Mapping School Children's perceptions of Environment: A case of elementary schools in Nakuru District, Kenya.

By
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March, 2009

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Thesis submitted to the International Institute for Geo-information Science and Earth Observation in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation - Natural Resources Management

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INTERNATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION
ENSCHEDE, THE NETHERLANDS

Dedicated to my loving parents,

Onesphore and Jane Kanamugire

And

My brother Andrew and sisters; Odetta, Vena, Devota and Annette.

Abstract

The aim of this study was to investigate schoolchildren's perceptions of environment to see if a mapping culture can be introduced in elementary schools. Participatory mapping was used to derive schoolchildren's knowledge about the environment in Nakuru District, Kenya. Children's perceptions of environment were extracted from sketch maps of good and bad environments. These were used to investigate schoolchildren's perceptions of environment in relation to the environmental problems in the area. The Wilcoxon rank-sum test was used to determine whether or not there are differences between schoolchildren's environmental perceptions from the different schools. The children's environmental perceptions extracted from their sketch maps reflect an interaction between children's mental representations and the environments to which they are exposed. The test statistic (W_s) from Wilcoxon rank-sum test resulted into rural group obtaining the smaller summed rank (W_s=754.7). The environmental perceptions based on sketch maps of a bad environment provided the urban group with the smaller summed rank (W_s=570.5). Basing on the sketch maps, schoolchildren's perceptions show a relation to some environmental problems that are located near their schools, homes and in areas outside the study area. Some of these problems can be differentiated among schoolchildren from different schools but some positive environmental perceptions are common to all. This research indicates that participatory mapping has the potential of being an integral part of teaching, particularly for the environmental educators. Knowledge about the environment based on schoolchildren's maps can be analyzed and even monitored by the environmental educators in search for children's progress on understanding the environment.

Key words: Environment, environmental education, schoolchildren, perceptions, participatory mapping, elementary schools.

Acknowledgements

My utmost thanks to Almighty God for his eternal grace, love and mercy and without whom all would not have been possible.

My sincere thanks to the Netherlands Fellowship Programme for awarding me the scholarship to undertake my studies at ITC. The experience has truly been one of a kind. My appreciation to the supportive staff at Rwanda Environment Management Authority for their great support and advice particularly Dr. Rose Mukankomeje for supporting me to take this opportunity.

Deep gratitude to my supervisors Drs. Jeroen Verplanke and Dr. Michael Weir for their expert guidance and moral support. Even during the darkest days you always gave me hope and your mind opening ideas always drove me into working harder. Same token of appreciation to Dr Michael McCall for your encouragement and helpful advises.

My sincere gratitude also goes out to the programme director, Dr M. Weir, your fatherly attitude and advises were very necessary during the course of my MSc study. I also thank my course lecturers in ITC for their great professionalism during the entire course.

Many thanks to Mr. Julius Muchemi and your family for all the logistics for work in Nakuru. I also thank the supportive staff at ERMIS Africa, headteachers of Primary Schools (Lions Primary School, Moi Primary School, Kagoto Primary School, Kiamaina Primary School and Nessuit Primary School), to all the schoolchildren and their teachers that took part in this study, you were all good company.

For all my fellow MSc students, Rwandese and International friends I met at ITC, you are far too many to mention, I deeply thank you for your enduring friendship and company, which was always necessary when I needed it.

Lastly but not the least, my heartfelt appreciation goes to my Mum and Dad, brother Andrew and sisters Odetta, Vena, Devota and Annette and friends in Rwanda for their love, encouragement and support throughout the 18 months of my study at ITC.

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1. Introduction

1.1. General Introduction

Early childhood education is about laying a sound intellectual foundation for development and lifelong learning. It has an enormous potential in fostering values, attitudes, skills and behaviours that support sustainable development, for example, wise use of resources (UNESCO, 2008). This study largely adopts an approach which is concerned with mapping schoolchildren's perceptions of environment.

"*Cognitive mapping is a process composed of a series of psychological transformations by which an individual acquires, codes, stores information about the relative locations and attributes of phenomena in his everyday spatial environment*" (Downs and Stea, 1973).

Young people at every stage of their education should be informed about the dangers of environmental degradation, overuse of fossil energies and the prospects of renewable energy (United Nations Children's Fund, 2007). The role of education in terms of dealing with environmental problems and opportunities is therefore crucial. It involves learning from the environment as well as about the environment therefore requiring changes within some well established approaches to teaching (UNESCO, 1977). For better information on children's understanding of the environment with its associated problems, then cognitive mapping is one of the most effective and generally useful strategies as well as toward spatial problem-solving (Downs and Stea, 1977).

Typically, outdoor environmental education is an activity-based experience. Concepts and lessons about the natural world are brought to life (through direct experience and movement). Techniques are well established in the environmental field. Unfortunately, methods utilised in outdoor environmental education lack the capacity to investigate mapping (Haskin, 2002). Understanding of space is reflected in human activities that attempt to communicate spatial information effectively (Kitchin and Frendschuh, 2000). Therefore, this study seeks to understand schoolchildren's perceptions of environment to see if a mapping culture can be introduced to enhance environmental education in elementary schools.

1.1.1 Promoting Environmental Education

"Kenya's wealth is endowed in its natural resources that are distributed throughout the nation. It is among the 47 countries within sub-Saharan Africa that depend heavily on their natural resources for economic and social needs. Two-thirds of the country's population live in rural areas and rely on agriculture and other natural resources. However, the natural resource base is shrinking rapidly, environmental problems are becoming increasingly severe, pushing the country into poverty and associated environmental problems such as deforestation, soil erosion, pollution and health. This indicates that these resources cannot be guaranteed for future generations in the same quantities and quality. It is unsustainable. Despite the various initiative and responses that have been practiced and recommended, there have not been any remarkable results" (Otieno, 2005).

As a response to the above challenges, Environmental Education (EE) is one of the efforts the Kenyan government adopted following the 1977 Intergovernmental Conference on Environmental Education, Tbilisi. The Kenyan government is committed to Agenda 21, Chapter 36 on Education and Sustainable Development, and demonstrated this by the adoption of the National Environment Action Plan (NEAP) (Otieno, 2005).

According to the National Environment Action Plan (NEAP, 1994), environmental education is used to increase awareness and to sensitise people on environmental issues. Efforts to implement this are already being introduced. For instance, environmental education programmes in Nakuru, Kenya aiming at strengthening knowledge and creating awareness of environmental problems with schoolchildren. The programmes have provided assistance to primary schools such as development of simple weather stations, establishment of nurseries for indigenous tree species, tendering of tree nurseries and organising training for the teachers. The environmental and wildlife clubs lack for instance, lesson plans for environmental classroom and outdoor activities (www.africanconservation.org).

Mapping activities have reflected an understanding of children's views given their different gender and age. For example, Green mapping is a popular community based technique for describing the opportunities for sustainable living and showing patterns of green space in addition, Green Map system focuses on mapping the community's perceptions and values of their local environment and inclusive are maps made by children (Tulloch, 2004). Like other educational experiences, (Anderson, 2005) provides a collection of children's mental maps such as world maps that were aimed at for

instance, promoting children's creative representation of the world, enhancing their cartographic awareness and building in them a consciousness of their environment.

Taking an opportunity, such as introducing a mapping culture with the school children in elementary schools of Nakuru, may create new ways in which the children can take a more active part in their communities. Studies carried out in mapping within various communities such as (Frost, 2004) further indicates the possibility of students learning the basic GIS technology: understanding how to use GPS and gain a thorough understanding of watersheds, maps and finally build a giant 3-D map of the watershed for display.

1.2. Background of the Research

The purpose of this study is to see if a mapping culture can be introduced into the teaching practices on environmental education. In the long term, this considers the influence of maps with children in learning about the environment. As children acquire new ways of mentally representing and using spatial information, their understanding of the environment could improve. Uttal (2000) felt that children's limitations in thinking about spatial information may reflect a lack of understanding of the functions and uses of maps. It is best to take activity-based lessons, such as mapping culture, to determining how best to achieve enhancing children's thinking about spatial information in terms of the environment and its associated problems.

Participatory mapping has spread with many variants and applications such as in natural resources management (Chambers, 2006). The recent growth in the availability of modern spatial information technology such as Geographic Information Systems (GIS), low cost Global Positioning Systems (GPS), remote sensing image analysis as well as the growth of participatory mapping techniques, is enabling communities to make maps of their lands and resources (Fox et al., 2006).

It is in this respect that participatory techniques can be used to elicit primary school children's knowledge about, for instance, environmental issues. Being a marginalized group in an adult society Children can demonstrate their competence given the fact that there is a need for more input into their environmental education activities to enhance a better understanding of the environment. As a result, infusing a map culture into schools - in this case, primary schools - can turn out to be a positive step towards map awareness (Mallick et al., 2005).

With the increasing need for learning skills such as mapping technology, school children can benefit from learning to think spatially. Spatial thinking is a skill used in everyday life, in the workplace and in science to solve problems using concepts of space, visualization, and reasoning. In this regard, the range of low and high technology tools such as Geographic Information Systems (GIS) can be necessary for their education by infusing it into the existing various subject areas (National Research Council, 2006).

Participatory mapping in a number of countries has shown that organizations have considerable positive experiences mapping children's perceptions for all various purposes. Experiences drawn from mapping with school children such as (Kumar, 2003; Mallick et al., 2005; McCall, 2005) provided opportunities to the children towards better understanding of environmental issues. Participatory mapping is used to discover and interpret people's mental maps. These are frequently, but not confined to indigenous peoples. This is the most problematic application of participatory mapping because it must often handle alternative indigenous spatial concepts (McCall, 2006).

The idea of children drawing mental presentations of space, sometimes known as cognitive maps, involves them in mapping environmental issues in their locality. This further draws children towards coming up with ideas for solving the environmental problems. Furthermore, it also stimulates them in learning to generate interactive GIS maps prepared in Personal Digital Assistant (PDA) coupled with Geographic Positioning System (GPS) (Mallick et al., 2005). Effective participatory mapping requires an understanding of school children's access to environmental learning in schools thus having individual perceptions on what they understand on the environment. However, a lack of a map culture imposes limitations to environmental activities by children.

1.3. Research Problem

Both formal and non formal education are indispensable to changing people's attitudes and for achieving environmental awareness, skills and behaviour consistent with sustainable development. There is a need to take into account specific interests of children on environment for environmental improvement (Stanley, 1993). Teaching techniques on, for example, outdoor environmental education, lack the exploration of mapping technologies (Haskin, 2002). Methods towards determining children's environmental perceptions would be important for environmental educators to identify which areas of little or no environmental understanding need more attention. Even though environmental awareness programmes are taking place within Nakuru, Kenya, participatory mapping has hardly been used. Although participatory mapping is the most adopted approach drawing people together, children are not used to expressing their views freely or being taken seriously by adults

because of their position in adult-dominated society (Debbie, 2006). This calls for further research in mapping school children's perceptions. Therefore the research will be conducted to investigate school children's perception on environment working in cooperation with their teachers.

Maps are therefore essential tools that are becoming increasingly important for enhancing environmental education and public awareness. Policy makers need to know environmental perceptions of the children to help identify areas where little or no access to environmental education exists. The information is also essential to help teachers to know children's knowledge of what and where environmental issues are and better teaching practises that could have great impact. Participatory mapping is also a tool that could be used by teachers to find out changes in environmental perceptions of the children over the years, furthermore, it can also be used for communicating information and findings to teachers, governmental authorities, NGOs, other disciplines and to the public as well.

1.4. Research Objectives and Questions

1.4.1. Main Research Objective

The main objective of the research is to investigate the school children's perceptions of the environment through participatory mapping approaches so as to introduce a mapping culture among the children.

1.4.2. Specific Research Objectives

1. To identify the key environmental problems in the study area
2. To identify available and common participatory methods and explore which Participatory Geographic Information System methods could be used with children
3. To examine the perceptions of school children of the environment.
4. To explore the capability of participatory mapping in identifying environmental issues from children

1.5. Research Questions

In response to the specific objectives as posed above, the following questions are formulated and will be answered in the course of the research

1. To identify the environmental problems in the study area
    1. What environmental variables are key focus in mapping children's perception?
    2. How are the environmental problems spatially located?
2. To identify of available and common participatory methods and explore which Participatory Geographic Information System methods could be used with children
    1. What are the common participatory methods existing in place?
    2. Which of the participatory methods are useful towards mapping environmental perceptions of the school children?
3. To examine the perceptions of schoolchildren on the environment.
    1. What activities are used to engage children in environmental learning?
    2. What are the children's perception of the environment?
4. To explore the capability of participatory mapping in identifying environmental issues from schoolchildren.
    1. What benefits can be derived from using participatory methods in identifying environmental issues with children?

