

# THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

## Influence of Teachers' Perceptions and Competences on Students' Achievement and Perceptions in Environmental Education in Secondary School Biology in Gilgil Division Nakuru District, Kenya

**Simon M. Kiarie**

Teacher, Department of Biology and Chemistry, St. Marks Eldonio Secondary School, Nakuru, Kenya  
Masters' Student, Egerton University, Njoro, Kenya

### **Abstract:**

*The teachers' perceptions and competences play a key role on how students learn, retain and apply the knowledge, attitudes and skills in changing their perceptions of the environment. This would also enhance their achievement in environmental education. This study was designed to investigate the influence of teachers' perceptions and competence on students' perceptions and achievement in environmental education in Gilgil Division of Nakuru District. A causal comparative survey research design was used for this study. Purposive sampling was used to identify the secondary school category and the class level that formed the study sample. The sample size was composed of 150 form three biology students who had been taught the topic ecology in biology and 20 biology teachers. Three instruments namely, Students' Questionnaire (SPEEQ), the Teachers' Questionnaire (TPCEEQ) and an achievement test (EAT) were used to collect data. Five experts in biology education validated the instruments developed. Reliability of the instruments was computed using the Cronbach's alpha coefficient and a value of 0.93 for SPEEQ, 0.80 for TPCEEQ and 0.87 for EAT were obtained. Both inferential and descriptive statistics were used in the analysis of data. The t-test and Pearson's product moment correlation coefficient were used to analyse data. The data collected were analyzed with the help of the statistical package for social science (SPSS). The alpha level for the rejection or acceptance of the hypotheses was at 0.05. The results show that both teachers and students had a good perception in EE. There was no statistically significant relationship between biology students' perception of their environment and EE and their achievement in EE. There was no statistically significant gender difference in students' perceptions and achievement in EE. There was no statistically significant relationship between biology teachers' competence in EE as perceived by students and the students' achievement in EE. Findings further indicate that teachers have no regular in-service training in EE. It is hoped that the findings of this study would help EE teacher trainers to evaluate the teacher-training curriculum and therefore form a basis for evaluating the present EE teacher-training curriculum.*

### **1. Introduction**

Environmental education (EE) has been conceived as a study that recognizes the values and various conceptions of the environment with the aim of determining the skills and approaches necessary for understanding the relationships between human beings, their culture and the biophysical environment (Otiende, 1991). It is conceived as a process and not a single subject as it involves all human activities (Ombech, 1991). Environmental education (EE) stresses the holistic nature of the environment, encompassing socio-economic, cultural and political aspects as well as the biophysical elements (Manjengwa, 1998). As a result, EE help to create an awareness of the economic, political and ecological interdependence in the present world so as to enhance environmental responsibility among nations. EE is an important tool for solving environmental problems caused by various human activities (Tsuma, 1998).

Kenya is experiencing a number of environmental problems that may broadly be referred to as an environmental crisis (Neshamba, 1999). These problems vary widely in magnitude and complexity. They include hunger and malnutrition, degradation of natural ecosystems and landscapes, desertification, depletion and wastage of natural resources, overproduction of wastes, pollution, conflict and poverty (Getao, 1999; Neshamba, 1999). Environmental problems occur primarily because of the ever-growing population and often-negative impact on the biosphere, through our technological processes and the products we use (UNEP, 1988). Environmentally sound and sustainable development requires new attitudes on the part of resource consumers and more realistic perceptions of global and local ecosystems to which we belong. The creation of environmental awareness in the communities is therefore essential.

Tsuma (1998) notes that environmental education (EE) is vital for the survival of mankind. He observes that without educating the masses especially in the early years of schooling, they will continue to mismanage and destroy the environment on which their existence depends. The misuse of natural resources and the degradation of the environment may threaten human survival if they proceed unchecked (UNEP, 1988). There are two approaches used in teaching EE in secondary schools. That is, interdisciplinary and

multidisciplinary approaches (Ombech, 1991: KIE, 1997; K'Omudho, 1999;). In the interdisciplinary approach, environmental education (EE) is taken as a unit and draws subject matter from existing disciplines while in the multidisciplinary approach; the disciplines and subjects use the environment as a resource for their teaching. Otiende (1991) observes that educators may not be familiar with the variety of interdisciplinary or multidisciplinary approaches available in dealing with environmental issues. This is because EE is a relatively new discipline and the trend in teacher education is increasingly oriented towards specialization. He further points out that effective or action oriented EE may not be welcome in the rigid institutional structures of certain educational establishments due to increased compartmentalization and specialization. In addition, in an already crowded curriculum, EE may constitute little to justify its inclusion. The learners need to be given an opportunity to investigate, discuss and analyse environmental issues.

Ecological education has a narrow focus than environmental education. Its study is usually restricted to those following examination courses in biology (Hale & Hardie, 1993). Though EE themes and messages have been introduced in other topics in biology, their contents are not more pronounced as in the topic ecology. EE is reflected in the contents of many areas in ecology. According to Sytnik (1985), the contents and methods of teaching EE were set forth in recommendations of the Tbilisi Conference of 1977, which considered that in most if not all programmes and curricular, the teaching of ecological concepts plays a fundamental role in EE. According to Freedman (1995), ecology has much to offer in terms of EE. In particular, he maintains that ecologists can facilitate the development of environmental education in high schools as students still have little exposure to ecology or to environmental issues.

Hale (1993) underscores the objectives of the fifth INTECOL (International Association for Ecology) congress held in Yokohama Japan in August 1990. It was meant to stimulate interest and commitment from ecologists to broaden the base for dissemination and application of ecological science on a wider educational basis. She notes that ecology is rapidly gaining ground as an integral part of modern education and is taking on a more integrated role and is included in a broad range of subjects, not just confined to biology but also in geography, history, physics, english and mathematics. Unlike other branches of biology, ecology is essentially a field study in which progress cannot be made without constant observation in the field. Teachers' attitudes and perceptions on their environment, therefore, can play an important role in shaping students' attitudes and perceptions in bringing about effective environmental management. UNEP (1988) recommends that EE be provided at all levels of formal education for pupils and teachers as well as in the various non-formal education activities for young people and adults. It should concentrate largely on young people who, as custodians of tomorrow's world, have much to lose from environmental degradation than others.

Environmental education in Kenya is faced with various constraints. At the moment, EE is not taken as a separate subject, thus making it to be rated second in importance to examinable subjects. Though efforts have been made to incorporate EE across the existing disciplines, the curriculum is congested to the extent that it is at times difficult for teachers to achieve the targets set in the disciplines. Most teachers assume it is covered in other subjects thus giving it less emphasis. As Kenya aims at becoming industrialized by the year 2020, it has to ensure that environmental education is provided to facilitate sustainable development (Murgor, 1999). There is need to find a balance between the utilization of natural resources and economic growth. Environmental education in secondary schools can help foster change of attitudes and values in order to develop the skills necessary to manage the environment sustainably. Cutter (2001) concludes that the problems associated with the implementation of EE are due to a perceived lack of adequate pre-service and in-service training on EE in the subjects where it's covered. Though Kenya has had several environmental initiatives over the last decade with positive impact on the environment, much still needs to be done to ensure the quality of the environment is maintained at the recommended level (K'Omudho, 1999).

Gilgil Division is an agricultural potential area that borders the Mau and Aberdare water catchment areas. The human encroachment on the Mau water catchment area has led to the destruction of forests, increased soil erosion and drying up of rivers that drain into Lake Nakuru. Njuguna (2005) has revealed that human activities and excessive use of pesticides on Lake Naivasha water catchment areas are having a negative impact on the lake's biodiversity especially the fish species. This study aimed at determining the influence of teachers' perceptions and competences on students' perceptions and achievement in environmental education in secondary school biology.

## 2. Theoretical Framework

This study was based on environmental action learning theory, which was adopted by governments in Africa, Asia and the Caribbean regions in 1988/89 during the Regional Programme of Action on EE and Training (Tsuma, 1998). Environmental Action Learning methods involve learners in diverse experiences such as hands on or encounter, dialogue through discussions and reflection so as to foster environmental awareness and meaningful change. It also puts emphasis on critical education that involve students in their own learning and interpretation of their world through dialogue, questioning, participation and decision (Roger, 1998). The emphasis on hands on (encounter) science puts constructivism in the middle of learning theories relevant for teaching and learning environmental education (Appleton & Asoko, 1996). It is expected that teachers will provide a range of learning opportunities that allows dialogue, encounter and reflections using a suitable range of methods as shown in Figure 1. Learners' perceptions of their environment can be influenced by environmental action learning 'about,' 'in' and 'for' the environment which can open up opportunities for steering environmental learning and the monitoring of learning outcomes.

