footprints of South Africa and the world.

You will be supplied with ideas on how to reduce your Ecological Footprint. By making some commitments towards a more sustainable lifestyle, you can re-complete the profile and see how it can reduce (or increase) your Ecological Footprint.

Thank you for your cooperation and participation. It is highly appreciated.

Ms Verena Meyer

Project leader

[Adapted from: www.eartheducation.org, s.a]

Appendix III

**POWER POINT PRESENTATIONS USED IN
LECTURES ON THE ECOLOGICAL FOOTPRINT
AND SUSTAINABLE DEVELOPMENT**