The first research questions, with respect to objective one examine some environmental problems in the study area. The questions, with respect objectives two and three explore participatory tools which could be used with children. This is helpful for investigating schoolchildren's perceptions of environmental problems in the area. To introduce a mapping culture in elementary schools in the long term, the answers with respect to the research questions will give more insight into the significance particularly for environmental educators.

1.6. Conceptual Framework

For environmental management to be effective, requires that people be aware of their environment and of environmental problems. To achieve this in the long term, environmental education must be infused into schools to provide environmental knowledge to the school children. This study therefore examines some environmental problems and investigates schoolchildren's perceptions of these problems.

Based on the concepts presented in the conceptual framework (Figure 1), awareness of the environment calls for transfer of knowledge about the environment. This can be integrated at all levels of education, in environmental clubs and through public awareness e.g. via the media.

Environmental education in elementary schools can be enhanced by introducing new tools for teaching practices. Participatory mapping applications for eliciting people's spatial knowledge is such a tool that is increasingly used, readily available and easy to use (Holly et al., 2006). This is likely to be helpful for the schools, and particularly for environmental educators.

In this study, we also incorporate skills from children's experiences where we have their knowledge about the environment, e.g. either directly through the environment or by use of secondary sources. This study largely adopts a participatory tool which relies on sketch maps of children's perceptions of environment. The knowledge about the environment based on their maps will be assessed by analysing the views and the results will be compared among schoolchildren from different schools. In the long term, a mapping culture can be introduced in elementary schools and this could be beneficial for the schoolchildren and the environmental educators.

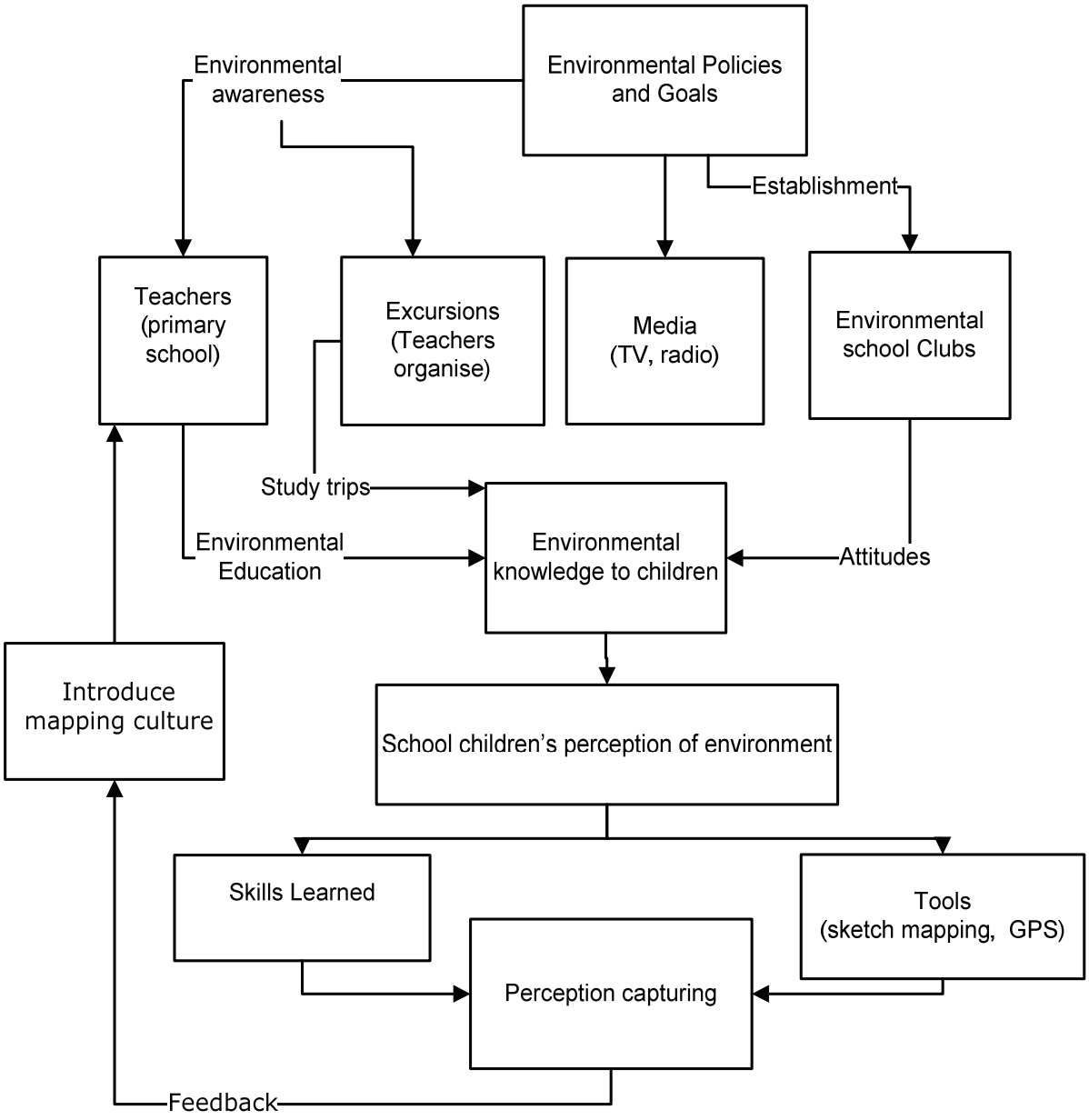


Figure 1: Conceptual framework of the study

1.7. Thesis Structure

This thesis is composed of seven chapters.

Chapter 1

Provides an introduction to the topic. It also discusses the environmental problems associated with the natural resources that lead to environmental education as one of the efforts the Kenyan government adopted. It defines the research objectives and questions.

Chapter 2

This chapter presents a review of relevant literature and summarises aspects related to the research topic. In this chapter, some tools that are useful for investigating children's perceptions are presented. The role of participatory mapping in this study is also discussed.

Chapter 3

Gives a general description of the education systems in Kenya and description of the study area. It also describes the methods, including the data collection techniques, used during this study and explains procedures used for data analysis.

Chapter 4

Provides the results of the study.

Chapter 5

This chapter presents the discussion of the results.

Chapter 6

Presents the conclusions of this research and recommendations for further work.

2. Literature Review

2.1 Children in sustainable development

The psychologist Jean Piaget's theory of children's development is based on the belief that the children's concept of space is the result of interaction between the child and the environment (Cele, 2006). Children are highly aware supporters of environmental thinking. In so doing, specific interests of children need to be taken fully into account in the participatory process on environment thus safeguarding sustainability of any actions upon improving the environment (Stanley, 1993). Among other United Nations millennium development goals, by 2015, member states have given a pledge to ensure environmental sustainability (United Nations Children's Fund, 2007). This is particularly the case when educating children in the perspective of sustainable environment.

Schools, such as elementary schools, are ideal places in developing children's knowledge about the environment. Some important suggestions for environmental education imply that it must develop skilled problem solvers, hence the need for problem solving approaches. Examples of environmental problem solving skills include; problem identification, issue investigation and evaluation (Harold and Robert, 1994). The international Environmental Education Program (IEEP) produced the first intergovernmental statement on environmental education (Palmer, 1998). Figure 2 shows the objectives for environmental education as adapted from the Belgrade Charter. Elementary schoolchildren are among the major categories within the global frame (UNESCO, 1975). In this study, we use the elementary schoolchildren as our audience.

The objectives for environmental education as adapted from the Belgrade Charter that could be relevant to this study, requires that people develop into environmentally responsible citizens. To achieve this in the long term, they should be citizens aware of and concerned about the total environment and its associated problems and should have knowledge, attitudes and skills to work collectively towards solutions for current problems and the prevention of new ones.

Environmental Education Objectives

The objectives of environmental education are:

1. Awareness. To help individuals and social groups acquire an awareness of and sensitivity to the total environment and its allied problems.

2. Knowledge. To help individuals and social groups acquire basic understanding of the total environment, its associated problems and humanity's critically responsible presence and role in it.

3. Attitude. To help individuals and social groups acquire social values, strong feelings of concern for the environment and the motivation for actively participating in its protection and improvement.

4. Skills: To help individuals and social groups acquire the skills for solving environmental problems.

5. Evaluation ability: To help individuals and social groups evaluate environmental measures and education programmes in terms of ecological, political, economic, social, esthetic and educational factors.

6. Participation: To help individuals and social groups develop a sense of responsibility and urgency regarding environmental problems to ensure appropriate action to solve those problems.

Audiences

The principal audience of environmental education is the general public. The major categories are:

1. The formal education sector - including pre-school, primary, secondary and higher education students as well as teachers and environmental professionals in training and retraining;

2. The non-formal education sector - including youth and adults, individually or collectively from all segments of the population, such as the family, workers, managers and decision makers, in environmental as well as non-environmental fields.

Figure 2: Environmental Education Objectives and audience

Adopted from (UNESCO, 1975).

2.2 Teaching mapping technologies with Experience-based Lessons

Education authorities are expected to develop and use proven educational approaches and innovative teaching methods. Such approaches and methods will help in promoting environmental awareness (Stanley, 1993) and depicting knowledge acquisition. As follows, relevant reviews on the use of technologies are presented such methods include; Map schemata, GIS technology and Participatory GIS methods. Two cases on the use of pictures and GPS-based mapping is presented to enhance understanding of the process examined.

Schemata are particularly useful in education whereby they enable the depicting of knowledge acquisition by use of semantic networks showing relationships in many directions. This is also conceived as nodes with links between them. Specific map schemata include road maps and topographic maps (Wiegand, 2002). This method is important in terms of understanding children's explanations about maps. But there may be differences between children's understanding of maps made by others and the understanding derived from making their own maps (Gerber, 1981) (Wiegand, 2002).

Environmental educators are introducing new tools, for instance GIS technology, into the teaching practices of environmental education. This is a computerised system helping in maintaining and displaying data about geographic space (de By et al., 2004). Incorporating in-depth project-based experiences in environmental education with hands-on learning, computer technologies such as GIS is bridging the gap between indoor and outdoor classrooms (Haskin, 2002). However, this method is costly and therefore not used in teaching environmental education given that some elementary schools do not have computers and teachers may be having no training with GIS.

"Blending outdoor environmental lessons with GIS technology provides a mixture of education and science to challenge students' perspectives". (Haskin, 2002)

With regard to the use of pictures, (Wiegand and Stiell, 1996) states that pictorial maps have a long tradition in cartographic history. They report on the exploration of map-located pictures as a form of cartographic communication with children. It included the following: picture identification and children's interpretation of picture location. This case illustrates children's understanding of pictures. The report mentions how children make sense of the pictures according to their prior knowledge and experience. Furthermore, it mentions that children were able to identify pictures depending on their own experience in terms of forms of representation and real life. In addition, questions were

developed to investigate understanding of the importance of picture location on the map. By exploring children's understanding of pictures, teachers have a way of drawing picture content of, for example, major environmental problems and unfamiliar images such as global environmental issues to the children, thereby improving children's understanding about the environment and studying their perceptions through useful strategies.

Describing the use of GPS is an example of a classroom projects in South Dakota (Shelhamer, 2002). South Dakota students participated in technologies such as GPS among others. Each students personal web page was created. They had GPS exercises whereby they collected waypoints and wrote essays about their homes hence, teachers fixed a GPS/GIS project of the school district using the essays as links to the waypoints. Another school project led by a science teacher, involved the use of GPS in the classroom with purpose to incorporate students' interest in animals. Students had a field visit whereby they collected images of selected animals then drew and observed the animals. With extensive internet and library research on the animals, the information was linked to a digital map of the zoo. To locate specific locations of the animals within the zoo boundaries, the GPS was used. There are other examples of studies using GPS (see, for example (Verplanke and McCall, 2003)). However, it might take several days and even years before some elementary schools invest in computers and tools such as GPS for use in teaching environmental education.

Even though technologies exist that can enhance environmental education, the methods could be costly for the schools. The problem especially with outdoor environmental education lacking the capacity to investigate mapping software has motivated looking for other inexpensive methods that offer simplicity and opportunities to enhance the capacities of schoolchildren. One such method is participatory mapping.