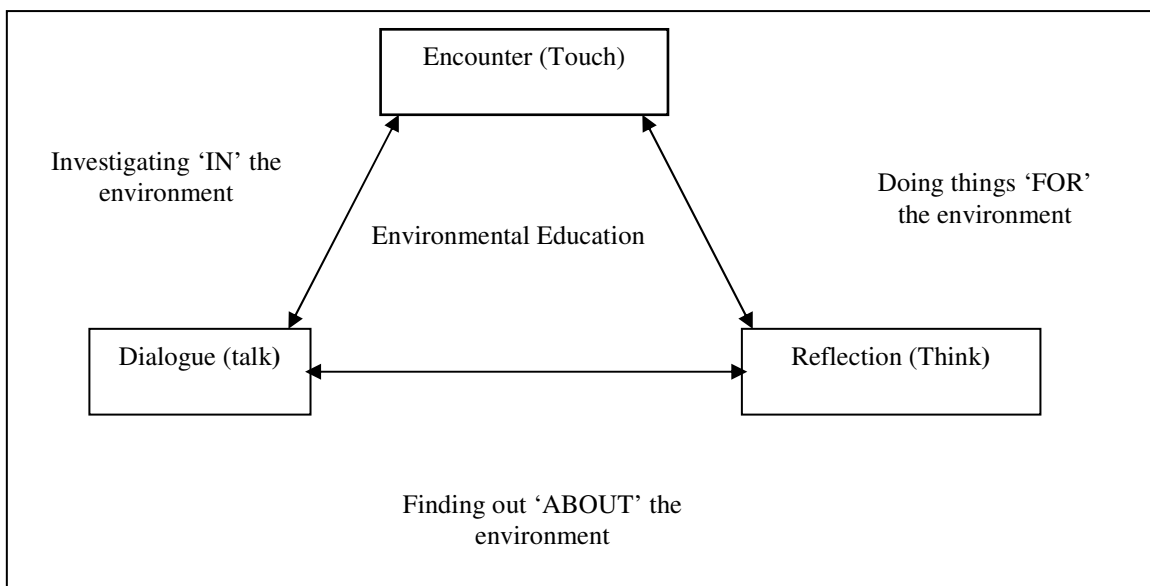


Figure 1: Environmental action learning methods 'In', 'About' and 'For' the environment  
Source: Adapted from Musyoki, 2003 (p. 3)

Learning how to care for our environment involves understanding concepts about the environment. EE for the environment emphasizes 'social actions' to improve the environment, while EE in the environment emphasizes 'environmental knowledge and practical environmental conservation skills'.

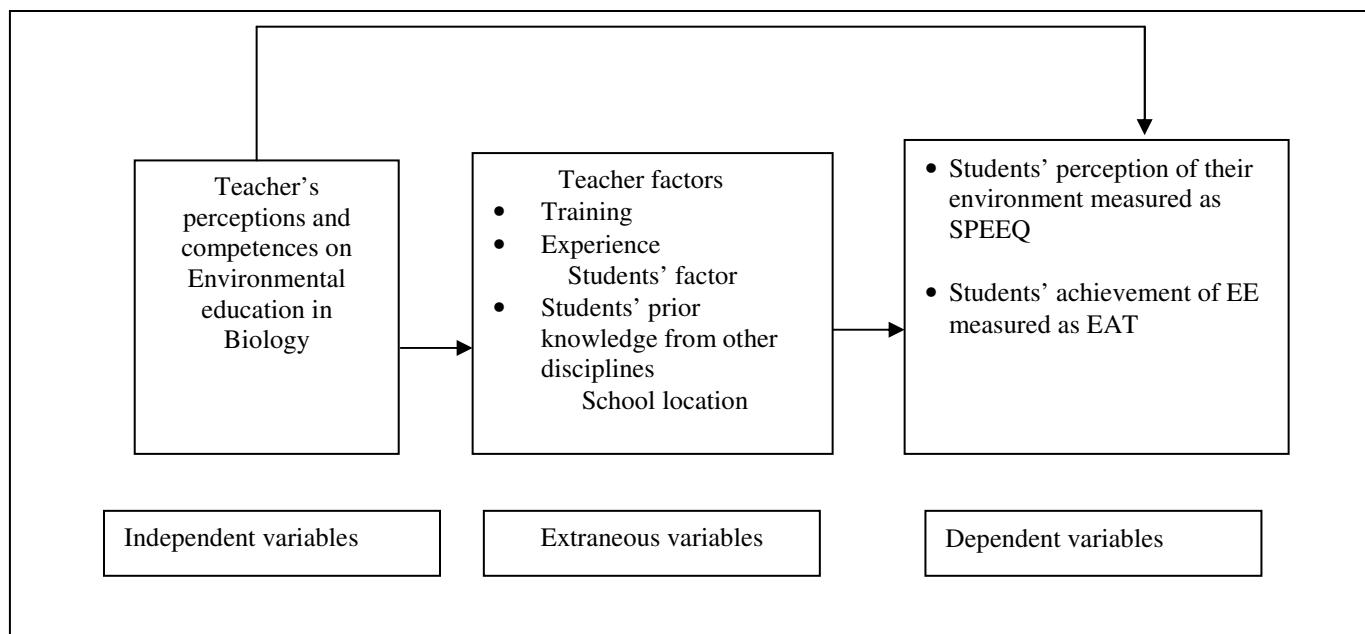


Figure 2: Conceptual framework showing relationship among the independent, extraneous and dependent variables

The learning of EE in biology is affected by moderating factors (extraneous variables) such as teacher's personality, experience and training. The study involved qualified biology teacher who had more than one years teaching experience. Student factors such as student's prior knowledge from other disciplines were partly the subject of the study. The study involved form three students who were approximately of the same age to control for students' age and level of education. School location and gender were controlled by involving co-education day secondary schools located in a rural set up.

### 2.1. Purpose and Objectives of the Study

The study was designed to determine the influence of teachers' perceptions and competences in environmental education on students' achievement and perceptions in environmental education in secondary school biology. Its specific objectives were:

- To determine the students' perceptions on their environment and environmental education and biology teachers' perceptions and competences in environmental education.
- To determine whether there is a relationship between students' perception of their environment and EE and their achievement in environmental education.

- To determine whether there is a gender difference in students' achievement and perceptions of their environment and environmental education.
- To determine whether there is a relationship between the competences of biology teachers in EE as perceived by students and students' achievement in environmental education.

## 2.2. Hypotheses of the Study

The following null hypotheses were tested: -

- H<sub>0</sub>1: There is no statistically significant relationship between the form three biology students' perception of their environment and EE and their achievement in environmental education.
- H<sub>0</sub>2: There is no statistically significant gender difference in form three students' achievement and perceptions of their environment and environmental education.
- H<sub>0</sub>3: There is no statistically significant relationship between the competences of biology teachers in environmental education as perceived by students and form three students' achievement in environmental education.

## 3. Research Design

The study used a causal comparative survey research design. According to Gall, Borg and Gall (1996), in causal comparative research design, the researcher studies the causes after exerting their effects on another variable. This study dealt with an already existing condition where the researcher had no control of variables. The topic of interest, ecology, is taught in form three (KIE, 1998). Students in form three select subjects of choice and therefore would not permit manipulation of the treatment. The sample was stratified for gender and the same number of boys and girls formed the sample. The study involved form three biology students in co-education secondary schools who have been taught ecology in biology. A survey method was used to collect data that was drawn from the study sample. According to Cohen and Manion (1987), a survey is an attempt made to gather data from members of a population at a particular point in time with the aim of describing the nature of existing conditions or determining the relationships that exists between specific events within that population.

### 3.1. Sampling Procedures and Sample Size

Kathuri and Pals (1993) recommend a minimum of 100 cases for each major subgroup and 20-50 cases for minor subgroup for survey research. District co-educational day secondary schools were selected because they enroll both boys and girls and also made up the majority of secondary schools in the division. Form three biology students were targeted because the topic ecology was taught at this level. There were 2 form three streams in all the sampled schools. As not all students took biology at form three level, one stream was taught physics while the other was taught biology. Five schools were included in the study sample and one stream from each school participated in the study. The study sample consisted of 150 biology students. On average, there were about 4 biology teachers per 2-streamed school; therefore 20 biology teachers in the sampled schools were also included in the study sample. Purposive sampling was used to identify the secondary school category that participated in the study and the class level that formed the study sample. Purposive sampling was used as it allows the use of cases with the required information with respect to the objectives of the study. A simple random sampling technique was used to draw five schools out of the accessible 14 schools for this study. This technique is appropriate because it ensures that all schools have an equal chance of being included in the study sample (Mugenda & Mugenda, 1999). Because of the small number of schools that were sampled, balloting method was employed. Stratified random sampling was used to select 15 girls and 15 boys from each school to form a homogeneous group. In stratified sampling, the population is divided using a given criterion and the proportionate numbers of cases are randomly selected from each population subgroup. The sampling frame consisted of a list of district co-education day secondary schools in Gilgil Division.

## 4. Instrumentation

### 4.1. Students' Perceptions towards their Environment and EE Questionnaire (SPEEQ)

The students' questionnaire (SPEEQ) had two sections with a total of 61 items. Section A collected biographical data and information about the students' perceptions towards their environment and EE in ecology. Section B collected information about the competence of biology teachers in EE as perceived by the students. The structure of the items was based on a four and five-point Likert scale rating technique. The respondents responded to each statement by placing a circle on one of the responses given. Scores ranged from 1-4 per item for a four-point scale and 1-5 per item for a five-point scale. Professional science educators in Egerton University did the validation of the instruments. 45 form three biology students in one co-educational secondary school in Bahati Division, Nakuru District was used in piloting of the instrument and the results were used to estimate the reliability. The reliability of the SPEEQ was determined using the Cronbach's alpha ( $\alpha$ ) coefficient as the items had scores with a range of values (Thorndike and Thorndike, 1990). The pilot result gave a reliability coefficient of 0.93. According to Fraenkel and Warren (1990), a reliability coefficient of 0.7 is considered suitable to make possible inferences that are accurate enough. SPEEQ instrument was adopted and used to collect data.

### 4.2. Teachers' Perception and Competences on EE in Biology Questionnaire (TPCEEQ)

The Teachers' Perception and Competences on EE in Biology Questionnaire (TPCEEQ) consisted of two sections with 30 items. Section A collected biographical data while B collected data on teachers' perceptions and competences on EE in biology respectively. Section A had 8 items, while B had 22 items. The items were closed ended. However, there were provisions of spaces for adequate

self-expression about their opinion on the syllabus. The structure of the items was based on a five-point Likert scale rating technique. Professional science educators in Egerton University did the validation of the instruments. 15 biology teachers from Bahati Division; Nakuru District was used in piloting of the instruments. The reliability of the TPCEEQ was determined using the Cronbach's alpha ( $\alpha$ ) coefficient as the items were not scored dichotomously but had scores with a range of values (Thorndike and Thorndike, 1990). TPCEEQ was adopted and used to collect data.

#### 4.3. Environmental Education Achievement Test (EAT)

The EAT was developed by the researcher. The test had 37 items, which carried different scores ranging from 1 to 6. The items were open-ended. The items tested knowledge, comprehension and application of what has been learned. The test was based on form three biology topic, ecology (KIE, 1998). Professional science educators in Egerton University did the validation of the instrument. A sample of 45 form three biology students in one co-educational secondary school in Bahati Division, Nakuru District was used in piloting of the instruments. The test was then marked using a common marking scheme and scored. The reliability of the EAT was determined using the Cronbach's alpha ( $\alpha$ ) coefficient as the items were not scored dichotomously and scores had a range of values (Thorndike and Thorndike, 1990). The pilot result gave a reliability coefficient of 0.87. EAT was adopted and administered to the selected sample of form three biology students in Gilgil Division.

#### 4.4. Data Collection

For this study, two sets of questionnaires TPCEEQ and SPEEQ were administered to the teachers and form three biology students. Biology teachers involved in the study were requested to administer the EAT to the students in their respective schools. The questionnaires were then collected, sorted out to see if there were incomplete ones and also to categorize the students in terms of gender and perceptions towards EE. 150 questionnaires and assessment test for students were returned. A total of 18 (90%) questionnaires for teachers were returned. All students' questionnaires were complete though not all achievement tests were fully completed. The researcher then scored the questionnaires and the achievement test (EAT) and generated quantitative data, which were analyzed.

#### 4.5. Data Analysis

Pearson's correlation coefficient was used to determine whether there was any significant relationship between form three biology students' perceptions on EE and their achievement in EE. A t-test was used to determine whether there was any significant gender difference in form three student achievement and perceptions of their environment and EE. Pearson correlation coefficient was used to determine whether there was any significant relationship between the competences of biology teachers as perceived by students in EE and form three students' achievement in EE.

### 5. Results

#### 5.1. Perceptions of Teachers and Students of Environmental Education and Students' Achievement in Environmental Education

In order to measure teachers' and students' perceptions of environmental education two questionnaire TPCEEQ and SPEEQ were administered to the teachers and students respectively. Responses were obtained from a series of statements that sought respondents' satisfaction with various aspects of their perceptions of the teaching of environmental education ecology. Their responses were recorded on a five point Likert scale ranging from 1=Strongly Disagree to 5= Strongly Agree. Their responses were used to calculate a mean rating score for each individual and the mean score for teachers and students. The maximum mean rating score an individual respondent could have was 5 and the minimum 1. This mean score reflected the respondents' perceptions. High mean scores were associated with positive or good perception and low mean scores with negative or low perception.

#### 5.2. Teachers Perceptions of Environmental Education

The results revealed that teachers had a good perception of environmental education. They had a mean score of 3.61 and a standard deviation of 0.62. Environmental education should be integrated in the existing curriculum was the highest rated item with a mean rating score of 4.72. This shows a high commitment of teachers in teaching environmental education through interdisciplinary approach. However, most biology teachers do not agree that the biology syllabus has prepared students well in environmental awareness (mean score of 3.17). They also are of the view that instructional methods used on environmental education are not appropriate (mean score of 3.22). Though ecology is one of the topics in biology that is supporting environmental education (Soerjani, 1993), teachers perceived themselves to be incompetent in enhancing environmental awareness through biology. Such findings indicate that individual commitment of a teacher to EE is a vital component with respect to the implementation of EE.

The lowest rated item by the teachers (mean score of 2.56) was that teachers did not find it difficult to develop a good working relation with the school administration while enhancing EE in biology. This shows that teachers had a good working relation with school administration while enhancing EE in their schools. School administrators were found to have the willingness to promote EE in schools. This is important because a biology teacher requires to keep in touch with school administrators while carrying out field activities outside the school especially involving ecology. However, a high proportion of teachers (83.3 per cent) perceived that they were unable to enhance environmental awareness among the students due to lack of initiative from the school administration mean score 2.61. This shows that there is lack of commitment among the school administrators in support of teachers who came up with issues or projects that enhance environmental awareness among the students.

Most teachers (61.1 per cent or mean score of 2.61) disagreed that personal commitment after school contributed to their being unable to enhance environmental awareness among the students. However, 77.8 per cent perceived lack of time during teaching was a hindrance to their enhancement of environmental awareness among students (mean score 3.83).

On the steps to be taken by MOEST concerning EE, a high proportion of teachers (77.8 per cent) perceived the need for in-service training for teachers (mean score 4.61). However, 67.7 per cent of teachers (mean score of 3.83) perceived the need for making environmental education an independent and examinable subject in national examinations.

Teachers indicated lack of practical skills (77.8 per cent), lack of relevant teaching materials (100 per cent) and lack of further training (77.7 per cent) as the major difficulties they encounter in teaching EE. The teachers in the sample were not adequately prepared in the in-service education. This shows that biology teachers maybe lacking the necessary competences for teaching EE. This may affect students' achievement and perceptions on EE.

There was also a perceived lack of necessary competence on the part of biology teachers in relation to teaching environmental education in biology. A number of teachers 66.7 per cent (mean score of 3.44) lacked competences in coordinating discussions with other subject's teachers on topic areas in biology that are taught across the disciplines (mean score 3.44). Environmental education is one such topic that is taught across different disciplines. It is therefore necessary for teachers to consult each other on topics that require a multidisciplinary approach on environmental education. Teachers also had difficulties in selecting and managing instructional resources for environmental education due to its multi-disciplinary nature (61.1 per cent). However, 55.6 per cent of teachers (mean score of 2.83) did not have problems in selecting appropriate learning resources for environmental education.

The response of teachers on the methods used in assessing pupil's knowledge on environmental education in biology showed that the most commonly used methods were through written work (94.4 per cent), practical work (77.7 per cent) and the general observation during school hours (50 per cent). A good proportion of teachers indicated having carried out a form of assessment on students in environmental education. This shows that though environmental education is not taken as a separate subject, teachers should endeavour to assess it in the subjects where it is taught.

Teachers perceived the instructional methods used on EE to be appropriate (44.4 per cent or mean score of 3.22). The low mean score can be attributed to lack of confidence among teachers on the instructional methods applied on environmental education. 44.4 per cent of biology teachers (mean score of 3.17) prepared their students well on environmental awareness creation in their school communities. However, 50.0 per cent of teachers (mean score of 3.67) perceived that they were unable to enhance environmental awareness due to resistance from the community. 44.4 per cent of teachers found it hard to influence people to accept change in relation to environmental conservation. Most teachers (83.3 per cent) were able to develop a good rapport with students during field studies. They also indicated that most students enjoyed discussions conducted on environmental education in biology lessons (66.7 per cent). This shows that students are willing to be involved in discussions about EE by their biology teachers. This should be a key factor for the success of environmental education. Teachers should therefore make their lessons more enjoyable and appealing to students.

## 6. Discussion

Biology teachers perceived the need for environmental education to be integrated into the existing curriculum. Research reveals that the analysis of environmental problems cannot remain restricted to one segment of the curriculum, but demands an overall and integrated examination of intricate and complex factors. For the full use of school as the site for environmental education, the curriculum must undergo a process of reflection and reorganization based on centers of interest, general themes, or possibilities that would give greater freedom for a new mapping of knowledge and what the school has to offer to its students (Krasilchik, 1987). There are many areas in the Kenya's formal school curriculum that are relevant to environmental education that require a multidisciplinary approach. The multidisciplinary approach to environmental education can be effective in bringing various skills and knowledge from various disciplines to facilitate environmental enquiries necessary for environmental education.

The findings also reveal that teachers understand the role played by ecology in promoting environmental education among the biology students. Biology teachers should endeavour to deliver environmental education, as the subject content is relevant to the cross-curricular theme for environmental education. This reinforces the idea that the study of biology is important in facilitating learning of environmental education in schools, but an interdisciplinary approach is needed for the solution of environmental problems and selection of activities for environmental education. Biology teachers realize the need for them to have general environmental awareness in biology for them to be able to teach environmental education effectively.

A number of biology teachers (55.5 per cent) perceived the need to participate in environmental awareness creation in the community around the school. However, on average, most teachers were not committed to this activity possibly due to resistance from the community. As Krasilchik (1987) notes, insecurity in dealing with controversial issues that involve decision making and formulation of value judgements may lead many teachers to avoid participating in these activities. Others, although well prepared, maybe frightened by the dangers that could be contained in subjects with obvious political connotations. They may fear the reaction of the school authorities, parents and often the community itself. It is thus not possible to educate conscientious and active citizens without giving them the chance to express and discuss their own ideas with other members of the community of which they are part of. Opportunities, therefore, need to be opened for the schools to be involved in real problems of the community to which they belong by means of actions linked directly to political and socio-cultural activities of the community.

The school administration was thought to have a good working relation with their teachers and the willingness to promote environmental education in schools. However, most teachers felt that the school administration lacked the commitment in supporting teachers who possibly come up with issues or projects that enhance environmental awareness among students. Since environmental

education is interdisciplinary in approach, the head teacher's commitment to its success is important. As Filho (1993) suggests, head teachers should ensure their staff undertake field studies and take part in the preparation of field study programmes. They should also provide formal support and ensure proper logistical support is made available to teachers undertaking field studies.