2.3 Participatory mapping in the identification of environmental problems with children.

Children's progress in understanding of environmental problems both global and local, depends on the transfer of knowledge in schools, hence, investigating their knowledge about the environment can be dealt with through the choice of existing participatory approaches. For example, PGIS elicits spatial knowledge and involves processes for people's participation (McCall, 2008b). Because PGIS is a flexible toolbox (Verplanke, 2008), it seems likely that it is appropriate for representing children's knowledge about the environment by PGIS.

PGIS is the result of a spontaneous merger of Participatory Learning and Action (PLA) methods with Geographic Information Technologies (GIT). PGIS practice merge geo-spatial information management tools ranging from sketch maps, Participatory 3-Dimensional Models (P3DM), scale mapping, ephemeral mapping, aerial photographs, satellite imagery, Global Positioning Systems (GPS) and Geographic Information Systems (GIS) to compose peoples' spatial knowledge (www.iapad.org). However, some of these tools increase in complexity (Holly et al., 2006). Useful discussions of the application of relevant PGIS approaches in different societies can be found in, for example, (Mandara, 2007; Minang, 2003; Trang, 2004). Information and maps describing the children's perceptions of environment in urban and rural settings are therefore essential for environmental education and awareness.

Improving environmental education and raising awareness is in accord with Environmental Management and Coordination Act, 1999, which mandates National Environment Management Authority (NEMA-Kenya) to "undertake cooperation with lead agencies, programmes intended to enhance environmental education and public awareness about the need for sound environmental management as well as for enlisting public support and encouraging the efforts made by other entities" (NEMA, 2004).

Cognitive mapping research has practical application in education (Kitchin, 1996). Developing a population in this case children, that are aware of, and concerned about the environment and its problems, PGIS methods allow the possibility of mapping and identifying the children's environmental perceptions. Among these methods, sketch mapping is an excellent tool in reflecting the visions of people (Alcorn, 2000).

2.3.1 The role of participatory mapping

Participatory mapping is defined broadly as any combination of participation-based methods for eliciting and recording spatial data (Vajjhala, 2005). Examples include, sketch mapping, transect walks, scale mapping, etc (Chambers, 1994). Based on the nature of this method, this study proposes an introduction of a mapping culture within the environmental education programs in elementary schools. Teachers use many tools in environmental education (Marcinkowski et al., 1990). Sketch mapping allows for introducing new ways of thinking and observing by enhancement of activity-based experiences. This would benefit the educators in areas of environmental study that need additional efforts based on the children's maps. In addition, they could make use of this method whilst finding out changes in environmental perceptions as result of exposure to local and global environmental

concerns within the programs. Specific examples on the use of sketch maps include (Green, 1998; Wiegand, 2002).

Map visualisation consists of two steps, the visualisation process and the visualisation strategy (Georgiadou et al., 2004). In this respect, the visualisation process involves children translating their spatial environmental perceptions into maps guided by methods such as, sketch maps. The visualisation strategy includes maps as final products (presentation, and means of visual communication) and maps as intermediate products (exploration, and an aid to visual thinking) (Georgiadou et al., 2004). Different visualisation tools include sketch mapping, participatory aerial photography, P3DM, among others (McCall, 2008a). Sketch mapping is adopted for this study because it offers the children opportunities to produce their environmental perceptions. This could also be helpful tool for the environmental educators because assessment is a necessary and integral part of planning for teaching (Wiegand, 1997). Therefore, this tool particularly for the educators can be used to monitor children's progress on understanding the environment based on their maps.

The focus in this study about introducing a mapping culture includes the kinds of maps that can regularly appear on the walls of school classrooms. More importantly for the schoolchildren, is the focus on the outcomes of exposure to maps that represent space and allow effective learning about the total environment and its associated problems.

The role of the teaching mapping technologies with experienced based lessons that could be used for environmental education and the practice of participatory mapping in the identification of environmental problems with children could improve children's understanding of the environment. This could call for introducing new tools into teaching practises such as a mapping culture. In addition, tools such as participatory mapping could be used to assess children's environmental perceptions thus giving more insight into environmental problems and the locations basing on what the children know and do not know.

"The influence of maps may be analogous to the influence of other symbol systems on cognitive development. The most general characteristic of maps is that they allow us to gain acquire, inspect and think about spatial information. In so doing, children may possess the ability to represent spatial information mentally at an early age." (Uttal, 2000).

3. Methods and Materials

3.1 Education system in Kenya

The aim to investigate schoolchildren's perceptions on environment requires the involvement of primary schools particularly where environmental education programs are in process. The research was therefore conducted in Nakuru, Kenya (Figure 3) because of its environment and its associated problems particularly in relation to the knowledge about environment that schoolchildren possess. The target group consisted of primary school children within the ages of 7 and 15 years olds.

Kenya's education system consists of early childhood education, primary, secondary and college. Early childhood education takes at least three years and primary education eight years. Primary school age is 6/7-13/14 years. Following the introduction of Free Primary Education in January 2003, the enrolment of children has increased over the years. Children are enrolled in both public and private primary schools. Others are enrolled in non-formal schools and centres (Ministry of Education, 2005). Kenya is a multilingual country. Among a total of African languages spoken in Kenya, its official languages are Swahili and English.

3.2 Description of study area

Nakuru lies within Northwest of Nairobi in the Kenyan Rift Valley. It is located at 139 kilometres from Nairobi, Kenya. The area is bounded by longitudes of 36°12'15.27"E and 35°56'1.22"E as well as latitudes of 0° 8'40.21"S and 0°24'54.25" S. Nakuru is a regional centre and is the Headquarters of the Rift Valley Province. The town serves as a service centre for the surrounding rich agricultural hinterland. The diversity of geographical, ecological and landscape features, resulting from the volcanic activities that accompanied the formation of the Rift Valley characterise the natural assets of the region served by Nakuru.

The main ecological features are the Menengai forest on the slopes of Menengai crater and a variety of diverse flora and fauna (a variety of wild animals and bird species) found within the Lake Nakuru National Park on the southern edge of the town. Lake Nakuru is especially known as one of the largest bird sanctuaries with flamingos and pelican bird species worth mentioning. Therefore, the town is sandwiched between Lake Nakuru, and the Eburu Hills in the south and the Menengai Crater and its

associated volcanic landscapes in the north. To the northeast of the town are the Bahati Highlands and to the southwest the Mau Escarpment.

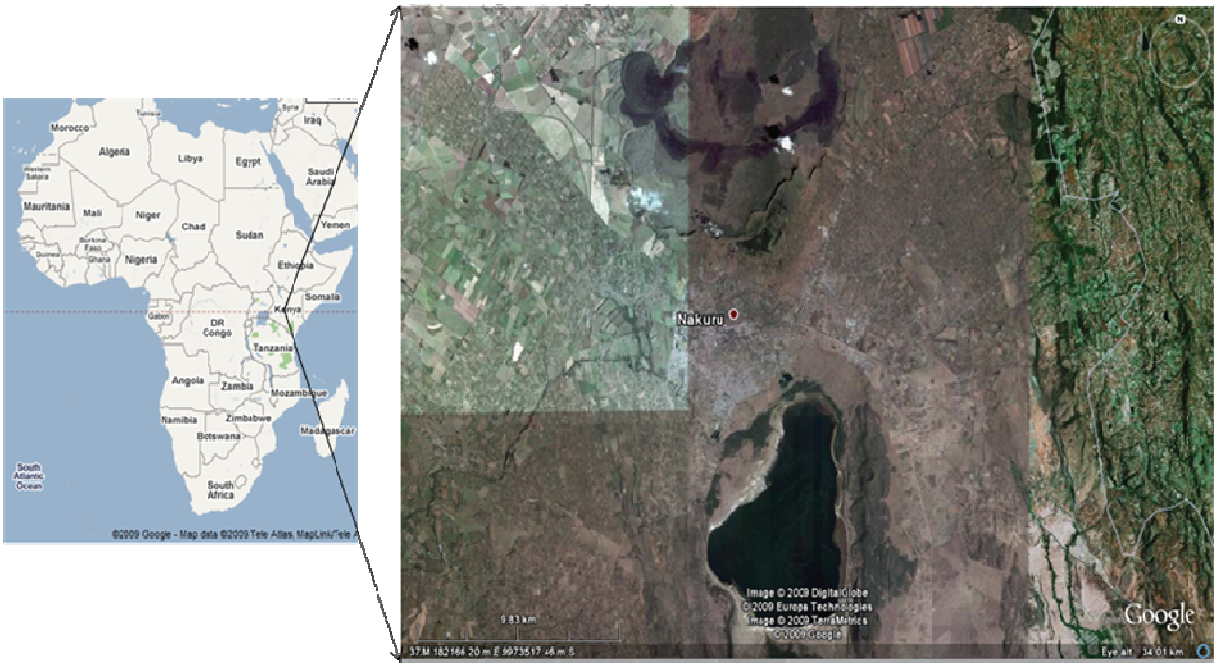


Figure 3: Location Map of study area
Source: Google Earth

3.3 Data collection

The data collection stage involved collecting relevant information such as literature and from schoolchildren's maps from elementary schools. Elementary schools were selected within areas of the district of Nakuru. The schools were selected from rural and urban areas with respect to the children's perceptions of the environment within the study area. Different environmental issues have been reported in the study area (MCN, 1999). These include dumping of solid wastes, pollution of both soil and water, water shortage, loss of biodiversity, soil erosion, storm water drainage and deforestation. During the field work data collection, the researcher was able to note some major environmental issues in the different areas in the study area within the location of the schools. Figure 4 (an oblique view) shows the distribution of the elementary schools that participated in this study.

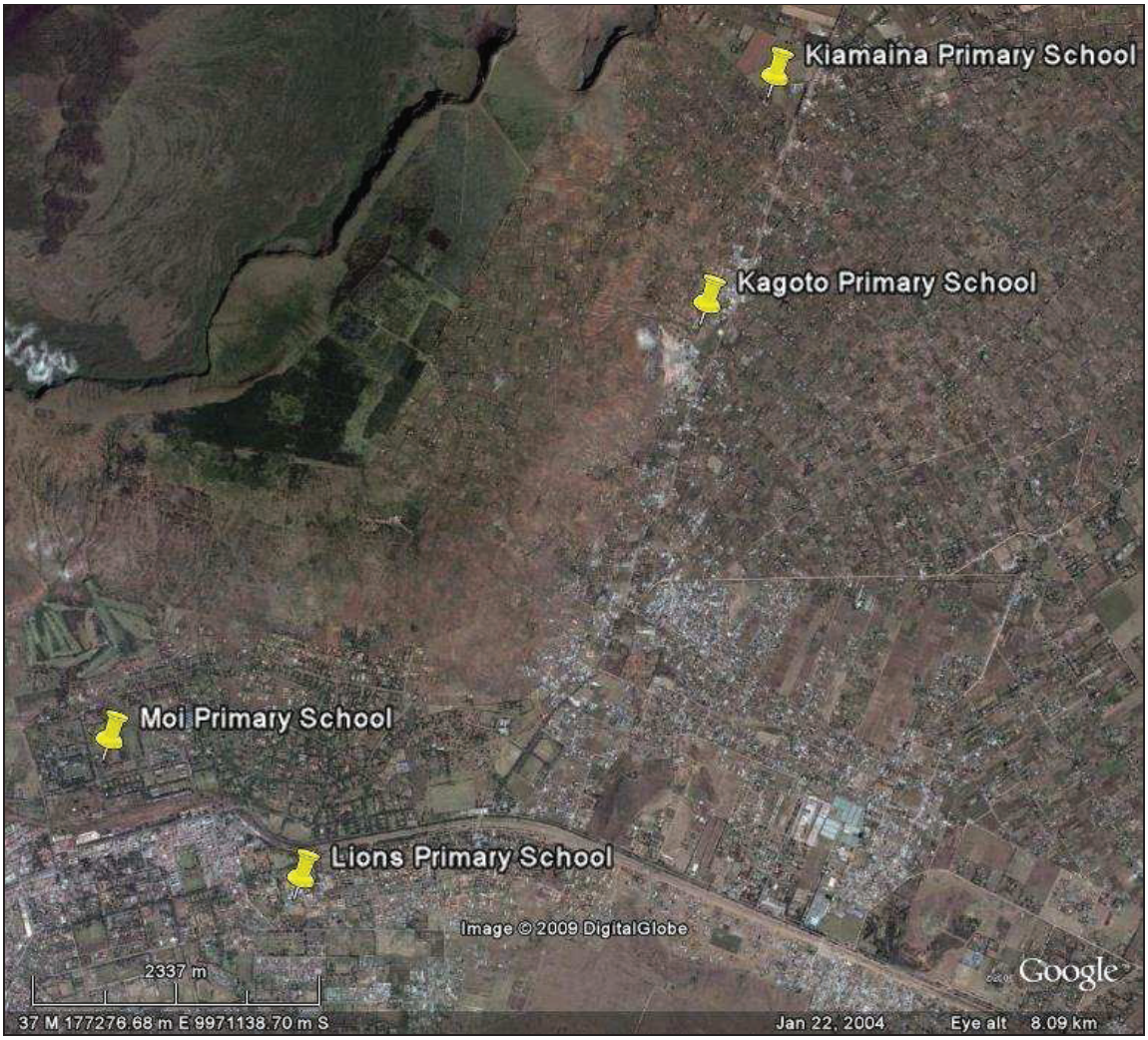


Figure 4: Location and distribution of schools
Source: Google Earth

During the field work data collection the sampling was taken from urban and rural schools. School Children aged 7- 15 year olds within elementary schools in Nakuru participated in this study (n=76). A sample of 5 schools were approached and consented to the research activities. A letter explaining the objectives of the study was provided to the Head teachers and environmental club patrons, and consent for the school children's participation was sought. Children were not required to give any written consent and were free to withdraw from participating in any aspect of the study. The research activities were conducted during afternoon lessons. The groups amongst the schoolchildren were selected since the mapping activity was incorporated in between the school programmes.