Lack of practical skills, relevant teaching materials and further training are some of the major difficulties encountered by teachers in teaching environmental education. This shows that biology teachers may be lacking the necessary competences for teaching environmental education. As Kanhasuwan and Webb (1987) suggest, no new trend in a curriculum can be effectively implemented without adequate preparation of teachers. This is necessary before one can expect to find desirable changes in attitudes and skills in the personnel involved. Besides facing the task of curricular reorganization demanded in environmental education, biology teachers are expected to handle the traditional aspects of biology, the social, political and cultural aspects as well. To be able to do this their training must be quite different from that which they currently receive (Krasilchik, 1987). Also finding relevant teaching materials can be a difficult task because environmental concerns are varied in different areas of the same country.

All the teachers in the study agree that ecology as a topic in biology is better placed to address environmental issues than any other topic in biology. Several researchers support ecology as a basic discipline supporting environmental education (Baez et al. 1987; Hale, 1993; Tilling, 1993; Filho, 1993; Freedman, 1995 and Trowbridge et al. 2004). Thus the concepts of ecology, which lie at the heart of environmental education, can be infused into the school curriculum as a whole making biology to play an important role in addressing environmental issues. However, this finding is in contrast to a lower number of biology teachers (44.4 per cent) who perceived that biology syllabus prepare the students well for environmental awareness. This shows there is still much that can be done in biology for it to be effective in addressing environmental awareness.

The reasons advanced by teachers for not enhancing environmental awareness among students such as lack of enough time during teaching sessions and lack of initiative from the school administration should not be an excuse for not teaching environmental education effectively. The key factor for the success of environmental education is the teachers' willingness and commitment to involve the learners in discussions about the environment in biology and the development and improvement of the school environment.

Teachers felt that MOEST should make environmental education an independent and examinable subject in national examinations. Roger (1998) observed that the inclusion of EE as an examinable subject would promote competitive learning (learning for the sake of passing exams), which is encouraged by the Kenya national examination system. This is therefore not a suitable ideology for carrying out EE in schools because EE in Kenya is still multi-disciplinary in approach and therefore not a subject that require students to sit for examinations. This therefore shows that teacher's perceptions of EE can be influenced by whether it is an examinable subject or not. Moreover, the environmental aspects in biology are examined by the Kenya national examination council (KCSE). A comprehensive view about the environment needs be reflected in the design, the structure of education content, strategy and methods of learning (Khoshoo, 1987). There is therefore need to provide environmental education in the existing curricula that cut across the disciplines in the education system. This is because the society requires essential knowledge about the environment in different ways because of varying needs. The addition of new school subject is likely to be resisted if it is not given the same examination status as in other subjects. The style of national examination tends to be a more important determination of the content and process of teaching than syllabus.

Studies by Roger (1998) and Cutter (2004) indicate that teachers may perceive EE to be an important learning area but may lack the skill and knowledge to effectively teach EE. A high proportion of teachers realize the need for pre-service training of teachers on EE in colleges and universities (66.7 per cent) and the need for in-service training in EE (94.5 per cent). There is need to equip teachers with the necessary skills and attitudes and help develop competences that will facilitate the learning activities of EE in schools. In this study, only 11.1 per cent of teachers had received in-service training on EE. The teacher qualities and training are important factors for the success of EE as teachers will be able to acquire certain competences that are important in teaching EE. Most may not have received in-service training on EE because the opportunities may not be there. In most cases when teachers carry out professional development, they are not in-serviced on EE but on other areas of their profession. This may affect the students' perception and achievement on EE.

UNESCO-UNEP IEEP no. 8 (1986) suggests that the benefits derived from in-service training filter all the way to the students. They recommended that in-service teacher training in EE be supported by classroom follow up activities result to a significant gain in students' knowledge and their positive attitude about their environment. The in-service workshops positively influence teachers' attitudes towards the subject. Therefore, as a consequence of this study and others (Cutter, 2004) it can be said that the problems associated with the implementation of EE are possibly due to lack of adequate pre-service and in-service EE training. Teachers might be willing to undertake in service training course on EE. Teachers should therefore be specially trained and this may require colleges of education to develop new curricula and equip special workshops and laboratories specifically for this purpose.

Teachers lacked competences in coordinating discussions with other subject teachers on topic areas in biology that are taught across the disciplines. Environmental education is one such topic that is taught across different disciplines. It is therefore important for biology teachers to consult other teachers on topics that require a multidisciplinary approach on environmental education. This may prevent duplication within topics that may arise in different subjects. As Knamiller (1987) notes, identifying the contents of environmental education for schools is a very challenging task. The difficulty is due to the all-embracing nature of its subject matter and the diversity of approaches and attitudes of those who promote EE. Also, there can be a great deal of cross-disciplinary empathy among subject teachers when reviewing the environmental contents of other subjects. This explains in this study, 61.1 per cent of teachers found it difficult to manage biology resources while 55.6 per cent found it hard to select appropriate instructional resources that relate to EE as the subject is taught across the discipline.

Results also indicated that students enjoyed discussions conducted on EE in biology. Teachers need to negotiate shared meaning with their students and provide them with opportunities to construct useful understanding by overcoming obstacles that may arise as they engage in purposive activities (Good & Brophy, 1995). Young et al. (1987) suggest that students have useful experiences in their communities that are under-utilized in their educational activities. The participation in discussions by students exposes them to new ideas from other students thus enabling them to learn. The need to discuss environmental issues with others forces them to articulate those ideas more clearly thereby sharpening their conceptions about the environment and often lead to recognition of new connections. Students should be involved in the development and improvement of their school environment. They should be allowed to criticize environmental policies and take action to improve the environment.

Students are motivated by active involvement. This explains why in this study teachers indicated that they were able to develop and maintain a good rapport with students during field studies. The physical manipulation of materials and the discussion with their peers while doing investigations contribute to their learning. According to Trowbridge et al. (2004), research conducted by psychologists indicates that a teacher's perception of self, students and the teaching task are critical to effective instruction. Effective teachers perceive themselves as good teachers who are needed and trustworthy and who relate well to other people may try to understand the perceptions and background of their students. Adequate personal relations with students and enthusiasm in working with them are ranked as the most important characteristic for the success of EE.

### 6.1. Students' Perceptions of Environmental Education in Biology

A questionnaire to assess students' perceptions towards their environment and environmental education questionnaire (SPEEQ) was administered to 150 from three biology students in five co-educational secondary schools in Gilgil Division. Students were asked to indicate the extent to which they agreed or disagreed with the given statements regarding their perceptions towards EE in biology. Their responses are presented on Table 3.

The results reveal that students' perceptions toward EE in biology were good. Their mean score of 3.99, and a standard deviation of 0.70 illustrate this. Of the 38 items, 33 had a mean score of 3.45 and above. Only five items were rated below 3.45. Ecology enlightened me more on environmental issues was the highest rated item with a mean rating of 4.79. This shows that students were more enlightened about issues concerning the environment through the topic ecology in biology. This can further be illustrated by the high number of students who disagreed that ecology had little value on EE (79.3 per cent or mean score of 1.93).

The item learning ecology made me dislike biology was the lowest rated item. It had a mean rating score of 1.62. This result implies that learning ecology made students like biology. It is therefore important for teachers to be varying their methods of teaching so as to make ecology a captivating topic as possible. This can be enhanced through fieldwork activities, which help students to appreciate ecology. Students also found it interesting when the subject is taught out of class (mean score of 4.40) rather than when the subject is taught in class (mean score of 3.44). Most students also (82.7 or mean score of 4.40) found it exciting to work in the field during ecology lessons.

While 92.7 per cent (mean score of 4.40) felt that ecology had made them have a desire to apply the knowledge learnt in solving environmental problems in the community, 45.3 per cent (mean score of 2.97) of students disagreed that they will rarely apply the knowledge learnt in ecology. 58.7 per cent (mean of 3.48) perceived the need for taking part in environmental conservation all the time. This shows lack of commitment to the solution of environmental problems by the students, despite the fact that 84.0 per cent (mean of 4.13) perceived that ecology had enlightened them on environmental issues both at school and at home (87.3 per cent) and therefore appreciate the need to conserve the environment. These reflect lack of commitment and laxity among the population in addressing environmental issues despite the fact that they see the need to conserve it. However, 74.7 per cent of students indicated they would like to take care of the environment by educating others on the need to conserve the environment (mean score of 4.05).

A high proportion of students indicated that ecology gave them opportunity to influence others to change their attitudes towards their environment (76.7 per cent), made informed decisions on environmental conservation (88.7 per cent) and appreciate the need to conserve the environment (93.3 per cent). There were mixed feelings when the respondents were asked if they found it hard to work independently on ecological problems, 45.3 per cent found it hard while 38.7 per cent found it easy. Nevertheless, 72 per cent (mean of 3.83) agreed that ecology lessons gave them the opportunity to interact with other members in a group.

On the participation in the community environmental issues, 69.3 per cent of students (mean of 3.95) saw the need to participate in community work on environmental awareness. 76.0 per cent were found to enjoy planting trees during tree planting days, while 90.7 per cent saw the need for their schools to be more involved in community environmental awareness. This is important as participation enhances learning on EE whether it is in the fieldwork or in other efforts for environmental change.

The students were also asked to indicate the extent to which different sources of environmental information had enlightened them about environmental conservation. Results from the study showed that, teachers were the students' most important sources of information on environmental issues (83.3 per cent, mean rating 4.36). Students also got environmental awareness from other sources such as mass media (70.0 per cent, mean rating score 4.00), the newspaper (68.6, mean rating score 3.84), parents (67.3 per cent, mean rating score 3.81), fellow students (60 per cent, mean rating score 3.67) and the least politicians 46.0 per cent.

The aspects on general environmental knowledge expected to have been gained primarily from various school syllabus was also investigated. These aspects involved what students perceived to be the effects of deforestations. A high proportion of students (over 92.0 per cent) perceived that deforestation leads to adverse environmental effects such as desertification, loss of habitat and loss of water catchments areas. However, comprehension of this knowledge on other effects of deforestation such as soil erosion and loss of biodiversity was relatively lower. This is illustrated by the failure of students to perceive how and why loss of biodiversity and loss of habitat are the effects of deforestation.



## 7. Discussion

The students were found to have a good perception of EE. They seem to realize the importance of the topic ecology in educating them on environmental issues. There is therefore need to strengthen the topic ecology in secondary schools so as to involve more themes on environmental education.

Teaching ecology enables students to appreciate nature. This is true especially when they carry out fieldwork, which advances their understanding of natural processes and their interactions. This could not only create interest in students' need to learn, but also enable them to appreciate ecology. Out of class activities appeared to have created interest among students in the topic ecology rather than when it was taught in class. Fieldwork activities provide a learning experience that is unique and therefore cannot be accomplished in the classroom (Trowbridge et al. 2004). Filho (1993) notes that out of class activities stimulate a positive sense of moral behaviour that should be promoted in the community life thereby making pupils to be more active and conscious of their role as citizens. This awareness can be fundamental in developing environmental conservation awareness.

Tilling (1993) found that pupils' perceptions to fieldwork were influenced by their teachers while those involved in problem solving activities benefited more from the field work experience. In the study, the students' experiences of different environments appear to have promoted a greater environmental awareness and understanding of many environmental issues, which may provide a link between the classroom and the wider world. Harvey (1993) noted that by providing lots of varied opportunities for children to be in contact with plants, parents and teachers could contribute to the prevention of environmentally detrimental attitudes in their children to some extent. They can acquire insight into how the environment can be influenced by their own actions. It was noted that though students would like to take care of their environment by educating others on the need to conserve the environment, they were not committed to take part in environmental conservation. This shows lack of commitment and laxity among the general population in addressing environmental issues despite the fact that they see the need to conserve it. Even if schools do effectively teach about environmental issues, research suggest that there are likely to be major constraints on the likelihood of such training influencing students' behaviour outside the school. This is because students do not see the 'school' knowledge as having any relevance to their everyday lives (Vulliany, 1986). Environmental education can be meaningful when knowledge gained by students can be applied to everyday life. It is meaningful only if the skills developed can be utilized in dealing with problems encountered in life. Thus, teachers need to include activities that will provide learners with opportunities to make decisions or choose between alternatives on current issues.

The teachers and the mass media need to be more knowledgeable on the environmental issues since they are the source of information, which students are in close contact with most of the time especially for those in secondary schools. The mass media should vary their programmes so as to include issues dealing with the environment. Since we are living in the information and technological era, students have access to vast amounts of information, which might be difficult to organize. As different forms of media have arisen over the past century, students need to be cautious of what information they perceive as factual. On a daily basis, students are bombarded with a variety of media: television, radio, the internet, and print media. With the growing popularity of environmental education as a discipline, more attention is focused not only on what to teach, but how to teach it. It is the responsibility of the teacher to utilize all of these media forms in productive manner in order to create a positive learning environment (Covert et al., 2004).

It is disappointing to note that students do not often hold discussions on environmental awareness among themselves, as this would certainly be helpful in the teaching of EE. Teachers should therefore use students-centred approaches that will encourage students to criticize environmental policies and take part improving the environment.

There was perceived need for schools to be more involved in environmental activities like participating in community work on environmental awareness. This is because most communities need information about the natural resources around them. If communities were well informed about the better use of natural resources, they would manage their environment wisely. Communities can join hands to better manage their natural resources if they are informed (Komba, 2005). Students can develop value of cooperation and social responsibility that the 8-4-4 system of education aims at. However, this education goal may not come into practice in Kenya if the students cannot participate in community environmental activities as part of their social responsibility. EE for the environment requires students to criticize environmental policies and take action for improving the environment. This can only be achieved if students are allowed to discuss issues openly in the environment through participation and making decisions (Roger, 1998). Participation enhances learning whether it is the fieldwork or in other efforts for environmental change.

Although the school has limitations as the only place for teaching EE, it is possible to find ways through the formal education system by which students can become active citizens (Krasilchik, 1987). This can be possible with the opening of the school to the real problems of the community to which it belongs through activities such as tree planting, garbage collection during Environmental Days, and citing of poems based on environmental issues. When students are actively involved in environmental issues in the community, they can be able to learn skills associated with solving environmental problems. However, participation in issue-based activities in the community is impractical due to lack of time, workload and is also politically dangerous. This can place the school in a political arena that is normally not acceptable to parents and politicians.

The EE aim of localization is often hindered by centralized education system with the common syllabus and examination. The tendency of teachers and students is to concentrate on the nationally devised curriculum materials and pay less attention to the local environment. Thus EE should be concerned about the best way to get viable EE programme into the formal education sector in a systematic way. Therefore, ecology can be taken to be an innovative way of getting the programme implemented in schools. The central objective of schooling should shift from an emphasis on individual advancement to helping students develop an environmental ethic that is practiced locally.

### 7.1. Students' Achievement in Environmental Education

An assessment test in environmental education (EAT) in appendix III was administered to 150 from three biology students in five co-educational schools in Gilgil Division. The assessment test had 20 items on aspects of EE in the topic ecology. The test was the marked using a common marking scheme and scored. Table 4 shows the distribution of marks scored by the students.

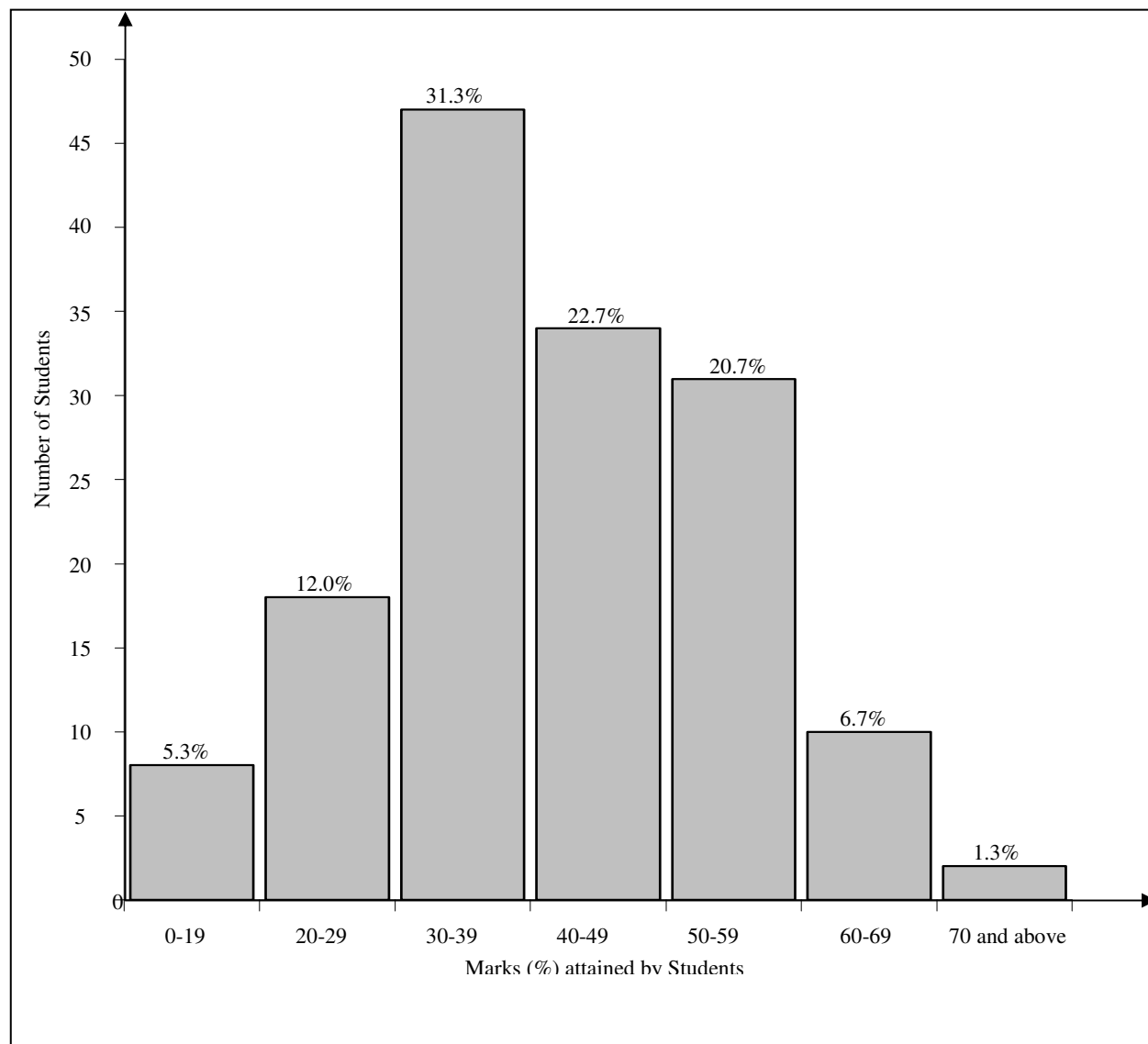


Figure 4: Distribution of Marks on Students' Performance on EAT

The results on Table 4 and Figure 4 show that majority of biology students in the sample (47 students or 31.3 per cent) scored between 30 and 39 per cent in the assessment test (EAT), 22 per cent (32 students) scored between 40 and 49 per cent while 20.7 per cent (31 students) scored between 50 and 59 per cent. Few students scored below 30 per cent (26 students) and above 60 per cent (12 students). It is important to note that most students scored below the average marks of 50 per cent. The mean score for the achievement test (EAT) was 40.93 per cent.