Visual examination and group discussion with the schoolchildren was done all together in describing the various items drawn on their maps. Notes were taken where environmental patrons explained different activities going on in their schools, role of, for example environmental clubs in the schools, etc. Differences and similarities amongst the different schools were noted basing on (e.g. location of schools, activities schoolchildren are engaged in, etc). In addition, there was a chance to observe the major environmental issues in the study area, where some of these issues were found to be known to the schoolchildren.

The study groups

Eight study groups of children were drawn from five elementary schools based on different education levels. Two schools within the urban area and three schools in nearby rural communities. The first school consisted of two study groups made of 20 children; (10 from class three; and 10 from class five) from a school within the urban areas. This group is currently exposed to an environmental education program. The second school located within the urban areas as well consisted of 15 children; (5 from class 2; and 10 from class 4). This group is engaged in a structured environmental education program. The third school and fourth school consisted of 10 children each that attend the schools in the nearby rural communities (10 class five pupils; and a mixture of 10 children from classes six and seven). Efforts are being made to teach the children about the environment. The final group consisted of 20 children (10 class six pupils and 10 class seven pupils). No efforts are currently in place for example, set up an environmental club in the school or plant trees compared to the other schools that are involved these activities and more.

3.4 Methods

The optimal tool for investigating the schoolchildren's perceptions of environment should reflect their knowledge about of the environment. The method could draw out some examples of the total environment and its associated problems (e.g. deforestation, pollution, solid waste management, etc) so that views that children know and don't know are discovered. To meet this condition, a tool was considered that involves making sketch maps of good and bad environments. Participatory mapping was used to elicit children's spatial knowledge about the environment. The use of this tool was used so that the children could each come up with their own maps .Among other methods include; group discussions for further understanding of their knowledge of about environment, interviews for teachers perceptions, pictures to find out how children make meaning of picture and a statistical method to assess the views among schoolchildren from different schools.

3.4.1 Participatory mapping as a tool

The map drawing sessions were two to three days apart, with the good environment map completed on the first day and the bad environment map completed on the following day. On both sessions, the purpose of the drawings and procedure for drawing the maps was explained to the children. It was explained that the map should include areas around places and things they know. Two sheets of A3 paper were provided to each school child and children were encouraged to use pencils and rulers on their maps. School children were provided with a definition of the word 'environment' as "our surroundings, the places and things that are around us". Children were asked to draw places they know or have been to. Shown in figure 5 are children drawing their maps during the mapping activity. This helped to see if there are significant differences or not in their views on the environment between the major environmental problems in the study area in relation to what is drawn on the children's maps.

Figure 5: Schoolchildren working on their maps

3.4.2 Group Discussions

To clarify children's understanding, discussions were held after each drawing sessions. Group discussions explored school children's perceptions about their drawings of the good and bad environment. Their drawings were used to explore the extent to which the school children have thoughts of a good and a bad environment within their surroundings and places they have been to. The absence of colored pencils or crayons to shade their maps lead to the discussion of the kind of colors

they would give to a good or a bad environment, and what physical spaces such as parks and leisure centers were known to them. They also discussed participation in school activities within their school environmental and wildlife clubs.

Figure 6: Schoolchildren during the group discussions

After the group discussions with the schoolchildren, the researcher went into the field to verify what they have sketched on the map. This was performed to ensure that the researcher fully understood what the school children had drawn. The GPS measurements included the taking GPS reading of some locations such as children's homes and schools as mentioned as a good environment and neighbour's homes as a bad environment. The locations of items drawn on maps as discussed with the schoolchildren were later recorded by GPS.

3.4.3 Interviews

In total 4 interviews were done during this research, 1 per school. This was done mainly with environmental patrons that cooperatively worked with school children during the participatory mapping process. During the fieldwork, it was of interest to talk to the environmental club patrons in particular such that they can share their experiences and knowledge about the environmental clubs programs. The interviews involving environmental clubs patrons (except for one rural school which does not have such a patron) applied an open structure, whereby the discussion focused on the exploration of actual practices, and views of the environmental club patrons. Questions (see appendix 4) ranged from what roles they play in the clubs to the teaching practices employed to have the school children actively involved into activities that foster their understanding of the environment. All interviews were recorded on audio tape with the consent of the interviewees.

3.4.4 Pictures

Pictures were used for finding out children's views on the environment. Environmental content of the pictures was randomly determined i.e. a general view on environment content within the pictures was set up for investigation. However, the range of alternatives between pictures on different aspects of the environment was limited. From one rural school that doesn't have an environmental club in place, a sample of 10 children participated. This was so that children could express their views about pictures that were shown to them. After the display of the eleven pictures, the school children provided a brief written explanation on paper. The pictures were selected to obtain an overview of the environment (see appendix 3). This was to help find out how children make meaning of the pictures.

3.5 Statistical method

To compare the differences between schoolchildren's environmental perceptions from the different schools, a non-parametric test was used. Non-parametric tests are a family of statistical procedures that do not rely on the restrictive assumptions of parametric tests. In particular they do not assume that data come from a normal distribution. The tests are non parametric equivalent of the independent t-test (Field, 2005). The test chosen is the Wilcoxon rank –sum test to determine whether or not the environmental perceptions of children from one school setting are different from another. The school settings in this case are the rural and urban settings. Therefore, with the equal group sizes of children

from urban and rural schools, the test statistic (W_s) from Wilcoxon's rank-sum test is the value of the smaller summed rank.

3.6 Data Analysis

1) **Environmental problems in the area**

To relate the environmental problems and children's perceptions of environment, the major environmental problems in Nakuru had to be examined. To achieve this, the problems were reported based on field observations and discussions with (e.g. Director of Environment, Nakuru Municipality). The knowledge about the environment based on the children's sketch maps was assessed by analyzing the views and results were compared among the schoolchildren from different schools.

Based on the children's environmental perceptions, the study also analyzed the examples of locations given by the children according to their sketch maps of good and bad environments. This was to help get insight into what the children know and do not know.

2) **Schoolchildren's perceptions of environment**

Based on the objective which focuses on the children's perceptions of environment, the Wilcoxon rank-sum test was chosen to find out whether or not the environmental perceptions of children from one school setting are different from another. This is because there are different teaching practices on environmental education that are being used in elementary schools.

Using the Wilcoxon rank-sum test, a total of 60 schoolchildren from urban and rural schools were considered to extract their knowledge about the environment and each individual produced maps of a good and bad environment. The following was prepared. First, scores were arranged in ascending order and labels were attached (In this case U was used for urban and R for rural). Secondly, starting at the lowest score, potential ranks were assigned starting with 1 and going up to the number of scores we had. According to (Field, 2005) these are called potential ranks because sometimes the same score occurs more than once in a data set (e.g. in the data from sketch maps of good environment, a score of 2 occurs 8 times). These are described as tied ranks and these values need to be given the same rank.

Therefore, we assigned a rank that is the average of the potential ranks for those scores (with the same example as above, with the 8 scores of 2, because they were ranked as 12, 13, 14, 15, 16, 17, 18

and 19, we took an average of these values (15.5) and used this value as a rank for the 8 occurrences of the score.

And this resulted into children's different views that were prepared and later assigned scores. The data collected provided information to analyze children's environmental perceptions of good and bad environments. With equal group sizes of schoolchildren both urban and rural, the test statistic (W_s) from Wilcoxon's rank sum test is the value of the smaller summed rank.

In addition, determining whether or not the test statistic is significant, the mean (W_s) and standard error of the test statistic (SE_{Ws}) were calculated from the sizes of each group. The direction of differences between the responses of elementary school groups provides the basis to understand schoolchildren's exposure to environmental education programs.

Focusing on children's perceptions based on their feelings towards pictures that were used in this study, the Wilcoxon rank sum test was used as well to determine whether or not responses of the male group and female group are different from one another. A fairly limited number of 10 children from one rural school in total were considered to express their views towards the pictures. This was to help give insight into children's views towards the content of the pictures.

A total of 4 environmental club patrons from the schools that participated (except for one rural school which does not have such a patron), were also interviewed and each discussed on the actual practices in their schools. This was necessary to obtain data that would provide information to get insight into the outcome of some environmental issues mentioned by the children.

4. Results

4.1 Introduction

This section presents the main findings of the study and these are presented as follows;

- Key environmental problems in Nakuru
- Perceptions of environment among schoolchildren from different schools
- Locations of some environmental problems in relation to children's environmental perceptions
- Approaches to environmental education in schools
- Picture content and response of elementary school children

4.2 Results from observation

Field observation and discussions with, for example, the Director of Environment, Nakuru Municipality was carried out to point out some of major environmental problems. These include; dumping of solid wastes, pollution of both soil and water, water shortage, loss of biodiversity, soil erosion, storm water drainage and deforestation among others. Relating some of the environmental problems in the area to children's knowledge about the environment provided insight into some of the locations of environmental problems that children know and don't know. Examples such as environments around schools, neighbourhoods and areas outside the study area would likely have to do with the exposure to environmental education or it could be environments with which children are reasonably familiar, such as their neighbourhoods.

On the other hand, results in relation to some of environmental problems in the area and what the children communicated through their maps suggests some environmental problems that children have been (e.g. air pollution, deforestation, etc) or not been exposed to either through environmental education or other ways that contribute to the understanding of environment. However, with the possible exception of individual differences in experiences, some of the environmental problems in the area that children know or not know could differ.

4.3 Results from participatory mapping

4.3.1 Differences between schoolchildren's environmental perceptions based on sketch maps of good environment

To investigate the children's environmental perceptions, the knowledge about environment based on their sketch maps of good environment was assessed by analyzing the views (see appendix 1 for their views). The results are presented in Table 1 below, whereby data has been ranked. The ranks for the two groups were added, sum of ranks for the urban group is 835.9 and for the rural group it is754.7. When the group sizes are equal, the test statistic (W_s) from wilcoxon 's rank -sum test is the value of the smaller summed rank (Field, 2005). According to these results, the test statistic for data extracted from sketch maps of good environment is $W_s = 754.7$.

4.3.2 Differences between schoolchildren's environmental perceptions based on sketch maps of bad environment

The results as presented in table 2 below, the data has been ranked as well. The ranks for the two groups were added, sum of ranks for the urban group is 570.5 and for the rural group it is 704.5. Therefore, the test statistic for data extracted from sketch maps of bad environment is $W_s = 570.5$.

With the test statistic for the data, determining whether or not the test statistic is significant was calculated. The mean (W_s) and standard error of this test statistic (SE_{Ws}) can be calculated from the sample sizes of each group (Field, 2005). Therefore, (n_1 is the sample size of urban group and n_2 is the sample size of rural group:

$W_s = n_1(n_1+n_2+1)/2$

$SE_{Ws} = SQRT((n_1*n_2)(n_1+n_2+1))/12$

(Note – SQRT is used instead of the √ notation).

We have 30 children in each group, so n_1 and n_2 are both 30. Therefore, the mean and standard deviation are:

$W_s = 30(30+30+1)/2 = 915$

$SE_{Ws} = SQRT((30*30)(30+30+1))/12 = 67.64$

With test statistic, the mean of test statistics, and the standard error, then convert the test statistic to a z-score using the equation:

$_Z = X\text{-}X/_s = W_s\text{-}W_s/SE_{Ws}$

Calculating the value for the views from the Good and Bad environment scores:

$_Z$ Bad = 570.5-915/67.64 = -5.09

$_Z$ Good = 754.7-915/67.64 = -2.36

If these values are bigger than 1.96 (ignoring the minus sign) then the test is significant at $p<.05$. Therefore, it looks as though there is a significant difference between the groups based on their sketch maps of good and bad environments.

Table 1: Ranking the data (extracted from sketch maps of good environment) for two groups

Good	Score	Rank	Actual rank	Group
	0	1	4	U
	0	2	4	R
	0	3	4	R
	0	4	4	R
	0	5	4	R
	0	6	4	R
	0	7	4	R
	1	8	5.4	U
	1	9	5.4	R
	1	10	5.4	R
	1	11	5.4	R
	2	12	15.5	U
	2	13	15.5	U
	2	14	15.5	U
	2	15	15.5	U
	2	16	15.5	U
	2	17	15.5	U
	2	18	15.5	R
	2	19	15.5	R
	3	20	21	U
	3	21	21	R
	3	22	21	R
	4	23	23.5	U
	4	24	23.5	U
	5	25	26	U
	5	26	26	U
	5	27	26	U
	6	28	28	U
	7	29	29.5	U
	7	30	29.5	R
	8	31	31.5	U
	8	32	31.5	R
	9	33	34.5	U
	9	34	34.5	U
	9	35	34.5	R
	9	36	34.5	R
	10	37	37	R
	12	38	39.5	U
	12	39	39.5	R
	12	40	39.5	R
	12	41	39.5	R
	13	42	42.5	U
	13	43	42.5	R
	16	44	44	U
	17	45	45	U
	18	47	48	U
	18	48	48	U
	18	49	48	R
	20	50	50.5	R
	20	51	50.5	R
	23	52	52	U
	24	53	53.5	U
	24	54	53.5	R
	25	55	55	R
	28	56	56	R
	29	57	57	U

Sum of ranks for Urban = 835.9, Sum of ranks for Rural = 754.

Table 2: Ranking the data (extracted from sketch maps of bad environment) for two groups

Bad	Score	Rank	Actual rank	Group
	0	1	5.5	U
	0	2	5.5	U
	0	3	5.5	U
	0	4	5.5	U
	0	5	5.5	U
	0	6	5.5	U
	0	7	5.5	R
	0	8	5.5	R
	0	9	5.5	R
	0	10	5.5	R
	1	11	13.5	U
	1	12	13.5	U
	1	13	13.5	U
	1	14	13.5	U
	1	15	13.5	R
	1	16	13.5	R
	2	17	20.5	U
	2	18	20.5	U
	2	19	20.5	U
	2	20	20.5	U
	2	21	20.5	U
	2	22	20.5	R
	2	23	20.5	R
	2	24	20.5	R
	3	25	26.5	U
	3	26	26.5	U
	3	27	26.5	R
	3	28	26.5	R
	4	29	30.5	U
	4	30	30.5	R
	4	31	30.5	R
	4	32	30.5	R
	5	33	35	U
	5	34	35	U
	5	35	35	R
	5	36	35	R
	5	37	35	R
	6	38	38.5	U
	6	39	38.5	R
	7	40	40	R
	8	41	41	R
	9	42	42	R
	14	43	43.5	U
	14	44	43.5	R
	15	45	45	R
	16	46	46	R
	17	47	47	U
	23	48	48.5	U
	23	49	48.5	R
	29	50	50	U

Sum of ranks for Urban = 570.5, Sum of ranks for Rural = 704.5

4.4 Results from group discussions

Location of environmental problems in relation to children's environmental perceptions

The general distribution of schools in this study is illustrated in Fig. 4. The main focus for this is to discover what the children mentioned such as, did they mention issues around their schools (Figure 7); Lake Nakuru, the Menengai crater, quarry site, farming activities, main dumping site, national park among others. Some of the problems could not be located spatially such as pollution and storm water drainage.

Figure 7: Location of some environmental problems
Source: Google Earth.

Names in white = Schools. Names in Green = Examples of areas for conservation and preventions from environmental degradation. Names in brown = Examples of some environmental problems.

4.4.1 Environments at school

Environments at schools occurred to be reasonably familiar with the children. This could be mainly as a result of their direct experience in the environment. Examples of locations that were mentioned by the children in relation to some of the environmental problems, provided more understanding into how children from different schools represent locations within the familiar environments such as those environments at school. Lake Nakuru is one such positive environmental perception that was common to all.

4.4.2 Environments within neighbourhoods

The children from their different schools gave the most examples of locations to their environmental perception in relation to their neighborhoods. This was mainly the case with the rural schoolchildren. Positive environmental perceptions such as farm animals, homes and trees among others (appendix 1) were illustrated in their maps and during discussions to locate examples of environmental perceptions such items were located at their homes, schools and distant family members' homes as well.

On the other hand, locating examples of some environmental perceptions particularly the negative ones, resulted into some of the children's mentioning negative environmental perceptions as being located within their neighbor's homes. Among the urban children, neighbors home were not mentioned as being examples towards negative environmental perceptions.

4.4.3 Areas outside study area

Assessing children's perceptions by analyzing their examples of locations to some of the environmental problems provided insight into environments with which children were also unfamiliar. Interviews with the environmental club patrons, provided useful understanding regarding how children learn about different environments. It was observed that some of the environmental problems and their locations were known to children based on the teaching practices used in the schools. For example, some of the children from urban schools mentioned of areas outside the study area. Schools exposing children in the teaching practices such as study trips, mainly resulted into giving locations of examples of some of their positive environmental perceptions such as parks, lakes and other nature areas outside the study area. These include; in Nairobi, Kericho and Naivasha (Figure 8). With regard to children from rural schools, some examples of areas outside the study area were mentioned specifically, in relation to areas where family members reside.

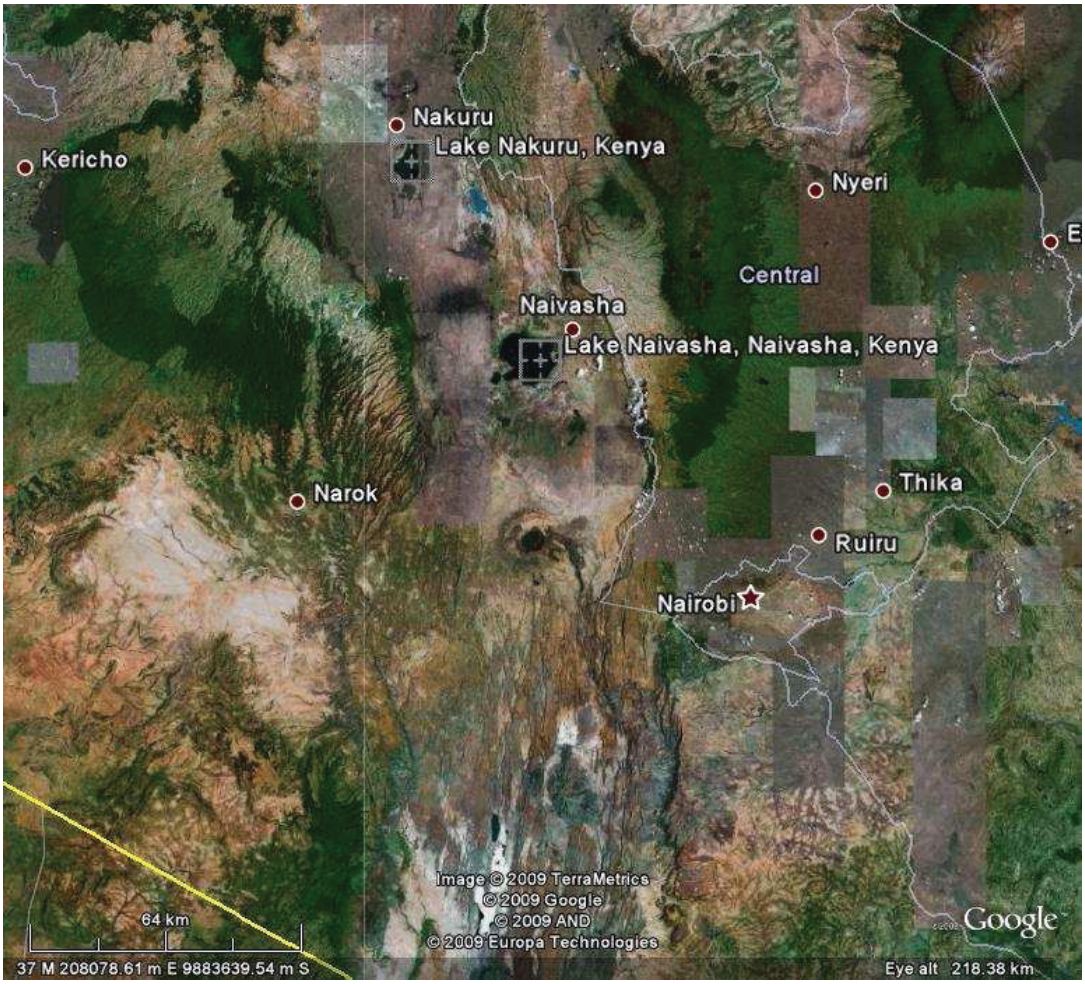


Figure 8: Study area and few other areas as mentioned by the children
Source: Google Earth

4.5 Results from Interviews

Approaches to teaching environmental education

The overall objective of environmental education in the schools is developing children's environmental understanding. The interview showed that there were 3 approaches in the field of teaching about the environment:

1) Extra curriculum activities. This is a result of no curriculum that schools can follow when introducing environmental education in schools. Often, the extra curriculum activities are used to enrich the children's learning experiences. For example, during the week, particular days are set aside for the children to take part in learning outside their classrooms by addressing issues such as health education. And participation in songs and drama for example, during ceremonies celebrating the World Environment day.

2) Education for sustainable development (ESD), where the strategy provides an opportunity for educating the Kenyan people on the importance of sustainable development and the contribution of various stakeholders (www.nema.go.ke). In the schools, the staff and patrons are not currently following the ESD strategy, except for one school- Lions primary school (location is shown in fig.7).

3) From theory to practice: This combines components of the formal curriculum with action plans which should result in the children's understanding and knowledge about the environment. Examples include plans based on the teacher's awareness and dedication.

Main activities that are used to engage children in environmental learning

The schools are focused around the activities such as; keeping school compounds clean, tree planting and visits to nature parks. The interviews revealed that the schools were involved in similar kinds of activities as planting trees, caring for the trees (watering) and picking litter around their schools whereby schoolchildren play major roles. Differences occurred in activities such as nature walks and excursions particularly in one of the urban schools thus exposing the children to other areas that they are unfamiliar with.

4.6. Results from pictures

4.6.1 Differences between schoolchildren's views based on pictures

The children's views towards the content in the pictures were analysed with the Wilcoxon rank-sum test as well. These provided their positive and negative views. The eleven pictures (Appendix 3) vary between different scenes that can be found in our surroundings. Table 1 shows an indication of positive or negative based on the views expressed in relation to the different pictures displayed to the children.

Participant	Gender	Pic A	Pic B	Pic C	Pic D	Pic E	Pic F	Pic G	Pic H	Pic I	Pic J	Pic K
1	Female	-	+	-	-	+	-	+	-	-	-	-
2	Female	-	+	+	-	+	+	+	-	-	-	+
3	Male	-	+	-	+	+	-	+	-	-	-	-
4	Female	-	+	-	+	+	-	+	-	-	-	+
5	Male	-	+	-	+	+	-	-	-	-	-	+
6	Male	-	+	+	+	+	+	-	-	-	-	-
7	Female	-	-	-	+	+	-	-	-	-	-	+
8	Male	-	+	+	+	+	-	+	+	-	+	+
9	Male	-	-	+	+	+	-	-	-	-	-	+
10	Female	-	-	-	+	+	-	+	-	-	-	+

Table 3: An indication of positive or negative views based on expressions in relation to the pictures

Note:

Pic = Picture

\+ = Positive

\- = Negative

The sum of ranks for the males and females were obtained from the rank-sum test. Table 1 and 2 show the summary of the ranking process for data extracted from the pictures. (M = Male and F = female).

Table 4: Ranking the scores based on the positive views towards pictures.