### 8. Discussion

The aim of giving the students an assessment test was to assess whether learners attain the objectives of EE. A good proportion of biology teachers assess their students' knowledge on EE through written and practical work.

Ausubel learning theory stressed that learning should be available for transfer to new contexts. Besides being able to remember and apply it with the context in which it was originally learnt, students should be able to generalize the learning to relevant applications and to assess and build on it when extending their learning into new areas (Good & Brophy, 1995). In this context, biology students were expected to apply their knowledge and skills learnt in ecology in responding to items in EAT.

The mean score for the assessment test (EAT) was 40.93 per cent (Table 4), which was below 50 per cent. This shows that teachers need to improve their teaching strategies on environmental education in order to enhance good performance. Teachers can fail in large measure to achieve the goal of meaningful learning and positive affective development if their evaluation of students' achievement

centers primarily on rote recall of information (Novak, 1981). If a learner studies and does not understand, his or her feelings and attitudes can be opposite to those we had wished to instill.

Although the topic ecology has always been a part of the content of biology syllabus, there is need for the Kenya National Examination Council to include more aspects of environmental education in the national examinations. This examination strategy will leave the teachers with no alternative but to include environmental aspects in a way that is very relevant to the students.

### *8.1. Teachers' Competences on Environmental Education*

In order to measure teachers' competences, the students were asked to indicate the extent to which they agreed that their biology teachers possessed the competences that were thought necessary for teaching EE in biology. Each item in the questionnaire was rated by each respondent on a four and five point Likert scale rating. From three biology students perceive their biology teachers to be competent on class management and lesson presentation in EE. A mean score of 3.54 was realized. The highest rated item was 4.67. Three items had a mean rating score below 3.44. The results show that teachers encouraged students to ask questions in the class (mean score of 4.67) and praised them for good work done during field studies (mean score of 3.75). It is also important to note that the students were given activities for discussion in groups where every student was expected to participate (mean score of 3.81). Apparently, 21.3 per cent of respondents felt girls received more individual help while 12.0 per cent of respondents felt that boys received more individual help than girls. However, less number of students (mean score 3.11) indicated to have depended on each other more than on their teachers in activities related to environmental awareness. Overall, teachers were found to possess most of the professional and technical competences by their students. The respondents indicated that biology teachers were able to interact with students during discussions (mean of 4.15), were able to listen to students' ideas (mean of 4.08) and were able to deal with unexpected events on students' responses during instruction (mean of 3.67). The students also hailed their teachers for being able to select club members (mean of 3.53), and maintain a working relation among club members (mean of 3.51). All these are important competences possessed by biology teachers.

Teachers were found to assist learners when they had learning difficulties during EE, solved students' problems and assessed them on ecology (Table 7). However, 55.3 per cent of teachers did not invite specialists/resource persons to discuss environmental issues. There is need to invite resource persons to bring variation in the teaching learning process. Few students (29.3 per cent) were noted to be involved by their teachers in planning and organizing field trips. This shows that few schools organized field trips on ecology in the study.

## **9. Discussion**

The ability of students to work effectively in small groups can be regarded as important as work place skills. While teaching based on traditional practices vests total authority on the teachers, learning in groups has manifestation of power, perceptions, motivation, leadership and decision-making. Students become actively involved as facilitators rather than passive and learn to give and receive feedback and reach a consensus. Teachers should attend to difficulties that may arise and help solve the problems brought forward by the students. Competent teachers recognize the importance of students centred approaches on participatory learning where students carry out hands on activities. These are important professional competences because biology is a science subject where students need to be given opportunities to manipulate objects actively and transform them through direct action. Students need to be given activities that encourage them to search, explore, analyse rather than respond to it (Good & Brophy, 1995). Such opportunities can increase student's knowledge about the topic at hand and also stimulate their curiosity. However, 53.3% of students indicated to have depended on each other more than their teachers in activities related to environmental issues (mean score of 3.11).

Mastery of the subject matter alone does not make a good teacher (UNEP UNESCO IEEP no.8, 1986). Teachers need to plan their strategy of teaching. The preparation is likely to be sound when the teachers motivate students to learn and facilitate their learning. Students' learning can be facilitated by good organization of the subject matter and the activities that match the students' readiness. The warm, friendly teachers influence their students positively towards the subject, while the cold teachers influence their students negatively. Thus, teachers should interact with students during discussions in order to correct any misconception that may arise. Teachers should have skills or the ability to listen to students' ideas and deal with unexpected events on students' responses during instruction. Regardless of how well the concepts and ideas are presented to learners in a classroom, they may not learn them unless they are actively involved in the process (Marsh II, 2004). Cooperative learning requires that students discuss, think and write together, solve problems without the teacher's direct supervision and guidance.

The participation of students in fieldwork activities helped them to appreciate ecology as well as EE. Teachers should outline their expectations from students during out of class activities and therefore focus on students' activities despite the loss of classroom physical constraints. They should try to relate class materials to everyday science applications. Biology teachers have the responsibility of creating awareness of the importance of science in the society (Trowbridge et al., 2004). Biology teachers need to provide students with role models who have contributed to environmental conservation. They can facilitate change students' perceptions of their environment and environmental education.

Science educators are becoming increasingly concerned with gender difference with respect to expectations, type of experiences and participation in classrooms. In this study an apparently high percentage of girls (21.3 per cent) received more individual help from teachers than boys (12.3 per cent). This shows that girls had a higher commitment to learning ecology than boys. This could possibly explain why they had a higher mean score of 42.04 than boys (39.38) in the environmental assessment test (EAT). However, Roberta Barba and Loretta Cardinale in 1991 investigated students questioning interactions in secondary science classrooms and found otherwise. Results of their study suggest that female students have fewer interactions with science teachers and received less attention

than males. Questions asked of female students are predominantly low-level questions. Males received more teacher interaction including more questions of higher levels. Tsuma (1998) notes that this may provide a signal to girls that they have low ability in the sciences. If this lack of interaction with girls begins in primary school, then by the time a girl reaches high school, she may attribute failure in the sciences to low ability.

In order for the interest of the learners in ecology and EE to improve, it is necessary to provide not only equal classroom experiences to both boys and girls, but also encourage more extra-curricular out of class activities. Given that extracurricular experiences play a role in the science interests and achievement of students, then students need to be encouraged at an early stage to pursue activities related to the science and environmental clubs. The ability of teachers to have criteria for selecting and maintaining a working relation among club members is an important competence for biology teachers. There are a number of clubs and societies that deal with environmental issues such as wildlife club and young farmers' club. The major problem with these extra-curricular activities is the maintenance of an effective patron and an active national and regional organization to back up local resources, efforts and recognition. Their major characteristic is that few students relative to the number of students in the schools attend them.

### 9.1. Relationship between Biology Students' Perceptions of their Environment and EE and Students' Achievement in EAT

In order to determine the relationship between form three biology students' perceptions of their environment and EE and their achievement in EE, mean scores of students' perceptions of EE in biology were correlated to their achievement in EAT. Pearson's product moment correlation coefficient was used to determine whether there was any correlation. The results are shown in Table 1.

Variables	Mean score	SD	Pearson's Correlation Coefficient
Students perceptions	3.99	0.69	-0.031
Students achievement	40.93	12.71	

Table 1: Pearson's Correlation Coefficient on the Relationship between Students' Perceptions of their environment and EE and Students' Achievement in EAT

$r$ -critical = 0.159       $df=148$     $P < 0.05$        $N$  Teachers = 18

The mean scores obtained by the students for SPEEQ was 3.99 and 40.93 for EAT.

A negative Pearson's Correlation Coefficient  $r$ -value of - 0.031 was obtained. The value obtained was lower than  $r$ -critical value of 0.159 at a level of significance of 0.05. This indicated that there was no statistically significant relationship between the students' perceptions of their environment and EE and their achievement in EAT.

### 9.2. Gender Difference in Form Three Students' Achievement and Perceptions on Environmental Education in Biology

In order to determine whether there was any gender difference in form three biology students' achievement and perceptions in EE, the mean scores of students' perceptions and the achievement scores on EAT of males and female students were compared. A  $t$ -test for independent samples was then used to determine whether the two groups differed in their perceptions and achievement. The results are shown in Table 2.

Item	Girls	n	Boys	n	t-statistic
Students perceptions	4.00	75	3.97	75	1.23
Students achievements	42.04	75	39.82	75	1.07

Table 2: Students' Perceptions and Achievements on EE in Biology by Gender

NB:  $t$ -critical = 1.645       $df=148$     $p < 0.05$

The mean score for boys was 39.83 per cent while the mean score for girls was 42.04 per cent. The mean score for the students' perceptions (SPEEQ) was 3.97 for boys and 4.00 for girls. A  $t$ -calculated value of 1.23 was obtained for gender and students' perceptions. Also a  $t$ -calculated value of 1.07 was obtained for gender and students' achievement. The two values were not statistically significant at alpha level of 0.05. The findings indicated no difference between the way boys and girls perceive their environment and EE and perform in EE.

### 9.3. Relationship between Competences of Biology Teachers in Environmental Education and Students' Achievement

In order to determine whether there existed any relationship between the competences of biology teachers in EE as perceived by students and students' achievement in EE the mean scores of teachers' competence in EE were compared with the students' mean score in EAT.

Variable	Mean score	SD	Pearson's Correlation coefficient
Teachers' competence	3.54	0.64	-0.143
Students' achievement	40.93	12.70	

Table 3: Pearson's Correlation Coefficient on the Relationship between Teachers' Competence in EE as perceived by students and Students' Achievement in EE

NB:  $N$  Students = 150,       $r$  critical = 0.159,       $df=148$     $P < 0.05$     $N$  Teachers = 18

A calculated Pearson's Correlation Coefficient  $r$ -value of  $-0.143$  was obtained which was lower than the critical value of  $0.159$  at  $df = 148$  at a level of significance of  $0.05$ . The results indicated no statistically significant relationship between the competences of biology teachers in EE as perceived by the students and students' achievement in EAT.

## 10. Discussion

### 10.1. Relationship between Biology Students' Perceptions of their Environment and EE and Students' Achievement in EAT

The findings indicated no statistically significant relationship between form three biology students' perceptions of their environment and EE and students' achievement in EAT. Though the form three students' perception of their environment and EE was found to be good, it played no role in their achievement in EAT. Trowbridge et al. (2004) suggested that authentic assessment tasks build on the strengths learners bring to the classroom. This is because teachers place the assessment in a context that is meaningful to learners. The success rate of students is related to continued achievement. If students do not experience some success in the early stages of lessons, their frustrations and lack of understanding can contribute to low achievement. UNEP UNESCO IEEP no.5 (1986) suggests that, teachers need to assess the strength and weaknesses of learners by measuring knowledge, skills and attitudes that pertain to the environmental education. The evaluation of the effectiveness of the teaching about the environment can be reflected in the learners' increasing awareness and interest in the environment. While written or oral questions may show increasing knowledge about the facts gained or the concepts acquired, the teacher can rely on the observation of the learner to assess this growth.

Students' behaviors are strongly influenced by teachers' behaviours. The teachers' behaviours of what they seek to develop in students tend to facilitate the learning of such behaviours (UNEP UNESCO IEEP no. 8, 1986). In environmental education where behaviours and actions are seen as the ultimate evidence of learning, the teacher becomes a focal point of students' learning. This is because teachers' influence extends beyond classroom. Students' achievement and perceptions in class are cued by teachers' behaviours. It has been shown that students taught by teachers who give more direction and rarely ask for opinions and ideas of students, learn less than those taught by flexible teachers who ask more questions and give less direction. In activities aiming for changed students' perceptions, it is therefore implicit that teachers be models of the desired perceptions that will encourage similar students' perceptions.

### 10.2. Effects of Gender Difference in Form Three Students' Achievement and Perceptions on Environmental Education in Biology

The findings indicated that gender had no statistically significant difference in form three biology students' perceptions and achievement in environmental education. Muchiri (1996) noted that boys generally achieve higher scores in science subjects than girls. Thus, boys should be expected to have higher scores than girls as far as perception and achievement on EE in ecology is concerned. In this study, it is therefore evident that gender does not significantly influence the students' perceptions and achievements in EE. This shows that though girls in co-education day schools in most communities are involved in family responsibilities such as home maintenance and domestic chores, this does not interfere with their perceptions and achievement in environmental education. Trowbridge et al. (2004) observed that girls and boys reinforce gender stereotypes through the type of activities they feel free to engage in. In fact, it is sometimes encouraged, so they are more likely to lose confidence in the sciences than boys. Thus as Goodrum et al. (2000) suggests, teachers must no longer rely on easy stereotypes of what appeals to girls but to offer a range of ways in which science can be a part of many different identities girls find useful and desirable.

Manjengwa (1998) noted that the students' perceptions of teachers' attitudes and expectations and treatment of female students in "traditionally" masculine subjects adversely affect the students' performance. Possibly, pupils and teachers bring their own preconceived attitudes into the classroom. Perhaps the girls themselves and teachers do not expect girls to solve problems, and therefore problem-solving skills are not encouraged or developed in schools. Girls as well as boys should therefore be encouraged and given the opportunities to participate in decision-making and responsibilities on environmental issues. More time should be made available in order to provide opportunities for pupils to discuss and apply the knowledge learnt and practice problem-solving activities.

### 10.3. Relationship between Competences of Biology Teachers in Environmental Education and Students' Achievement

The findings from the study indicated no statistically significant relationship between the teachers' competences as perceived by the students in EE and student's achievement in EE. Evaluation of the effectiveness of teaching about the environment is reflected in the students' increasing awareness and interest in the environment. Though written questions may show increasing knowledge, the teacher should also rely heavily on observation of the students to assess this growth (UNESCO UNEP IEEP no 8, 1986). Evaluation need to provide evidence that learning has taken place and that this learning is attributable to the educational activity.

Since teachers' skills and competence on a given subject can be evaluated through the students' achievement, the results of the analysis show no significant correlation between the teachers' competence as perceived by the students in EE and form three students' achievement in EE. Probably other factors may have contributed to enhancing the students' achievement in EE. Trowbridge et al. (2004) suggested that decisions made about questioning could also influence the teachers' teaching effectiveness. Teachers should first consider the cognitive level of the questions before asking students. Higher-level questions facilitate thinking and learning. Questions that require learners to analyse and synthesize will produce high levels of students' achievement. Teachers are also expected to give corrective feedback so as to facilitate positive achievement and attitudes on the part of the students. The purpose of assessment is to provide feedback to both the students and the teachers, about students' understanding of concepts and ability to use skills.

## 11. Conclusions

Biology teachers had a good perception of EE. Biology teachers had requisite qualifications although they saw the need for in-service training on environmental education. Though teachers perceived environmental education to be an important learning area, they seemed to lack competences and knowledge to teach successful environmental education despite having the requisite experience. This was due to lack of practical skills and relevant teaching materials on EE such as the audio-visuals teaching aids. As the success of EE largely depends on a well-developed system of instructions and consistency in the presentation of its various issues, biology teachers require a range of skills and knowledge on how to handle it. The flexibility and variety of teaching methods depends on how the teacher motivates the learners and the practical materials that form the basis of instruction. Since the teachers and the mass media were the students' important sources of environmental information, they need to be more knowledgeable about environmental issues so that learners can learn more from them.

The success of community based teaching approach involving participatory learning requires co-operation and closer link between the local communities and the school. With increased students, teachers and parents' willingness in the community participation on environmental education, the students' action learning on environmental education programmes in secondary schools can be of immediate benefit to both the learners and the community. However much still remain to be done in order to implement this programme fully. The practical experience of students in the environment through fieldwork on ecology should be encouraged. The contact of the students with the environment can help to influence their perceptions towards their environment. The importance given to EE and out of class experience on problem solving activities, data handling and observation skills provide opportunity for ecology to acquire an important place in EE curriculum.

The out of class experience by Form three biology students on problem solving activities, data handling and observation skills provide opportunity for ecology to acquire an important place in the environmental education curriculum. Therefore, teachers need to provide opportunities for their learners to undertake ecological studies in the environment. Though there may be problems and constraints that are encountered in teaching field ecology at school level, the benefits that arise from this experience underline the need to ensure learners are given opportunities to study in the environment.

Form three biology students' perception of their environment and environmental education had no statistically significant relationship with their achievement on environmental education. Schools should celebrate the diversity and range of approaches and environmental experiences each learner bring to the classroom.

Gender had no statistically significant effects on students' perceptions and achievement on environmental education in biology. Teachers in co-education secondary schools should ensure learners are given opportunities to discuss their experiences on the effects of gender roles on the environment. The competence of biology teachers as perceived by students had no statistically significant relationship with form three biology students' achievement on the environmental education.

Judging by the results, the teachers' perceptions and competences play a key role on how students learn, retain and apply the knowledge, attitudes and skills in changing their perceptions and achievement in environmental education. Thus environmental awareness in secondary schools needs to be encouraged so that students can develop positive and caring attitudes towards their environment.

### 11.1. Implications of the Study

The findings of this study have implications for the policy and curriculum developers, teachers and researchers in EE. The substantive implications are that EE can be improved through teacher education both at in-service and pre-service level. This will enable the teachers to acquire the skills and competences that are needed for teaching environmental education effectively. Teachers cannot teach environmental values without teaching concepts meaningfully. The objective of EE is to move from awareness to action. To enhance meaningful learning, learners need to be motivated into understanding and solving real life problems by relating them to the environment in the subject through which it is being discussed accompanied by direct experience through hands on activities. To effectively develop and implement EE activities in schools an environmental policy is needed. This can make EE process to be an integral part of the school curriculum, enable learners to manage the school resources wisely and plan for better learning opportunities using the out of class environment. Environmental education in Kenya is inter-disciplinary in approach and cannot be taught as a separate subject. Therefore, teachers should endeavour to assess the students' knowledge and skills on environmental education in the subjects where it is taught. Teachers are required to be flexible and ensure they employ a variety of teaching methods in solving environmental issues that are of immediate concern to the students.

Environmental education programme should be encouraged though the formation and strengthening of environmental clubs and societies in all education institutions in order to provide a flexible way of supporting EE at the school level through integration of outdoor experiences with classroom studies. The lack of involvement of secondary schools in the community environmental awareness implies that schools do not develop in their students the participation and problem solving skills which are advocated for in the teaching of environmental education. Students need to participate in community environmental education activities as part of their social responsibilities.

Most of the subjects' teachers in secondary schools are traditionally more concerned with their own disciplines than with the hard to handle environmental education skills of inter-disciplinary activities (Trowbridge et al., 2004). As ecology is concerned with application of ecological knowledge for the effective management of the environment (Hale, 1993) biology teachers therefore have an important role on EE than any other subject.