Score	0	0	0	0	0	0	1	1	1	1	1	2	3	3	3	3	4	4	4	5	5	5
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Actual rank	3.5	3.5	3.5	3.5	3.5	3.5	9	9	9	9	9	12	14.5	14.5	14.5	14.5	18	18	18	21	21	21
Gender	M	M	F	F	F	F	M	M	M	F	F	M	M	M	F	F	M	F	F	M	M	F

Sum of ranks for Males = 135, Sum of ranks for Females = 118

Table 5: Ranking the scores based on the negative views towards pictures

Score	0	0	0	1	1	1	2	2	2	2	3	4	4	4	4	4	5	5	5	5	5	5
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Actual rank	2	2	2	5	5	5	8.5	8.5	8.5	8.5	11	14	14	14	14	14.5	19	19	19	19	19	19
Gender	M	M	F	M	F	F	M	M	F	F	M	M	M	M	F	F	M	M	F	F	M	F

Sum of ranks for Males = 117, Sum of ranks for Females = 133

Responses between males and females using the Wilcoxon rank-sum test (Field, 2005) confirm significant differences. Smaller summed ranks were obtained between the male and female group (Table 1 and 2). The sum of ranks for pictures with positive views resulted into the males scoring a higher rank than females (sum of ranks for females = 118, sum of ranks for males = 135). However, in relation to negative views, the males scored a lower rank than the females (sum of ranks for females = 133, sum of ranks for males = 117).

Determining whether or not this test statistic is significant, the mean (W_s) and standard error of this test statistic (SE_{Ws}) was calculated. (n_1 is the sample size of male group), and n_2 is the sample size of female group:

$W_s = n_1(n_1+n_2+1)/2$

$SE_{Ws} = SQRT((n_1*n_2)(n_1+n_2+1))/12$

(Note – SQRT is used instead of the √ notation).

n_1 is 5 (males) and n_2 is 5 (females). Therefore, the mean and standard deviation are:

$W_s = 5(5+5+1)/2 = 27.5$

$SE_{Ws} = SQRT((5*5)(5+5+1))/12 = 4.79$

With test statistic, the mean of test statistics, and the standard error, converted the test statistic to a z-score using the equation:

$_Z = X\text{-}X/_s = W_s\text{-}W_s/SE_{Ws}$

The value for Positive and Negative view scores:

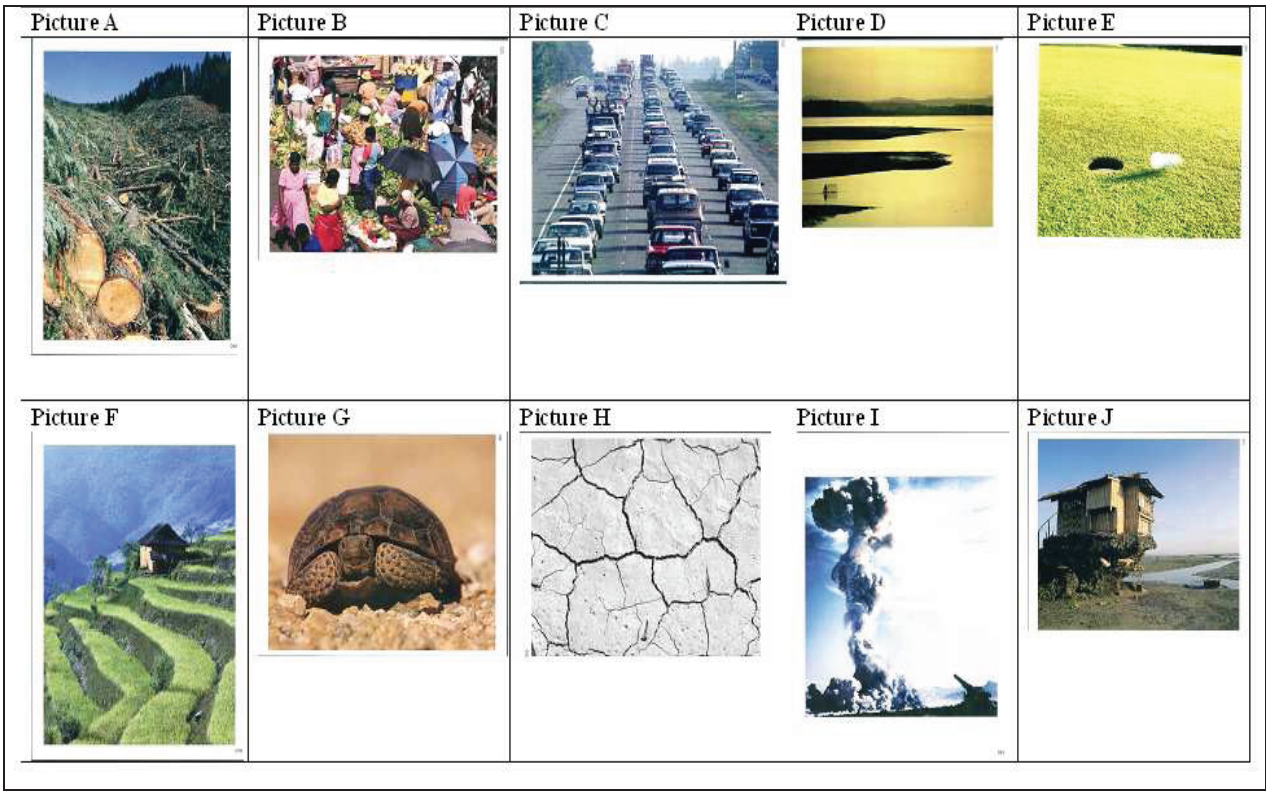
$_Z$ Negative = 117.5-27.5/4.79 = 18.69

$_Z$ Positive = 118.7-4.79/4.79 = 18.90

Values bigger than 1.96 (ignoring the minus sign), the test is significant at $p < .05$. Therefore, it looks like there is a significant difference between the groups on positive and negative views towards the pictures

Results by kind of response

Examination of the eleven pictures reveals different representations as picture A (cut down tress), picture B (Market), picture C (transport; cars), picture D (water), picture E (Golf course), picture F (house on a hill), picture G (tortoise), picture H (dry earth), picture I (air pollution), picture J (old house) and picture K (roads). The pictures and the most positive, negative and different responses are as follows:



Picture K

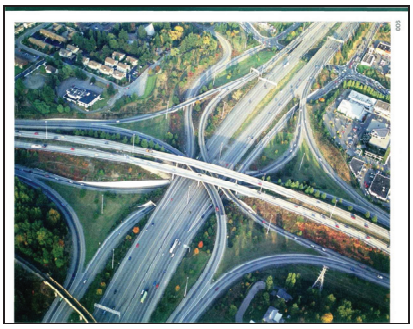


Figure 9: Pictures used for finding out children's views on the environment

Most negative responses

In picture A (cut down tress) and picture I (air pollution) (appendix 3), all the schoolchildren expressed their most negative responses toward these pictures as shown in Table 3. Picture J (old house), picture H (dry earth) and picture F (house on a hill) held high negative responses as well. These results suggest that regardless of no exposure to environmental education programs the children can make good sense of pictures in relation to their experiences and prior knowledge.

Most positive responses

The scenes in pictures (E=Golf course, D=water) were included to determine children's views towards scenes of natural areas (appendix 2). The most positive response is expressed in picture E (Golf course) (table 3) and followed by a close range in picture D (water) and pictures B (market) and K (roads). It might be assumed that the children in this school, with no environmental education programs had the opportunity to study about these areas within various subjects offered at their school and visit similar areas as well. Therefore, they responded from a position of awareness, which, promoted positive environmental views.

Differences in responses

The views of all the students differed in pictures such as (C=transport; cars and G=tortoise) (table 3). This indicates that they responded from a position of unfamiliarity thus bringing about a mixture of positive and negative perceptions.

Picture	Description of picture	Children's interpretations	Positive perceptions (n=10)	Negative perceptions (n=10)
Picture A	Cut down trees	**Negative** - Lost homes (animals) -No rain -Animals die -Causes soil erosion -Bad image to environment	0	10
Picture B	Market	**Positive** -Harding working people -People get money -Buying what one wants **Negative** - Scorching hot days while shopping -Fruits go bad -No trees	7	3
Picture C	Transport; cars	**Positive** -People get money for transport goods -Going to work -Travelling in cars **Negative** -Causes accidents -Small road -Traffic jam	4	6
Picture D	Water	**Positive** -Animals living in water -Transport; boat; ship -Can't travel long distance in search for water -Go fishing -Drinking water -Water is important **Negative** -If contaminated, kills animals living in water	8	2
Picture E	Golf course	**Positive** -Grass is good for animals; cows, sheep and goats -Environment looks attractive -Good for a football.	10	0
Picture F	House on a hill	**Positive** -People can live there -Plants growing prevent erosion **Negative** - No trees - Its cold; living there	2	8

		-Long distance when collecting water -Strong winds can carry away house		
Picture G	Tortoise	**Positive** -Can feed it with plants -Attract tourists -Love animals -Children can tour to visit wild animals **Negative** -No trees (animal has nothing to eat) -No grass	6	4
Picture H	Dry earth	**Negative** -No rain -No water -No food -Doesn't look attractive -Dangerous for animals **Positive** - Can find such areas within Kenya	1	9
Picture I	Air pollution	**Negative** -Birds can die -Cause diseases -No water -Destruction of buildings -Incase of a war, people die	0	10
Picture J	Old house	**Positive** -Living near water -Good house **Negative** -Dumping garbage in water -No trees -No food (absence of growing plants -Strong winds can carry away the house -No people around the house	1	9
Picture K	Roads	**Positive** -Roads look attractive -Travelling is easy -The best roads -Pupils can cross safely **Negative** -Cause accidents	7	3

Table 6: Interpretation of pictures. Pictures (see appendix 3).

The results of the analysis also reveal that pictures can be used to assess children's views. However, in this study, it relates to a small number of children. It is not on purpose to criticise any of the views expressed between the males and females. Like in agreement with (Wiegand and Stiell, 1996) pictures would be suitable for educational use. Interest was in expressions children make from pictures. With respect to the limitations of this approach ,was that the study did not investigate whether children are able to locate examples of what they have seen in the pictures.

5. Discussion

5.1 Environmental problems in the area

The Research questions, with respect to objective one, were addressed to examine some environmental problems and investigate schoolchildren's perceptions of these problems. Some of the major environmental problems in Nakuru were discussed and noted (section 4.2). This was possible based on descriptive explanations that were given about the area. Results from the discussions about some of the environmental problems include, dumping of solid wastes, pollution of both soil and water, water shortage, loss of biodiversity, soil erosion, storm water drainage and deforestation. Some of these problems concur with the children's perceptions of environment. Furthermore, through discussions, the schoolchildren were able to locate some examples of the environmental problems (Section 4.4). Some of the locations as mentioned by the schoolchildren include environments at schools, environments at home and areas outside the study area. This result agrees with previous study (Uttal and Tan, 2000) which found out that there is an interaction between the child's developing of mental representations and the environments to which they are exposed. However, exposure to mapping culture should lead to improvement in the ability to learn of unfamiliar environments and its environmental problems.

5.2 Participatory methods that could be used with children

To investigate schoolchildren's perceptions of environment, the research questions (research objective two) addressed are as follows; what are the common participatory methods existing in place? and which of these methods are useful towards mapping environmental perceptions of the schoolchildren? With the aim of investigating schoolchildren's perceptions of environment, participatory mapping was found appropriate to be used with children because it is such a tool that is increasingly used, readily available and easy to use (section 2.3.1). There are other participatory methods increasingly used (such as, ephemeral mapping, scale mapping and Participatory 3-Dimensional Modelling (P3DM)) but they were not considered to address the mentioned research questions. Those participatory methods were not chosen to address the research questions (research objective two) because of their complexity and some schools lack teaching materials such as computers for the use of GIS (section 2.3). In addition, the use of some tools, like GPS, requires training of the participants. This can only be used in cases where GPS is part of the curriculum otherwise it could take much of children's time.

5.3 Schoolchildren's perceptions of environment

The schoolchildren's perceptions of environment extracted from their sketch maps (appendix 5) gave insight into the different positive and negative perceptions that children possess. Their perception of the environment, based on their maps, shows that the problems can be differentiated among schoolchildren from different schools but some positive environmental perceptions were found common to all. The environmental club patrons from the schools that participated in this study were able to explain the outcome of some differences in issues mentioned by the children.

Discussion of results from interviews, with respect to [question -What activities are used to engage children in environmental learning?] shows that outdoor activities that are used to engage children in environmental learning at school include, tree planting, adopting trees, keeping school compounds clean e.g. through picking litter and visits to nature area. Among the children's environmental perceptions based on their sketch maps, the results indicate a relation to some of the environmental problems that are located near their schools, homes and in areas outside the study area. This result agrees with previous studies (Uttal and Tan, 2000) which found that children's ways of mentally representing information is in relation to the environments which they are exposed to.