**12. References**

- i. Appleton, K. & Asoko, H. (1996). A case study of teachers' progress towards using a constructive view of learning to improve teaching in elementary science. *Science Education*, 80(2), 165-180.
- ii. Baez, A.V., (1987). Science, technology and environment. In Baez, A.V., Knamiller, G.W. & Smyth, J.C. (Ed), *The environment and science and technology education*. New York: Pergamon Press.
- iii. Cailloids, F & Gottelmann-Duret, G. (1997). Science education and development IIEP seminar paper, 15 (2) 11-2
- iv. Carin, A .A., Bass, J.E. & Contant, T.L. (2003). *Methods for teaching science as an inquiry* 9th Ed. New Jersey: Pearson Merrill PrenticeHall.
- v. Cohen, L. & Manion, L. (1987). *Research methods in education* (2nd Ed). London: Croom Helm.
- vi. Covert, G., Garntson, E. & Obrycki, J. (2004). Environmental education of high school and elementary students. Available on the internet at- [covertgm@muohio.edu](mailto:covertgm@muohio.edu) on 10/7/04.
- vii. Cutter, A. (2001). Ganging primary school teachers environmental literacy, Rockhampton, Queensland: Central Queensland University. Pg 2-6. Available on the internet at- <file:///A:/CHAPTER ONE.htm>. 7/11/2004
- viii. Filho, W.D.L. (1993). Field studies as a technique for EE in developed and developing nations. In Hale, M. (Ed), *Ecology in education*, Cambridge: Cambridge University Press
- ix. Fraenkel, J.R. & Warren, N.E. (1990). *How to design and evaluate research in education*, New York: McGraw-Hill Inc.
- x. Freedman, B. (1995), *Environmental ecology: Ecological effects of pollution, disturbance and other stresses*. London: Academic Press limited.
- xi. Gall, M.D., Borg, W.R. & Gall, J.P. (1996). *Educational research, An introduction*. New York: Longman Publishers.
- xii. Getao, C. (1999). Environmental planning and management for the 21st Century. Unpublished Papers Presented during a Workshop held at Environmental Education Centre, Nairobi 11th – 13th March, 1999.
- xiii. Good, L.T. & Brophy, J. (1995). *Contemporary educational psychology*. 5th Edition. Longman Publishers USA
- xiv. Goodrum, G., Hackling, M. & Rennie, L. (2000). The status and quality of teaching and learning of science in Australian schools. Canberra: Department of Education, Training and Youth Affairs.
- xv. Hale, M. (1993). Ecology and environmental education in urban environment. In Hale, M. (Ed), *Ecology in education*. Cambridge: Cambridge University Press.
- xvi. Hale, M. & Hardie, J. (1993). Ecology and environmental education in Britain. In Hale, M. (Ed), *Ecology in education*. Cambridge: Cambridge University Press.
- xvii. Harvey, M. R. (1993). Learning through contact with vegetation. In Hale, M. (Ed), *Ecology in education*. Cambridge: Cambridge University Press.
- xxviii. Kanhasuwan, L. & Webb, J. (1987). Project for elementary and secondary schools level. In Baez, A.V., Knamiller, G.W. & Smyth, J.C. (Ed), *The environment and science and technology education*. New York: Pergamon Press.
- xix. Kathuri, N.J. & Pals, G. (1993). Introduction to educational research. Njoro: Egerton University Education Material Centre.
- xx. Kenya Institute of Education (KIE), (1998). *Secondary biology and biological sciences, book three* (2nd Ed) . Nairobi: Kenya Literature Bureau.
- xxi. Kenya Institute of Education (KIE), (2002). *The secondary school syllabus, Vol.2*. Nairobi: KIE.
- xxii. Khoshoo, T.N. (1987). *Perspectives in environmental management*. New Delhi: Oxford and IBH Publishing Co. P.V.T. Ltd.
- xxiii. KIE (1997). *Environmental education. Source book for primary teacher education in Kenya*. (pp 15-18). Nairobi: SESP
- xxiv. Komba Magazine, (2005). Issue no.3-2005, (pp21-23). WCK, Geeska Printing Press: Nairobi.
- xxv. K'Omudho, B. (1999). History of EE in Kenya, the huddles that the National Environment Secretariat (NES) has had to overcome and measures that need to be taken to ensure that values, behaviour and attitude of people are charged. Unpublished paper presented at a workshop held Environmental Education Centre, Nairobi on 11th – 13th March 1999.
- xxvi. Krasilchic, M. (1987). Some problems and perspectives of environmental education in the schools. In Baez, A.V., Knamiller, G.W. & Smyth, J.C. (Ed), *The environment and science and technology education*. New York: Pergamon Press.
- xxvii. Manjengwa, J.M. (1998). EE for sustainable development in secondary schools in Zimbabwe, A focus on gender difference. *The International Journal of EE and Information*. 17(1), 17-25.
- xxviii. Marsh II, G.E. (2003). Available on the internet at- [File:///C:/Keraro/Constructivism.htm](file:///C:/Keraro/Constructivism.htm). on 1/13/2003 (p.13 of 22).
- xxix. Muchiri, J.M. (1996). Secondary school administrators, agriculture and teachers perceptions of agriculture. Unpublished M.S.c Thesis. Njoro: Egerton University.
- xxx. Mugenda, O.M. & Mugenda, A.G. (1999). *Research methods, quantitative and qualitative Approaches*. Nairobi: African Centre for Technology Studies (ACTS).
- xxxi. Murgor, B. (1999). The position of the inspectorate of schools on environmental education. Unpublished paper presented at a workshop held at Environmental Education Centre, Nairobi on 11th – 13th March 1999.
- xxxii. Musyoki, Z. (2003). Use of active learning framework to address environmental issues and risks. Unpublished paper presented at a workshop held at AFEW Kenya Ltd, Giraffe Center Nairobi August 18-20, 2003.
- xxxiii. Neshamba, F. (1999). Sustaining environmental action learning programs. Unpublished paper presented during a workshop held at Environmental Education Centre, Nairobi (EECN). 11th – 13th March, 1999.
- xxxiv. Novak, J.D. (1981). Applying learning psychology and philosophy of science to biology teaching. *The American Biology Teacher*. Vol. 43 No. 1. (pp 12-20).

- xxxv. Njuguna, M. (2005, March 17). Human activity decimates fish in Lake Naivasha. *The Daily Nation* pp. 28-29. Nairobi: Nation Media Group.
- xxxvi. Ombech, A.N. (1991). Teaching environmental education. In Otiende, J.E., Ezaza, W.P. and Boisvert, R. (Eds), *An introduction to environmental education*. Nairobi: Nairobi University Press.
- xxxvii. Otiende, J.E., Ezaza, W.P., & Boisvert, R. (1991) (Eds), *An introduction to environmental education*. Nairobi: Nairobi University Press.
- xxxviii. Otiende, J.E. (1991). Environmental education in perspective. In Otiende, J.E., Ezaza, W.P. and Boisvert, R. (Eds), *An Introduction to environmental education*. Nairobi: Nairobi University Press.
- xxxix. Roberta, B. & Cardinale, L. (1991). Are females invisible students? An investigation of teacher student question interaction. *School Science and Mathematics*, 91(7), 306-310.
- xl. Roger P.K. Ho. (1998). Perceptions of environmental education amongst primary and secondary school teachers in Nairobi, Kenya. *The International Journal of EE and Information*, 17 (1), 71-90.
- xli. Rugumayo, E. (1987). Key issues in environmental education. In Baez, A.V., Knamiller, G. W. & Smyth, J.C. (Ed), *The environment and science and technology education*. New York: Pergamon Press.
- xl. Science curriculum framework (2004). Available on the internet at- File://A:\K-12 Science Curriculum Framework.htm. on 7/11/2004
- xl. Soerjani, M. (1993). Ecological education as a basis to environmental education in Indonesia. In Hale, M. (Ed), *Ecology in education*. Cambridge: Cambridge University Press.
- xl. Swaminathan, M.S. (1987). Education, environment and livelihood security. In Baez, A.V., Knamiller, G.W. & Smyth, J.C. (Ed), *The environment and science and technology education*. New York: Pergamon Press.
- xl. Sytnik, K.M. (1985). *Living in the environment: A source book for environmental education*. UNESCO: Nankora Dumka Publishers.
- xl. Thorndike, R. L. & Thorndike, R. M. (1994). Reliability in education and psychology measurements. In Husen, T. & Postleth-Waite, T. W. (Eds), *The International Encyclopaedia of Education*. Vol. II 2nd Ed. Boulevard: Pergamon.
- xl. Tilling, S.M. (1993). Ecology education and field studies: Historical trends and some present day influences in Britain. In Hale, M. (Ed), *Ecology in education*. Cambridge: Cambridge University Press.
- xl. Trowbridge, L.W., Bybee, R.W & Powell, J.C. (2004). *Teaching secondary school science strategies for developing scientific inquiry*. New Jersey: Pearson Education Inc. Merrill PrenticeHall.
- xl. Tsuma, O.G. (1998). *Science education in the African context*. Nairobi: Jomo Kenyatta Foundation.
1. UNEP.(1988). *System-wide medium term environment program for the period 1990 – 1995*. Nairobi: UNEP.
- li. UNESCO UNEP IEEP no. 5. (1986). *Environmental education module for pre-service training of teachers and supervisors for primary schools*. UNESCO.
- lii. UNESCO UNEP IEEP no. 8. (1986). *Environmental education module for in-service training of science teachers and supervisors for secondary schools*. UNESCO.
- liii. UNESCO UNEP IEEP no. 25. (1987). *Strategies for the training of teachers in environmental education*. UNESCO.
- liv. Vulliany, G. (1987). Teaching for the environment in the third world schools. In Baez, A.V., Knamiller, G.W. & Smyth, J.C. (Ed), *The environment and science and technology education*. New York: Pergamon Press.
- lv. Young, A.J. & Maggs, J.E. (1987). Issue based learning at primary level. In Baez, A.V., Knamiller, G.W. & Smyth, J.C. (Ed), *The environment and science and technology education*. New York: Pergamon Press.