Results to research [question-what are the children's perceptions of environment?] enabled the children to locate examples of their environmental perceptions. This was done through descriptive explanations and the main locations can be categorised as follows; (1) environments at school (2) environments at home and (3) areas outside the study area. With regard to environments at school, its obvious that examples of their positive and negative perceptions about the environment were located around schools for instance, both urban and rural schoolchildren found the playgrounds and gardens within their schools as a positive environmental perception. Another example is the dumping site (figure 7) which was particularly pointed out as a negative environmental perception by the urban children that attend school closest to the site. These results were expected, however, this study pointed out that some examples of locations were not mentioned by the children. This is particularly for some environmental problems that could be found in spaces with which they are unfamiliar.

Locating examples of their negative environmental perceptions around environments at home was common amongst the rural schoolchildren. Some of the children's negative environmental perceptions were located mainly within their neighbour's homes. Reasons for pointing them out included for example, the neighbours that did not have any trees planted in their compounds and those that had trouble with water shortage. This was unexpected because in my opinion the transfer of environmental

knowledge through the existing methods used in the schools, should be helping children acquire basic understanding of the environment and its associated problems.

With respect to locations outside the study area as examples of the children's positive environmental perceptions were found common among the urban schoolchildren. Based on some of the teaching methods used, it was expected that they would easily confirm to locations outside the study area. An example of such a method is study trips. However, not all the schools involved in this study make use of study trips as a teaching practice on environmental education. In addition, it can be assumed that sampling a bigger number of schoolchildren from different educations levels within schools for this study could have given insight into other diverse examples of locations.

The Wilcoxon rank-sum test can determine whether or not there are differences between schoolchildren's environmental perceptions from the different schools. The test statistic (W_s) from Wilcoxon rank-sum test resulted into rural group obtaining the smaller summed rank (W_s=754.7). This means that the sum of ranks (table 1) for the children from the rural group was as a result of the least number of views mentioned in the sketch maps of good environments compared to the diverse views mentioned by urban schoolchildren (sum of ranks for rural =754.7, sum of rank for urban = 835.9). The environmental perceptions based on sketch maps of bad environments provided the urban group with the smaller summed rank (W_s=570.5). This means that the urban group had least number of views mentioned on their maps compared to the diverse views from the rural schoolchildren (sum of rank for urban group = 570.5, sum of rank for rural group =704.5).

However, if there were no differences between the groups then it would be expected that the study would find a similar number of high and low ranks in the urban and rural group. Then, if ranks are added up then the study would expect the summed total of ranks in the urban and rural group to be about the same. The results confirm to the findings of (Kitchin and Frendschuh, 2000) who view that children's mental representations of the environment rely on their knowledge of familiar places. (Uttal, 2000), however, viewed limitations in children's thinking about spatial information and suggested that this could reflect a lack of understanding of the uses of maps. The results support the study by providing insights that could be used to improve teaching practices for environmental education in elementary schools. Therefore, new tools can be introduced into the teaching practices such as a mapping culture.

Evidence from pictures (appendix 3) gave insight into a range of positive and negative views that they possess. The results though limited to a small number of children (n=10) from one rural school, revealed a difference in views between the female and male group. The results suggest that their knowledge of picture content was as a result of direct experience or through illustrative form. The test statistic (W_s) from Wilcoxon rank-sum test resulted into the female group obtaining smaller summed rank. (Sum of ranks for females = 118, sum of ranks for males = 135). Basing on the negative views expressed towards picture content, the male group obtained the smaller summed rank (Sum of ranks for females = 133, sum of ranks for males = 117). The results agree with previous studies (Wiegand and Stiell, 1996) which found out that pictures would be suitable for educational use. The results support the study with insights into how children can make meaning of pictures, relying on their knowledge and experiences. An introduction of new practices such as mapping culture could enhance children's understanding of environment.

5.4 Capabilities of participatory mapping in identyifng envornmtal problems with schoolchidren

With respect to the use of participatory mapping, in investigating the schoolchildren's perceptions of environment, the results gave an indication of the possibility of this tool being used in mapping schoolchildren's perceptions of environment. Examining some of the major environmental problems in the area in relation to the potential participatory mapping had in investigating schoolchildren's perceptions of these problems, the results agree with previous studies (Holly et al., 2006; Mandara, 2007; Minang, 2003; Trang, 2004) who found that this is such a tool that is increasingly used, readily available and easy to use. This is likely to be helpful for the schools, and particularly for environmental educators.

The research question [what benefits can be derived from using participatory methods in identifying environmental problems with children?] was addressed to point out appropriate methods that could be used with children (research objective two). The results suggest that children's perceptions of environment are mainly gained through direct experiences in the environment. However, the results support that a mapping culture can be introduced in elementary schools. In the long term, mapping will provide a perspective on spatial information. Using maps could help children acquire a better understanding about the environmental problems in relation to their spatial locations. This is especially the case with understanding environments and associated problems of areas they are unfamiliar to. Furthermore, mapping could help schoolchildren acquire new ways of thinking about environmental perceptions of various spatial locations.

Feedback to the environmental educators

The results of the study reveal there are differences between schoolchildren's environmental perceptions particularly among schoolchildren from the different schools. These results are in agreement with previous studies (Wiegand, 1997) which found that assessment is a necessary and integral part of planning for teaching. The children's environmental perceptions of the environment can be analyzed but in addition to that, the perceptions can be monitored by the environmental educators in search for children's progress on understanding the environment. Therefore, this helps the educators acquire a wide range of views among the schoolchildren. More importantly, the results support the purpose of this study which is to introduce a mapping culture into elementary schools. This could enhance environmental education in schools.

6. Conclusions and recommendations

6.1 Conclusions

In this research study, the main aim was to investigate schoolchildren's perceptions of environment through participatory mapping to see if a mapping culture can be introduced in elementary schools. Examining some of the environmental problems in the area include, dumping of solid wastes, pollution of both soil and water, water shortage, loss of biodiversity, soil erosion, storm water. Schoolchildren were able to identify some of these problems. They were able to locate examples of some environmental problems. The main locations cab be summarised as; (1) environments at schools, (2) environments at home and (3) areas outside the study area. This can contribute towards a better understanding of children's perceptions of environment.

The study was able to point out that those environments at schools and homes were easily confirmed by the children from different schools. And some of the urban schoolchildren were even able to locate examples of areas outside the study area due to the school programs that involve exposing the children to learn about the environment in other areas particularly nature areas. The further away the environmental problems from the school and even homes, limitations in children's thinking about the environment surfaced. This was achieved by having children individually draw sketch maps of good

and bad environments. Also by using group discussions to understand better the knowledge about environment based on their map.

Outdoor activities that are used to engage children in environmental learning at school include, tree planting, adopting trees, keeping school compounds clean e.g. through picking litter and visits to nature area. It was observed that children's ways of mentally representing information is in relation to the environments which they are exposed to. This was achieved through interviews with environmental club patrons in the schools. This lead to insight into some of the children's environmental perceptions as illustrated in their sketch maps (see appendix 5).

Participatory mapping was used to elicit children's knowledge about the environment. The Wilcoxon rank sum-test helped to (see appendix 1) find out differences between schoolchildren's environmental perceptions from the different schools. The sum of ranks presented the scores on the items as illustrated in the sketch maps of good and bad environments. The summed ranks revealed that the rural group had the least number of views mentioned in the sketch maps of good environments compared to the diverse views mentioned by urban schoolchildren. Based on the maps of bad environments, the urban group had the least number of views compared to the diverse views from the rural schoolchildren.

Apart from the participatory mapping, pictures were used to find out children views towards the pictures (see appendix 3). This is because based on the children's views, it could be helpful for teachers to use pictures for educational use. From the use of pictures, relationships were established between children's environmental perceptions and content of the pictures which in turn gave insight particularly into the knowledge about environments with which children are familiar and unfamiliar with. Therefore, pictures can be helpful to educators by drawing children's attention towards pictures that could improve their understanding of environment. In addition, mapping can be introduced into the teaching practices.

The capabilities of participatory mapping in identifying environmental problems from schoolchildren indicated that among other teaching practices used in environmental education, the children's perceptions of environment are mainly gained through direct experiences in the environment. Acquiring a wide range of views among the schoolchildren though the use of participatory mapping, could be of great interest to particularly the environmental educators. This could enhance environmental education in schools. In addition, children's progress on understanding the environment can be monitored through their sketch maps. This also implies that children could benefit from new ways of understanding the environment.

More important is the purpose of this study which is to introduce a mapping culture into elementary schools. Helping children acquire a better understanding of the environment could be done through introducing a mapping culture in elementary schools. This will in the long term provide a perspective on spatial information which could enhance environmental education in elementary schools.

6.2 Recommendations

1. I hope that the information and ideas generated by this study serve as a baseline for introducing a mapping culture in elementary schools.

2. Re-test the study using more schools and children from different schools that may reveal further understanding of children's perceptions of environment.

3. In addition, a research with children from the same neighbourhood could reveal other environmental perceptions that best characterise the layout of their neighbourhood.

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Appendices.

Appendix 1: Summary of items based on the children's sketch maps

Good Environment														
Name of Sch.	House-bulidings	Trees	Water; lakes, rivers	Playground	Rubbish pit	Toilets	Farm aniamls	Grass	Water tank	Farm;garden	School	Stones (quarry)	Flowers	People
Kagoto-R														
Boys	5	5	3	3	3	4	3	5	3	4	3	1	2	2
Girls	5	5	3	0	2	3	3	5	2	3	1	2	4	0
Sum	10	10	6	3	5	7	6	10	5	7	4	3	6	2
Kiamaina-R														
Boys	5	5	3	2	3	3	3	5	2	4	3	0	2	2
girls	5	5	2	0	1	1	5	5	1	5	0	0	4	3
Sum	10	10	5	2	4	4	8	10	3	9	3	0	6	5
Lions- U														
Boys	2	2	2	0	1	0	0	1	0	0	0	0	0	0
girls	5	8	8	0	1	0	3	5	0	3	2	0	2	2
Sum	7	10	10	0	1	0	3	6	0	3	2	0	2	2
Moi-U														
Boys	7	9	6	1	1	0	3	4	2	3	1	1	7	2
girls	9	10	8	1	3	0	1	8	0	3	1	0	8	0
Sum	16	19	14	2	4	0	4	12	2	6	2	1	15	2
Nessuit-R														
Boys	5	2	4	1	0	1	4	2	0	2	4	0	0	2
girls	3	2	3	1	0	0	2	3	2	2	1	0	0	0
Sum	8	4	7	2	0	1	6	5	2	4	5	0	0	2

Flying birds	Other animals	Hills	The sun	Clouds	Cars	Butterflies	Fish pond	Bridge	Mountain	Rainbow	Rain	Swimming pool	Roads
0	0	0	0	0	0	0	0	0	0	0	0	0	4
0	1	0	0	0	0	0	0	1	0	0	0	0	0
0	1	0	0	0	0	0	0	1	0	0	0	0	4
0	1	1	1	0	1	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	1	1	1	0	1	0	0	0	0	0	0	0	4
1	1	0	2	2	0	0	0	0	0	0	0	0	0
8	5	5	8	3	4	2	2	0	2	1	1	0	3
9	6	5	10	5	4	2	2	0	2	1	1	0	3
6	2	4	5	4	2	2	0	1	0	0	0	1	4
3	0	3	1	4	0	1	0	4	0	1	2	1	2
9	2	7	6	8	2	3	0	5	0	1	2	2	6
2	0	4	0	0	1	0	0	0	0	0	1	0	3
0	0	3	0	0	1	0	0	0	0	0	0	0	2
2	0	7	0	0	2	0	0	0	0	0	1	0	5

Bad Environment													
Name of Sch	Road Accidents	Litter	No rubbish pit	No toilets	Dirty toilets	No grass	No trees/cutting trees	Garbbage	Bad food	Trees (no leaves)	Soil erosion	Polluting water	Polltuion air
Kagoto-R													
Boys	1	5	3	3	0	2	1	0	1	1	1	3	2
Girls	0	2	2	1	3	2	5	0	0	0	2	3	3
Sum	1	7	5	4	3	4	6	0	1	1	3	6	5
Kiamaina-R													
Boys	0	2	0	0	0	2	5	1	0	1	0	1	4
Girls	0	5	0	0	0	2	5	0	0	0	0	2	3
Sum	0	7	0	0	0	4	10	1	0	1	0	3	7
Lions- U													
Boys	0	2	0	0	0	0	1	0	0	0	0	1	1
Girls	0	8	0	0	3	0	8	1	0	0	0	6	6
Sum	0	10	0	0	3	0	9	1	0	0	0	7	6
Moi-U													
Boys	0	10	0	0	0	1	7	3	0	0	0	4	5
Girls	0	9	0	0	0	1	7	2	0	1	0	6	3
Sum	0	19	0	0	0	2	14	5	0	1	0	10	8
Nessuit-R													
Boys	1	0	0	0	0	0	4	2	0	0	1	5	1
Girls	0	1	0	0	0	1	3	2	0	0	2	2	1
Sum	1	1	0	0	0	1	7	4	0	0	3	7	2

Dead animals(farm)	Poor houses/slums	No water	Smoking	No rain	Damaged crops	Drought	Animals e.g pigs	Sewage	Fire e.g trees	Scorching sun	Bad roads		
1	2	0	0	0	1	0	0	0	0	0	0		
1	2	5	1	1	1	2	0	0	0	0	0		
2	4	5	1	1	2	2	0	0	0	0	0		
1	1	1	1	0	0	2	0	0	0	0	0		
1	1	0	0	0	2	1	0	0	0	0	0		
2	2	1	1	0	2	3	0	0	0	0	0		
0	0	0	0	0	0	0	0	0	0	1	0		
0	3	0	2	1	0	1	1	0	0	1	1		
0	3	0	2	1	0	1	1	0	0	2	1		
3	0	1	0	0	0	0	0	0	0	2	0		
0	2	1	0	1	0	0	1	4	1	1	0		
3	2	2	0	1	0	0	1	4	1	3	0		
0	1	1	0	0	0	0	0	2	0	0	0		
0	1	1	0	0	0	0	0	1	0	0	0		
0	2	1	0	0	0	0	0	3	0	0	0		

Appendix 2: Ranking the data (extracted from sketch maps of good and bad environment) for two groups

Good	Score	Rank	Actual rank	Group
	0	1	4	U
	0	2	4	R
	0	3	4	R
	0	4	4	R
	0	5	4	R
	0	6	4	R
	0	7	4	R
	1	8	5.4	U
	1	9	5.4	R
	1	10	5.4	R
	1	11	5.4	R
	2	12	15.5	U
	2	13	15.5	U
	2	14	15.5	U
	2	15	15.5	U
	2	16	15.5	U
	2	17	15.5	U
	2	18	15.5	R
	2	19	15.5	R
	3	20	21	U
	3	21	21	R
	3	22	21	R
	4	23	23.5	U
	4	24	23.5	U
	5	25	26	U
	5	26	26	U
	5	27	26	U
	6	28	28	U
	7	29	29.5	U
	7	30	29.5	R
	8	31	31.5	U
	8	32	31.5	R
	9	33	34.5	U
	9	34	34.5	U
	9	35	34.5	R
	9	36	34.5	R
	10	37	37	R
	12	38	39.5	U
	12	39	39.5	R
	12	40	39.5	R
	12	41	39.5	R
	13	42	42.5	U
	13	43	42.5	R
	16	44	44	U
	17	45	45	U
	18	47	48	U
	18	48	48	U
	18	49	48	R
	20	50	50.5	R
	20	51	50.5	R
	23	52	52	U
	24	53	53.5	U
	24	54	53.5	R
	25	55	55	R
	28	56	56	R
	29	57	57	U
Sum of ranks for Urban			**835.9**	
Sum of ranks for Rural			**754.7**	

Bad	Score	Rank	Actual rank	Group
	0	1	5.5	U
	0	2	5.5	U
	0	3	5.5	U
	0	4	5.5	U
	0	5	5.5	U
	0	6	5.5	U
	0	7	5.5	R
	0	8	5.5	R
	0	9	5.5	R
	0	10	5.5	R
	1	11	13.5	U
	1	12	13.5	U
	1	13	13.5	U
	1	14	13.5	U
	1	15	13.5	R
	1	16	13.5	R
	2	17	20.5	U
	2	18	20.5	U
	2	19	20.5	U
	2	20	20.5	U
	2	21	20.5	U
	2	22	20.5	R
	2	23	20.5	R
	2	24	20.5	R
	3	25	26.5	U
	3	26	26.5	U
	3	27	26.5	R
	3	28	26.5	R
	4	29	30.5	U
	4	30	30.5	R
	4	31	30.5	R
	4	32	30.5	R
	5	33	35	U
	5	34	35	U
	5	35	35	R
	5	36	35	R
	5	37	35	R
	6	38	38.5	U
	6	39	38.5	R
	7	40	40	R
	8	41	41	R
	9	42	42	R
	14	43	43.5	U
	14	44	43.5	R
	15	45	45	R
	16	46	46	R
	17	47	47	U
	23	48	48.5	U
	23	49	48.5	R
	29	50	50	U
Sum of Ranks for Urban			**570.5**	
sum of Ranks for Rural			**704.5**	

R = Rural, U = Urban.

Appendix 3: Pictures.

Picture A

Picture B

Picture C

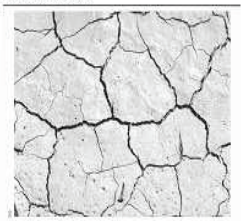
Picture D

Picture E

Picture F

Picture G

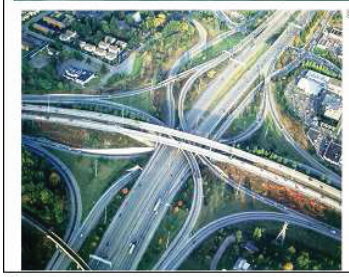
Picture H



Picture I

Picture J

Picture K



Source: ERMIS Africa: Environmental Research, Mapping and Information Systems in Africa; Nakuru, Kenya.

Appendix 4:

Guiding questions

1. Why does the school have programs or clubs on environment?

2. Is there any outside demand for these clubs?

3. What are the priorities in these environmental clubs?

4. What role do environmental teachers play in this school?

5. What direct approach is used to pass on the key issues of the environment to the schoolchildren?

6. How do the environment teachers deal with teaching complex environmental issues?

7. Do you value the perceptions of the children? If yes, what are the measures taken for finding out children's perceptions of environment. If no, why?

8. What are the difficulties children find in learning about environmental issues?

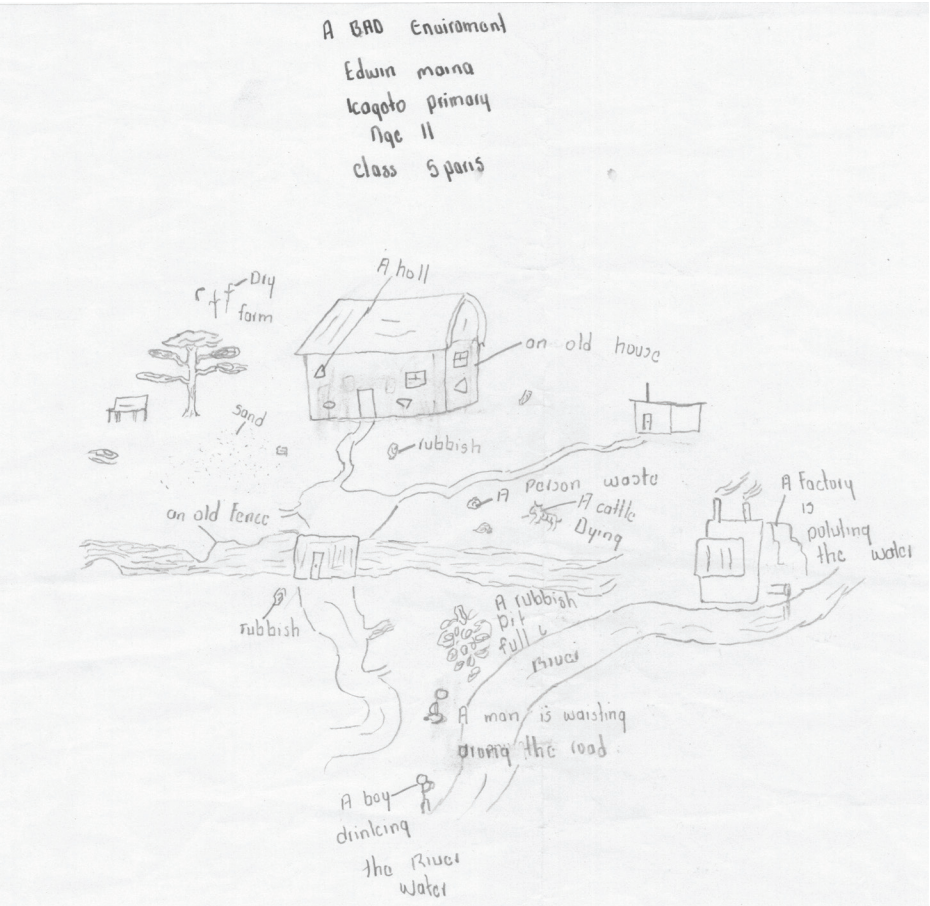
9. What is your judgment if nothing is done?

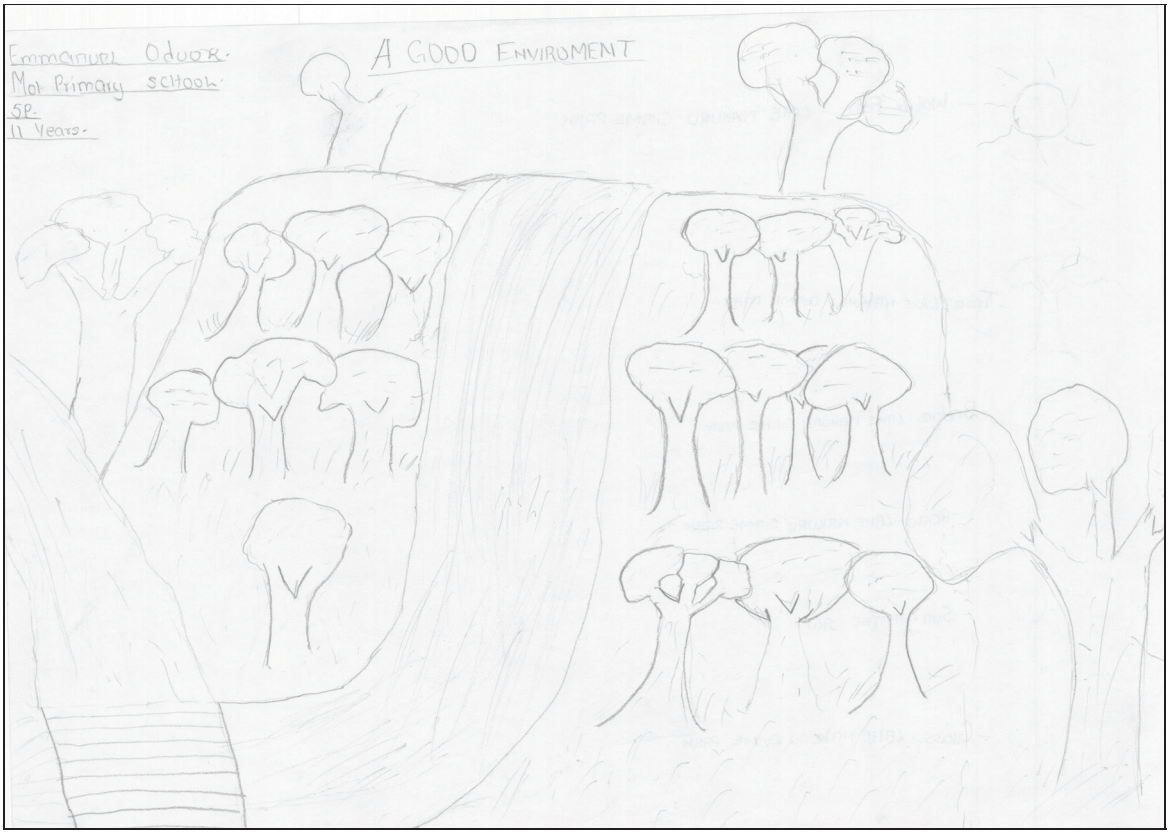
10. What can be done to encourage schools pass on environmental knowledge to the schoolchildren?

11. Which outdoor activities do you apply?

12. Does the school have a nursery bed? If no, why?

<u>Appendix 5.</u> Some examples of children's maps.




Emmanuel Oduor.
Mot Primary school.
SP.
11 Years.
A GOOD ENVIROMENT


Mitchell Wairima.
9 years.
Lions Primary School.
4 Galana.
BAD ENVIRONMENT.
TRUST
Pit